भा.कृ.अनु.प.
I.C.A.R.

ICAR-IISWC

ISO 9001:2015

Annual Report 2017-18

ICAR-Indian Institute of Soil and Water Conservation

218-Kaulagarh Road, Dehra Dun-248195, Uttarakhand

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218-Kaulagarh Road, Dehra Dun-248195 ,Uttarakhand

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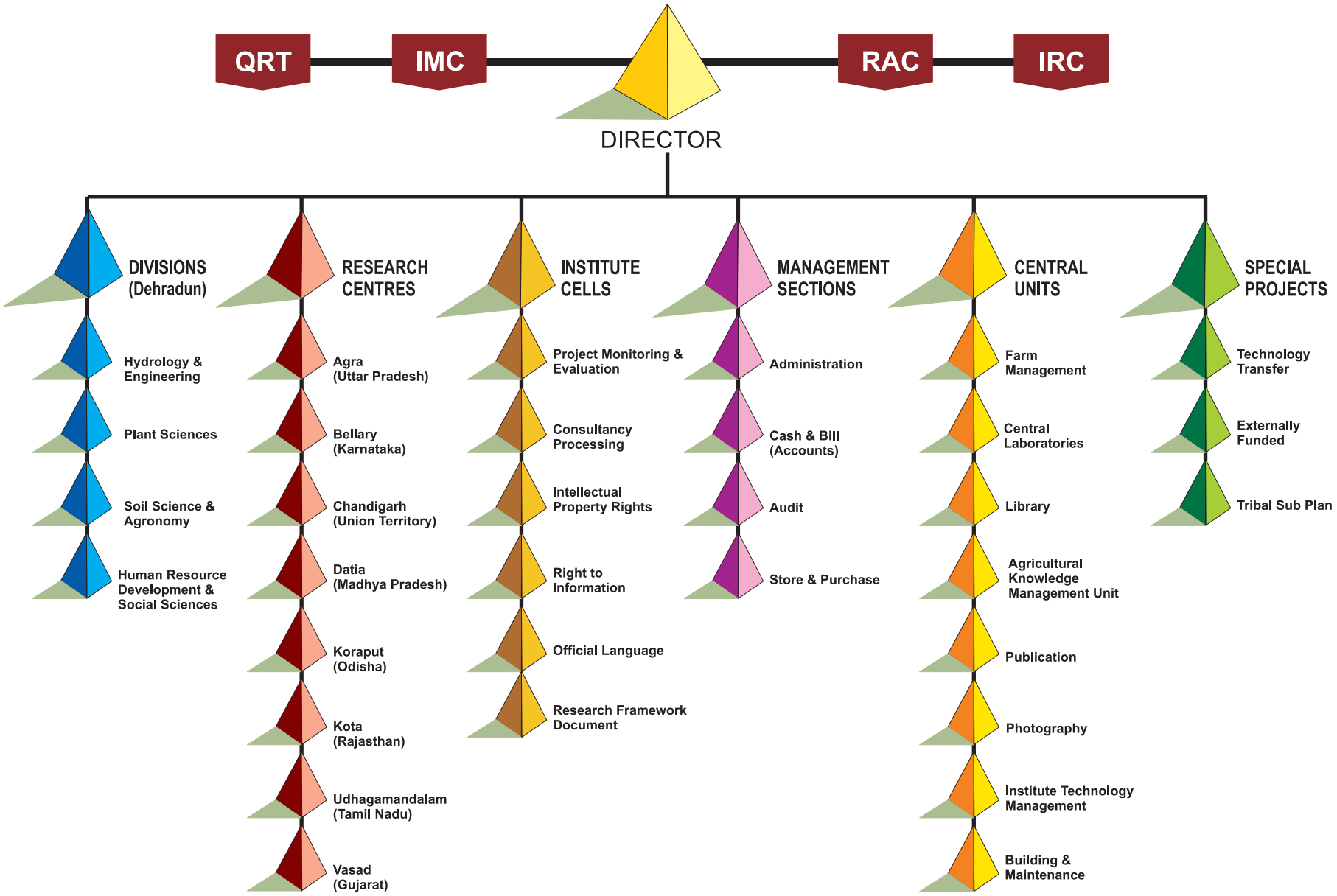
ORGANISATIONAL SETUP



Preface

It gives me immense happiness and sense of fulfilment to present the accomplishments of Indian Institute of Soil and Water Conservation (IISWC) during the year 2017-18 on research, extension, training and related activities. This Annual Report presents a summary of progress of research activities of the Institute under different thematic areas. I have not an iota of doubt to under line the fact that our efforts, over the years, have not only yielding results but also gaining due recognition.

This year has been extermely rewarding with IISWC scientists receiving awards, fellowships and recognition from ICAR and professional societies. The Institute was bestowed with Sardar Patel Out Standing ICAR-Research Institute Award-2016 (large institue category) for its commendable efforts in the field of research and technology development in the field of soil and water conservation. The institute also received the Swachchta Pakhwada Award 2017(First Prize) in the Institute category.

Though we have a number of trend setting findings but I would like to emphasise upon the techniques that have a far reaching impact with regards to soil and water conservation as well as suastainable production, especially under rainfed conditions. Conservation furrow, a green water harvesting technique for rain-fed crops, successfully mastered and demonstrated by the institute scientists at farmers field, recorded maximum green water harvest (up to80%) with minimum runoff and soil loss, and 30% increase in yield. With ever increasing problem of water scarcity alternate furrow methodology of irrigation with surge flow have the potential to save irrigation water up to 70% without having any significant impact on yield potential.The innovative low-cost pre-fabricated plastic checkdams developed and perfected by the Institute can be a suitable instrument in the process of soil water conservation.

Institute's Research and Development efforts got major thrust/strength/impetus from well structured, well defined and time bound projects targeting specific group. The crucial financial support comes from inhouse budget as well as from externally funded projects. The institute constantly strives to diversify its area of action. In this regard, apart from undertaking consultancy project's supported by different organisations a number of extension and training activities in collaboration with external agencies were conceived and implemented.

The research findings of the Institute were documented in 74 peer reviewed papers published in international and national research journals. Also, 34 research papers were presented at international and national conferences apart from publication of 11 books and 41 book chapters.

Friends by the time this document reaches your table I would be taking leave from the services of ICAR. It is very hard to leave the people who are commited to doing right things in a specified manner. I sincerely hope that you will continue to live up to the expectations of the Nation.

I wish to place on record my thanks for unconditional support from the ICAR Head Quarters and members of Board of Management, Chairman and members of RAC for their invaluable guidance. Thanks are also due to the respective theme leaders and all the staff members for their efforts in bringing out this report.

(P.K. Mishra)
Director

Contents

1.	Introduction	01
2.	Research Achievements	10
3.	Training and Education	104
4.	Awards and Recognitions	106
5.	Linkages and Collaborations	109
6.	List of Publications	112
7.	Approved on –going Projects	125
8.	Consultancy	128
9.	RAC, Management Committee, IRC Meetings	129
10.	Participations	133
11.	Infrastructural Development	155
12.	Workshops, Seminars, Summer Institutes, Farmer's Day etc	156
13.	Distinguished Visitors	162
14.	Personnel	164
	Appendix 1	
	Appendix 2	

EXECUTIVE SUMMARY

Indian Institute of Soil and Water Conservation(IISWC) is one of the premier institute under NRM Division of ICAR, engaged in research and developmental activities related to Soil & Water Conservation and Watershed Management. Also, the Instititute actively participates in a variety of programmes in association with SAUs, State,Central Government and International organisations and has developed a strong bond with the farming community. Some of the salient features of different activities accomplished,undertaken during the year are summarised as follows.

Inventory and Data Base of Erosion Status Using Modern Tools and Procedures

Rainfall Energy Calculator, software to calculate rainfall energy as well as rainfall intensity at different intervals (5 minute to 24 hour) has been developed. IDF curves of 31 meteorological stations located at different agro-ecological regions of India have been developed using recent rainfall data (data up to 2014).

Study undertaken by employing high resolution geo-spatial data on topography, LULC, and rainfall erosivity on soil erosion fluxes has helped in improving erosion estimates also it shows that stream bank and other mass erosion processes contribute significantly to total sediment load of hilly streams. Estimation of potential erosion rate with 30 m resolution data showed that 21.6% area of Uttarakhand is under >10 t ha^{-1} yr^{-1} rate as compared to previous estimate of 55.6%.

Soil Erosion Process Modelling and Climate Change Studies

Under inter-institutional and interdisciplinary project National Mission on Sustaining Himalayan Ecosystem (NMSHE), suitability maps for the year 2050 have been prepared for the Indian Himalayan Region of maize crops. The shift matrix shows the shift in areas suitable for growing Maize in Base period (1950-2000) to the years 2050 for different RCPs. 50 vulnerability parameters have been identified and the list has been circulated among the partner institutes.

Studies conducted on atmospheric and soil carbon dioxide fluxes in temperate mountainous ecosystem of Western Ghats with reference to climate change impact assessment have indicated that maximum CO_2 level (420 ppm) exist in atmosphere during the night time after 21 hrs whereas during day time, between 10 to 17hrs, the CO_2 level was around 400 ppm. With regards to available soil moisture, in all the land uses, moisture recorded in the surface soil layer was lowest, may be for the reason of well developed stable macro aggregates that permits easy infiltration and the deeper soil have more effective volume per unit area for greater moisture storage.

Soil Carbon Dynamics and Erosion Productivity Studies

In general the erosion losses increased with increasing slope gradient. At Dehra Dun the analysis of data generated through comparative plots revealed that, In general, runoff and soil losses were found to be higher in unfertilised plots as compared to fertilised plots. The yield component varied with the variation in slope and application of manure and fertilizer. At Bellary higher amount of potassium was lost through runoff as compared to nitrogen and phosphorus and the slope recorded marked negative impact on yield potential (Chickpea) . While at Chandigarh the Improved management practice of contour sowing with recommended doses of fertilizers caused increase in grain yield. At Datia the grain yield of sorghum followed trend negatively to runoff, soil, and organic carbon and clay content losses. The magnitude of yield under unfertilized plots was lower than that of fertilized plots. Whereas at Kota land slope recorded linear relationship with soil loss in Vertisols of Rajasthan. Also, it was observed that increase in fertility level markedly enhanced yield (soybean grain) and reduced soil loss.

This may be due to better growth of the crop in well fertilized treatment better cover of the soil. At Koraput runoff and subsequent soil loss were found to be more on upland paddy crop as compared to finger millet crop and the use of fertiliser recorded reduced runoff and soil loss over unfertilised plots for both the crops and all the slope conditions. Soil moisture content was relatively better at subsoil (15-30 cm) on all the slopes compared to the surface soil (0-15 cm) and this difference was prominently marked at higher slopes.

Resource Conservation Measures for Arable Lands

The application of recommended rate of fertilizers (RRF) + FYM + Biochar at 10 t ha^{-1} has a marked impact on the yield potential of sorghum and it was found to be about 75% higher than the control (only recommended rate of fertilisers and FYM was applied). Also the application of Biochar recorded marked reduction in runoff, soil loss and micronutrients.

The application of zinc and N and adoption of water saving irrigation techniques in place of continuous flooding in paddy cultivation improved plant growth and chlorophyll content index apart from saving water under water scarce situations in Tungabhadra canal area.

Amongst the three *In-situ* moisture conservation practices studied under aonla based agro forestry system for sustainable production in red soils of Bundelkhand, the V shaped micro catchment was found to be most effective with regards to soil erosion, nutrient loss and yield potential of inter crop (black gram and Indian mustard) as well as fruit yield of aonla

The results of study undertaken on restoration of shifting cultivated land to develop management as well as restoration strategies for resource conservation and sustainable production in Eastern Ghats have indicated that with regards to grain yield (Ragi) and biomass the treatment 'Earthen bunding + BP of *Gliricidia sepium'* was most suitable. However as far as erosion parameters are concerned the treatment earthen bunding with vegetative barrier of sambuta + BP of *Gliricidia sepium* was found to be most effective.

Reduced tillage in combination with residue retention resulted in minimum runoff and soil loss. Whereas maximum values for runoff and soil loss were recorded by permanent broad bed & furrow and broad bed & furrow practices respectively.

The experiments on enhancing productivity and soil health in rainfed farming system in the hilly terrains implying cover crops and reduced tillage have indicated that the highest biomass (3.2 t ha^{-1}) in quickest time (55 days) was achieved with buckwheat. The highest N (76.8 kg), P (17.2 kg) addition per hectare due to cover crops incorporation was observed in fodder oats & K (27.5 kg) in mustard under reduced tillage. While higher soil moisture was observed under reduced tillage and cover crops compared to the conventional tillage and without cover crop.

Resource Conservation Measures for Non-Arable Lands

Improved varieties of finger millet and barnyard millet out yielded the local varieties being grown traditionally. With regards to crop tree interaction, the average productivity of finger millet and barnyard millet under *Grewia optiva* was higher as compared to that under *Morus alba*. With regards to erosion parameters the tree crop combinations were found to be quite effective with Mulberry and finger millet combination recording minimum runoff and soil loss.

Amongst all the three soil conservation measures *viz*., Rectangular trenches (R), semicircular trench (S) and V-shaped ditches put to test to ascertain their efficacy with regards to resource conservation and bamboo productivity the growth parameters revealed that semicircular trenches were most effective as far as the plant growth parameters are concerned. Whereas, soil pH, organic carbon and available P recorded reduced values under all the treatments, in 0-15 cm soil layer, as compared to control.

The experiments conducted on rooting media and rootstocks of major subtropical fruit species for raising quality planting materials on degraded lands have revealed that the application of 10 g AZB + 10 g PSB + Soil +FYM recorded (after 6-8 months) higher growth for all rootstocks of mango, guava and aonla.

Analysis of data (five year) collected on seven different species of bamboo *viz*., *Bambusa bambos, B. balcooa, B. nutans, B. vulgaris, Dendrocalamus hamiltonii, D. strictus, D. stocksii* planted at Dhulkot research farm indicated that the species '*Bambusa bambos'* has developed maximum number of coarse (CR) and fine roots(FR). With regards to rain fall data the species '*D. hamiltonii'* recorded highest rain fall interception as well as stem flow where as the species 'B. vulgaris' recorded maximum through fall.

Studies on cover crops under cashew and mango plantation for improving soil health and productivity in Eastern Ghats high land region of Odisha have revealed that the cover crops have a significant impact on reduction in soil loss and amongst seven cover crops planted highest biomasses, was obtained in *Mimosa invasia* plot of about 9.6 and 11 t/ha at mango and cashew plantation respectively.

Hydrological Behaviour of Land use and Management Practices

Amongst the four landuse systems studied at Agra, the minimum soil loss (3.91 t/ha) and run off (17.26 mm) was recorded in horticulture block whereas maximum soil loss(13.72 t/ha) and run off (61.56 mm) was observed in the Agri-Agri block. At Chandigarh the agriculture land use recorded maximum runoff (16 %) and soil loss (125 kg/ha) while At Kota, of the three land use systems studied, the "*Neem(Azadirachta indica) + Cenchrus ciliaris (*Silvi-pasture)" recorded minimum values for runoff generating potential (6.1%) and the sediment yield (3.9 t/ha-yr).

The analysis of hydrologic systems across multiple spatial scales and its implications on hydrologic processes in sub-humid catchment of Eastern Ghats high land region of Odisha revealed that the highest mean runoff coefficient is generated for barren land. Scrub having stony soil recorded higher runoff coefficient as compared to agriculture land use whereas scrub with small pebbles recorded lesser runoff coefficient in comparison to forest land use (though good cover, but soil with big rocks) irrespective of plot length.

Water Harvesting, Ground water recharge and Management

Under CRP on Water (Theme 1) 61 statistical distributions have been employed using 57 years of daily rainfall data (1951-2007) for developing design rainfall. So far design rainfall of 1-day maximum, seasonal total at 50%, 65% and 75% probability have been developed. Rainwater harvesting potential at the design rainfall of 75% probability (the criteria used in semi-arid regions for estimating runoff volume) has been worked out for Karnataka, AP and Telangana states.

The long term experiment being conducted for estimation of water budget components for predominant land uses of South-Eastern Rajasthan indicated that amongst six land use systems the Pasture: *Cenchrus ciliaris* land use recorded less values for runoff (13.3%) as well as sediment yield (0.527t/ha). The moisture retention behaviour of soil under different land uses revealed that among the treatments, Pasture: *Cenchrus ciliaris* land use retained more moisture.

The results of experiment conducted to evaluate the strategies for water utilisation on sustainable basis, indicated the value of pan factor (PF: the ratio of actual surface evaporation to measured pan evaporation) to be below 0.25 when the Jalkunds were covered with thatch cover. Hence, the strategy for application of water at weekly interval with 0.4 fraction of cumulative evaporation was found to be sufficient to provide water to eight plants on sustainable basis.

Rehabilitation of Areas Affected by Mass Erosion

The tree species, Desi babool *(Acacia nilotica*) and Karanj *(Pongammia pinnata*) performed markedly better than the other species planted especially with regards to plant height and collar diameter at stone mine spoil sites of South Eastern Rajasthan .

The Experiments conducted in micro watersheds on field evaluation of design of trenches under different agro-climatic regions have underlined the significance of contour trenches. At Koraput the data recorded clearly established the positive impact of contour trenches on controlling runoff and soil loss. Lowest values of runoff and soil loss were recorded from watersheds which has the maximum intensity of trenches (80%).

The plantation of Sapota (*Achras sapota* L.) with intercropping of cowpea and castor in terraces (SCCBT) not only recorded better fruit yield (126number of fruits per tree) but also performed competitively with regards to growth parameters. The SCCBT (Sapota+ Cowpea+ Castor in Bench Terrace) inter cropping system recorded minimum runoff values (61mm).

Capacity Development Approaches and Information and Communication Technology

The introduction of cost effective technological intervention of spring water harvesting and developing a self sustainable mechanism of participatory water resource management in difficult hilly terrain has resulted in steep increase in production of high value crops (off-season vegetables).

Participatory Technology Dissemination and Adoption

Productivity of improved variety of groundnut (Girnar-2) was at par with that of local groundnut variety being grown by the farmers traditionally. However, the training imparted to farmers on real time N management using leaf colour chart (LCC) helped the farmers to save 100 kg/ha of urea in both paddy and wheat crops and saved non-renewable energy of 8400 MJ/ha which reduced carbon emission of 410 kg Ce per ha.

Soil and water conservation ITKs which are being practised by Kurumbas, Irulas and Malayali tribes of Vellore district have been documented. Amongst various SWC ITKs documented, validation of three promising ITKs viz., incorporating Eupatorium with FYM; burial of pruned tea leaves & branches in trenches in tea estates and planting of Erythrina in the tea estates have been undertaken. Preliminary results indicate that under the Erithrina+pepper +tea system, soil moisture, SOC (2.4%), N (309 kg/ha) and K (294 kg/ha) were higher as compared to Silver oak + pepper +tea. Whereas in the case of ITK 'burial of tea pruning in trenches in tea estates' soil moisture content was found to be more at all the three depth levels when compared to trenches without tea pruning

Training on Soil and Water Conservation

During the year 2017-18, two batches of regular four month training courses on "Soil & Water Conservation and Watershed Management" were conducted at Institute Head Quarters DehraDun. In all 51 participants attended the training programme. Up to 31 March 2018, a total of 2913 officers have been trained at institute Head Quarters DehraDun and its Regional Research Centers.

01 INTRODUCTION

Historical Back Ground

The Indian Institute of Soil and Water Conservation (formerly known as Central & Soil Water Conservation Research and Training Institute) was established on 1st April, 1974 with Headquarters at DehraDun by combining Soil and Water Conservation Research, Demonstration and Training Centers established in 1950's at DehraDun, Kota, Bellary, Udhagamandalam, Vasad, Agra and Chandigarh. Research centers were initially established by the Government of India and transferred to the Indian Council of Agricultural Research (ICAR) on 1st October, 1967. Subsequently two new Research Centers were established, one at Datia in Madhya Pradesh (18th September, 1986) to tackle soil and water conservation issues of Bundelkhand region and another at Koraput in Orissa (31st January, 1992) to address the ill effects of shifting cultivation. The Institute and its Research Centers, since inception, have focused primarily on evolving strategies for controlling land degradation (by adopting watershed approach), targeting area specific problems (such as ravines, landslides, mine spoils and torrents), demonstration of technologies for popularisation and imparting training besides developing technologies for water harvesting and recycling.

In the year 1956, experimental watersheds were set-up for generating watershed-based protection and production technologies. From the year 1974 onward, the Institute pioneered in operationalising the watershed concept through four Operational Research Projects at Sukhomajri (Haryana), Nada (Chandigarh), Fakot (Tehri-Garhwal in Uttarakhand), and G.R. Halli (Chitradurga, Karnataka). On realising, tremendous tangible and intangible, benefits from these watersheds, the ICAR developed 47 model watersheds in sixteen states in collaboration with State Agricultural Universities and State Agriculture Departments. Encouraged with the success of the model watersheds, the Ministry of Agriculture conceived a mega project entitled "National Watershed Development Programme for Rainfed Areas" (NWDPRA) for resource conservation and sustainable agricultural development in 29 states during 1991. Subsequently, the focus of watershed development programmes shifted towards community participation besides biophysical aspects to achieve sustainability in production systems. Success of the watershed management programmes generated a lot of interest among different stake holders and attracted many international agencies, like World Bank, ICIMOD, EEC, DANIDA, KfW Germany, SIDA and Swiss Development Corporation, for support, collaboration and funding. The research and training experience of the Institutes and its Research Centers is being put to good use by the Ministries of Agriculture, Rural Development, Environment & Forests, NRAA and various Central and State departments for capacity developmental programmes.

Land Degradation Scenario

India is blessed with vast natural resources but increasing pressure on land is disturbing the natural balance between the soil formation and soil depleting processes resulting in serious problems of land degradation which is threatening the national food security. As per the harmonized database on land degradation, about 120.72 m ha (36.70%) is suffering from various forms of land degradation on arable (104.19 m ha) and non-arable (16.53 m ha) lands out of the total geographical area of 329 M ha. In the degraded arable land, water erosion is the chief contributor (73.27 m ha) followed by chemical degradation (17.45 m ha), wind erosion (12.40 m ha) and physical degradation (1.07 m ha). Also, water erosion (9.30 m ha) and chemical degradation (7.23 m ha) are two major factors for land degradation in open forest areas. Land degradation through specific problems affects 17.96 m ha area comprising 8.53 m ha waterlogged, 5.50 m ha saline soils including coastal sandy area, 3.97 m ha ravines and gullies, 1.73 m ha shifting cultivation and 2.73 m ha riverine areas and torrents. Denudation of forest land in various watersheds has resulted in recurring floods, *chaos* and torrents besides there are serious issues of landslides, silting of rivers and reservoirs. The annual production loss in major rain fed crops due to erosion in the country has been assessed as 15.7% of total production of cereals, oilseeds and pulses. These losses can be prevented or minimised by adopting appropriate SWC strategies on arable and non-arable lands following the concept of participatory integrated watershed management.

Mandate

Research for management of land degradation in a primary production systems and rehabilitation of degraded lands in different agro-ecological regions of the country.

Co-ordinate research network for developing location-specific technologies in the area of soil and water conservation.
Centre for training in research methodologies and updated technology in soil and water conservation and watershed management.

Presentation of Research Progress

The research progress for the year 2017-18 is being presented in a programme mode as per the advice of Research Advisory Committee of the Institute and as recommended by ICAR committee. Accordingly, the research activities were rationally divided into six programmes and 13 sub-programmes. For meaningful and logical comparison of research findings within a research programme/project, the order of presentation is as per agro-climatic regions, viz; hill region (Dehradun, Chandigarh, Udhagamandalam Centres), ravine region (Agra, Kota, Vasad), Bundelkhand region (Datia), black soil semi-arid region (Bellary) and shifting cultivation-lateritic soil region (Koraput). The research programmes and Programme Leaders are as follows:

Research programme	Project Leaders
P-1 : Water erosion appraisal in different agro-ecological regions.	Dr. P.R. Ojasvi
P-2 : Conservation measures for sustainable production systems.	Dr. N.K. Sharma (Arable) Dr. Harsh Mehta (Non-arable)
P-3 : Watershed hydrology for conservation planning.	Dr. D.R. Sena
P-4 : Rehabilitation of areas affected by mass erosion.	Dr. Ambrish Kumar
P-5 : Integrated watershed management for socio-economic growth and policy advocacy.	Dr. Pradeep Dogra
P-6 : Human resource development and technology transfer.	Dr. Bankey Bihari

Organisational Set-up

The information on organizational set-up had been presented through a chart in the beginning of the report.

Important Events

Institute Conferred Sardar Patel Outstanding Institution Award

The IISWC was awarded the Sardar Patel outstanding ICAR institution Award, 2016 in the large Institute category on July19, 2017. The Institute with primary mandate of conservation of natural resources and having over 60 years of experience, has done pioneering work in developing a number of resource conserving technologies, both, for arable and non-arable lands, which have potential to check land degradation, minimise soil erosion, preserve soil's fertility, sustain productivity, conserve rainwater *in-situ*, harvest and recycle inevitable runoff, mitigate drought, moderate floods downstream, and ensure environmental security in different agro-ecological regions of India. The institute's biggest contribution has been to evolve, demonstrate and popularise the concept of participatory integrated watershed management encompassing biophysical and socio-economic aspects for food, environmental and livelihood security of local communities. It has successfully demonstrated a number of technologies in different agro-ecological regions in watershed mode. It has established networking and linkages with stakeholders, SAUs, State and Central Government agencies and International organisations through collaborative multi-disciplinary research and consultancy projects. The Institute has continuously strived hard for effective development and management of country's precious soil and water resources through imparting technical skills as a nodal agency to manpower engaged in natural resource conservation and watershed management.


Indian Council of Agricultural Research

Certificate

SARDAR PATEL OUTSTANDING ICAR INSTITUTION AWARD 2016

(For Large Institute category)

is presented to

ICAR-Indian Institute of Soil & Water Conservation

Dehradun, Uttarakhand

16 July, 2017
New Delhi

(T. Mohapatra)
Secretary (DARE) &
Director General (ICAR)

(Radha Mohan Singh)
Minister of Agriculture & Farmers Welfare
Govt. of India

Hon'ble Cabinet Minister of Uttarakhand visited IISWC

Hon'ble Cabinet Minister for Tourism, Culture, Irrigation and Minor Irrigation for the State of Uttarakhand, Sh. Satpal Maharaj visited the Institute on August 22, 2017. He had a brief discussion with the scientists of the Institute, officials from Watershed Directorate, Dehra Dun and Minor Irrigation Department. Hon'ble Cabinet Minister urged the research fraternity to reach out to local masses through media and Door Darshan so that the problem of water scarcity in the hills of Uttarakhand is resolved. On account of Tourism and Culture, he mooted the idea of development of Ecotourism or "Herbal tourism" in Uttarakhand, and suggested use of lemon grass and other medicinal plants for rehabilitation of degraded land. He also urged scientists to collectively address the issue of water scarcity in Neelang valley on way to Gangotri, and to introduce more fodder plants in the villages.

Institute/ Annual Day Celebrated

The IISWC celebrated its 63rd Annual Day on April 7, 2017. Dr. Trilochan Mohapatra, Hon'ble Secretary, (DARE) &DG (ICAR), Ministry of Agriculture and Farmers Welfare, Government of India, graced the occasion as Chief Guest. On the occasion a group meeting to discuss issues related to "Doubling of Farmer's Income" with members of the Uttarakhand State Coordination Committee and other stakeholders was also conducted.

Dr. P.K. Mishra Conferred Dr. J. Venkateswarlu Award 2016

Dr. P.K. Mishra, Director, ICAR-IISWC, Dehra Dun was conferred the prestigious "Dr. J. Venkateswarlu Award for Excellence in Dryland Agriculture Research, 2016" by Indian Society of Dry land Agriculture (ISDA) at ICAR-CRIDA, Hyderabad on May 27, 2017. On the occasion, Dr. P. K. Mishra gave a presentation on his engagements in various activities of Dryland Agriculture and the way forward.

Sankalp Se Siddhi- New India *Manthan* (2017-2022) Organised

On the occasion of 75th Anniversary of Quit India Movement, a function was jointly organised by IISWC Dehra Dun and KVK, Dhakrani, at Veer Shiromani Madho Singh Bhandari Kissan Bhawan, Dehra Dun on August 26, 2017 to launch "Sankalp Se Siddhi – New India *Manthan*". The Hon'ble Governor, Uttarakhand, Dr. K.K. Paul graced the function as

Chief Guest. Shri Subodh Uniyal, Hon'ble Minister of Agriculture and Horticulture, Government of Uttarakhand was the Guest of Honour. Dr. P.K. Mishra, Director, IISWC welcomed the dignitaries and all the participants, and appraised about the assignments being undertaken by the IISWC and KVK for development of agriculture and overall upliftment of farming community in the region. In his address, the Chief Guest stressed upon coordination between scientists of various R&D organisations and State Government Departments for achieving the target of doubling farmer's income by 2022. While making a reference to the issue of migration from hills, he suggested that this serious problem needs to be tackled by providing livelihood security through different Government schemes. Hon'ble Minister of Agriculture and Horticulture urged the State Departments to adopt cluster approach with Panchayats for specialised agricultural production as per the prevalent farming system. On the occasion, the message of Hon'ble Prime Minister was also read out.

Annual IRC Meeting, 2017

The Institute Research Committee Meeting for the year 2017 was held at the Headquarters, DehraDun during May 1-6, 2017. During the meeting, progress reports on 80 ongoing projects (including five Core Projects and seventeen Externally Funded Projects) were presented and discussed. Also, eight observational trials approved for 2016-17 and twenty new project proposals agreed by the Research Advisory Committee (RAC), 2017 were discussed. Further, the detailed discussion on progress and achievements of the Institute during XII Five Year Plan, recommendations of RAC-2017, action taken report of IRC (2016), intangible benefits of NRM Interventions, Tribal Sub Plan (TSP), Transfer of Technology (ToT), Status of Hydrological Instruments and Performance Indicators etc. were also held.

Institute Conferred Swachchta Pakhwada Award

The Institute was awarded the Swachchta Pakhwada Award 2017 (For Institute Category-First Prize) during Director's Conference held at NASC Complex, New Delhi on March 08, 2018. Institute and its eight research centres, spread all over the country has undertook the mission Swachch Bharat Mission in right perspective and conduct various activities on regular basis to motivate staff members and sensitize the students and villagers in adopted villages.


Indian Council of Agricultural Research

Certificate

SWACHHATA PAKHWADA AWARD

(For Institute Category – First Prize)

is presented to

ICAR-Indian Institute of Soil & Water Conservation

Dehradun, Uttarakhand

8th March, 2018
New Delhi

(C. Rose)
Special Secretary (DARE) & Secretary (ICAR)

(T. Mohapatra)
Secretary (DARE) & Director General (ICAR)

World Soil Day Celebrated

World Soil Day was celebrated at IISWC Head Quarters, Dehra Dun and its research centres on December 5, 2017. At ICAR-IISWC Dehra Dun Sh. Satpal Ji Maharaj, Hon'ble Minister of Tourism, Culture, Irrigation and Minor irrigation, Government of Uttarakhand graced the occasion as Chief Guest. The staff members, students and faculty from Shri Guru Ram Rai University, DehraDun and farmers from four villages adopted by the institute actively participated in the proceedings. 'Save Soil Campaign' oath was administered by the chief guest to all the participants. On the occasion two hundred fifty (250) Soil Health Cards were distributed to the farmers. In his address, the Chief Guest appreciated the Institute's efforts in preparing and distributing 'Soil Health Card' and urged the farmers to make proper application of the card. He also spoke about Super Food and Protein Revolution and urged the institute to make efforts in this direction. Sh. Harbans Kapoor, MLA indicated the importance of utilizing improved farm techniques for increasing farmer's income and highlighted the great role which the Institute has to play in achieving it. Dr. S.C. Gairola, DG, ICFRE, spoke about integration of soil & forest and developing strategies to improve forest productivity through soil testing. Dr. N.K. Sharma, I/C Director, ICAR-IISWC briefed the gathering about Institutes efforts towards soil and water conservation.

The ICAR-IISWC, Research Centres, Ballary, Koraput and Udhagamandalam also celebrated World Soil Day and conducted a variety of programmes to sensitise the students, farmers and general public about the importance of soil and its quality for food security underlining the fact that the soil is a precious natural resource and all citizens needs to take responsibility not only to attain higher crop production but also to conserve it for future generations.

Conference on "Food Processing and Kisan SAMPADA Yojna" Organised

One day conference on "Food Processing and Kisan SAMPADA Yojna" was organised by ICAR-IISWC, DehraDun in collaboration with ASSOCHAM, New Delhi on 13th March, 2018 at DehraDun, Uttarakhand. Hon'ble Governor of Uttarakhand, Dr. Krishna Kant Paul graced the occasion as Chief Guest. He was accompanied by Hon'ble Minister of Agriculture of Uttarakhand Sh. Subodh Uniyal. Sh. Chetan Vij, Asstt. Director, ASSOCHAM also graced the occasion. Hon'ble Governor in his inaugural address highlighted the need of processing and value addition for ensuring livelihood security of the farmers. He emphasized on the formation of "***Agri-business consortium***" for bringing all the market related information under a single window which could benefit the farmers and entrepreneurs. Sh. Subodh Uniyal, Hon'ble Minister of Agriculture of Uttarakhand, discussed the various Government Schemes available to farmers and entrepreneurs for processing and Value addition. Dr. P.K. Mishra in his address stated that though it was one day program but it is a gateway for awareness for farmers and entrepreneurs who would be benefitted in the long run.

Conference on "Farmers First for Conserving Soil & Water Resources in Western Region" Organised

Indian Association of Soil and Water Conservationists, DehraDun in association with ICAR-IISWC, DehraDun and AAU, Anand, Gujarat organised three day Conference on "Farmers First for Conserving Soil & Water Resources in Western Region" during 1-3 February 2018 at Anand Agricultural University. This was the 4th conference in the series after Southern, Northern and North-Eastern region of the country. Sh. Sanjay Prasad, Additional Chief Secretary, Govt. of Gujarat inaugurated the conference and emphasised on conservation and utilisation of precious soil and water for enhancing productivity and income by reducing cost of production through judicious use of external inputs. Guest of Honour; Dr S.A. Patil, Chairman, Farmers Commission of Karnataka and Former Director of ICAR-IARI shared his rich experience with the farmers and scientists. He inspired the farmer participants by quoting many successful case studies of farmers particularly in the dry region and rain dependent agricultural production area of Karnataka and Maharashtra. Dr N.C. Patel, Vice-Chancellor, AAU, Anand, Gujarat also addressed the participants and requested all the farmers and scientists to share their farming and research experience for the benefits of each other to conserve natural resources to meet food and environmental security. Dr P.K. Mishra, Director, ICAR-IISWC and President of IISWC, DehraDun in his welcome address highlighted the objectives of the conference and emphasised on the importance of conserving natural resources like soil and water in the changed climate scenario to meet the food, nutritional and environmental security. The conference was attended by 350 registered delegates including 105 invited farmers from the states of Rajasthan, Gujarat, Maharashtra, Goa and UTs of Daman & Diu and Dadra and Nagar Haveli

Directors, Heads and Scientists of ICAR Institutes and Regional Centers, Academicians from Universities, NGOs etc., from the Western Region also participated. The participating farmers shared their experiences on Land and Water resources conservation though different interventions carried out their own or with the help of KVKs or other research or extension agencies including NGOs. Presentations by Padam Shri Rajendra Singh from Tarun Bharat Sangh, on Community decentralised Land and water management for benefit of Farmers and by Shri Habib Sayyad (co-worker of Shri Popatrao Pawar) on Hiware Bazar – model village development were key attractions in addition to addresses by experts on relevant issues for farmers of this region. The valedictory function was chaired by Dr T. Mohapatra, Secretary (DARE) & DG (ICAR). All the 105 invited farmers were felicitated by dignitaries for their contributions and encouragements. Researchers and students from different Institutions and Universities presented their work and achievements in farmer's perspective through posters.

Seminar on "Scientific Mining of River Bed Material and Environmental Impact in Hilly and Foot Hill region" Organised

ICAR-IISWC organised a two day all India seminar **in association with** IE(I), UKSC and Indian Association of Soil and Water conservationists(IASWC) during 24-25 October, 2017 at IE(I), UKSC Conference Hall, DehraDun. Dr. V.K. Bahuguna, Ex DG, ICFRE graced the occasion as Chief Guest. Swami Chitanand Sarswati from Parmarth Niketn, Rishikesh and Dr. Anil Prakash Joshi, Director HESCO was Guest of Honour. Dr. V.K. Bahuguna in his inaugural address said that unscientific mining brings lot of sediment, contaminate water and causes huge environmental damage. Swami Chitanand Sarswati laid emphasis on conservation of rivers and enunciated that rivers are inherited by us from our earlier generations and

should be used so as to keep them intact for sustenance of our future generations. Dr. Anil P. Joshi expressed the need of setting up independent Mining Corporation on the pattern of the forest corporation to undertake mining works in the state. Dr. P.K. Mishra, Director and co-chairman of the programme appraised the august gathering about the variety of assignments being undertaken by the ICAR-IISWC. Two technical sessions, "Scientific approach, planning and extraction methods/ techniques for river bed mining" and "RBM policy, rehabilitation strategies and management of mined areas" were conducted.

Visit of Quinquennial Review Team (2012-17)

The Quinquennial Review Team, Dr. M.V. Ranghaswami (Dean Agril Engg., Bannari Amman Institute of Technology, Sathyamangalam, TN), Dr. Basudev Behera (Prof & Head, OUAT, Bhubaneshwar, Odisha), Dr. S.P.S. Kushwaha (Retd. Prof & Head, IIRS, Dehradun, UK) and Dr. G. Maruthi Sankar (Retd Pr. Scientist, ICAR-CRIDA, *Hyderabad, Telangana)* under chairmenship of Dr. Pratap Narain (Ex-Vice-Chancellor, RAU, Bikaner and former Director, CAZRI, Jodhpur) conducted review of research, extension, trainining and other activities undertaken at Institute Headquarters, Dehra Dun (December 19-20, 2017). The Quinquennial Review Team also reviewed the research, extension and other programmes undertaken at Research Centre Udhagamandalam, Ballary and Koraput.

MoU Executed with TCS, Mumbai

Memorandum of Understanding was signed with TATA Consultancy Services (TCS) Limited, Mumbai on 26th February, 2018 in order to provide the ICT Extension services to the farmers of the nine states i.e. Uttarakhand, Chandigarh, Uttar Pradesh, Rajasthan, Madhya Pradesh, Odisha, Karnataka, Gujarat and Tamil Nadu. The memorandum underlines collaboration with regards to ICT based extension activities under the name "IISWC & TCSL Collaboration – PAWS (personalized advisory on water and soil)" which will be based on TCS patented platform mKRISHI®.

Capacity Building under INBAR Project

Training on "Allometric and Environmental Metrics in Bamboo" was organised under INBAR's project on "South-South Knowledge Transfer Strategies" jointly co-financed by IFAD and the European Union (August 1-20, 2017). Dr. Rajesh Kaushal, PI and Dr. Ambrish Kumar, Co-PI of the project visited Injibara (Ethopia), Kibaha (Tanzania)) and Toamasina (Madagascar) to impart training. The training was imparted to over sixty two trainees from different academic, research and development institutions. The participants were involved in classroom and field exercises related to research design and methodologies for studying morphological, growth parameters, biomass estimation, root distribution, litter collection and diversity measurement.

International Training Programme under Aegis of India Africa Forum Summit-III Conducted

International Training Program under the Aegis of India Africa Forum Summit-III was organised at ICAR- IISWC, Dehra Dun from 6th to 20th March, 2018**.** The fifteen day program was a part of the 15 short term trainings organised by the Department of Agricultural Research and Education – ICAR under the India Africa Forum Summit-III and sponsored by the Ministry of External Affairs, Govt. of India. Fourteen African delegates from 6 countries viz., Ethiopia, Ghana, Kenya, Malawi, Nigeria

and Zambia in Africa participated in the training program. Dr. V. N. Sharda, Ex-member ASRB and Ex-Director ICAR-IISWC, DehraDun, chaired the inaugural function as the Chief Guest and shared his vast experience on soil and water conservation and watershed management. Dr. P.K. Mishra, Director, ICAR-IISWC, DehraDun greeted the participants and referred to the common interests of both India and African Nations in agriculture and natural resource management.

Important Publication

Annual Report 2016-17, ICAR-IISWC, DehraDun.

IISWC News, No.12 (April to September 2017). ICAR-IISWC, DehraDun (Half yearly Newsletter).

IISWC News, No.13 (October 2017 to March 2018). ICAR-IISWC, DehraDun (Half yearly Newsletter).

Nath, V., Pandey, S. D., Kumar, A., Patel, R. K., Srivastava, K., Kumar, G., Purvey, S. K. (2017) Challenges and Options in Litchi Production and Utilization, Gyan Manthan, Vol. 6 – pp-184, published by Westville Publishing House New Delhi, ISBN 978-81-932266-2-9.

Sharma, N. K. Awasthe, R. K., Kumar, A., Mandal, D. Kaushal, R.,Singh, L, Das, A. Kumar, G. Singh, R. , Mishra, P. K. (2018) "Farmers Innovation, Initiative and Expectation in Natural Resource Conservation in North Eastern Region". IASWC, DehraDun, pp-128.

Sharma, N.K., Bhatnagar, P.R., Subbaiah, R., Ambrish Kumar, Mandal, D., Rajesh Kaushal, Gopal Kumar, Dinesh, D., Kakade Vijay and Meena, O.P. (2018). Souvenir of the Conference on "Farmers first for conserving soil and water resources in Western Region", 1-3 Feb., 2018, IASWC, DehraDun, 159p.

Sharma, N.K., Dinesh, D., Batnagar, P.R., Subbaiah, R., Ambrish Kumar, Mandal, D., Rajesh Kausha and Gopal Kumar (2018). A compendium of Abstract of Papers. In : Conference on "Farmers First for Conserving Soil and Water Resources in Western Region" (FFCSWR-2018) held at AAU Anand, Gujarat, 1to3rd Feb 2018.IASWC, Dehradun,100 p.

Kaushal, R., Kumar, A., Jayaraman, D., Mandal, D., Rao, I.V.R., Dogra, P. Alam, N.M., Gupta, A., Tomar, J.M.S., Singh, D.V., Mehta, H. and Mishra, P.K. 2018. Research Methodologies for field monitoring analysis and evaluation of resource conservation aspects of bamboo. International bamboo and rattan organization. Beijing, China. PP 124. ISBN: 978-92-990082-9-4.

Sharma, N.K., Avasthe, R.K., Kumar, A., Mandal, D., Kaushal, R., Singh, L., Das, A., Kumar, G., Singh, R. J., Mishra, P.K.2018. Farmers Innovation, Initiative and Expectation in Natural Resource Conservation in the North Eastern Region. Indian Association of Soil and Water Conservationists, Dehradun, Uttarakhand. 125p.

Mishra, P.K., Singh, Lakhan, Kumar, Ambrish, Mandal, D., Kaushal, Rajesh, Alam, N.M. 2017. Soil and Water Conservation Bulletin - 2017. Bulletin No. 2. Indian Association of Soil and Water Conservationists, Dehradun, Uttarakhand. 92p.

Manivannan.S, O.P.S. Khola and V. Kasthuri Thilagam (2017). Hand Book on Field Engineering Structures for Forest Watershed Management. ISBN: 978-81-924624-2-4. pp 185.

Manivannan.S, V. Kasthuri Thilagam and O.P.S. Khola (2017).Application of GIS and Mobile techniques in watershed management.(ISBN: 978- 93 - 87314 - 41- 2) pp 166.

Manivannan.S, V. Kasthuri Thilagam, Balaji Kannan and G.Thiyagarajan (2018).Integrated Watershed Management (Tamil), Thannambikai Publication, Coimbatore (ISBN 978-93-87314-60-3).Pp. 262.

Important Meetings

49th Meeting of Institute Management Committee at Dehradun on 8 Februrary 2018.
Research Advisory Committee meeting of the Institute held at IISWC, Dehra Dun during 06-07March.2018.

Training Programme

During the year 2017-18; two batches of four months Courses on Soil and Water Conservation and Watershed Management were organised in which 51 officers, that include eleven women participants, were imparted training. Up to 31 March 2018, a total of 2913 officers have been trained at institute Head Quarters DehraDun and its Regional Research Centers.

Resource Generation

During 2017-18, revenue worth ₹ 235.85 lakhs was generated. Highest revenue was generated through the sale of farm produce (₹97.70 lakhs) followed by internal resource generation activities *viz.* training & consultancy (₹24.47 lakhs) and lab analysis (₹1.99 lakhs). It is attributed to efficient management of resources at Research Farms, organisation of short-term courses, analytical testing fee and undertaking a number of consultancy projects. The details of institute unified budget are as under.

Unified Budget	Funds	₹5918.00 lakhs
[IISWC, DehraDun and its Eight Research Centres]	Expenditure	₹5895.52 lakhs

Staff Position

The strength of sanctioned staff as on 31.3.2018 including filled and vacant positions is given as follows:

Category	Sanctioned	In position				Vacant
		Total	SC	ST	OBC	
RMP	01	01	--	--	--	--
Head/ Pr. Scientist	15	7	--	--	--	8
Sr. Scientist	28	18	--	01	02	10
Scientist	85	68	10	07	17	17
Administrative	83	61	10	06	05	22
Technical	176	100	20	06	07	76
Supporting	207	157	39	07	27	50
Total	**595**	**412**	**79**	**27**	**58**	**183**

02 RESEARCH ACHIEVEMENTS

P-1: WATER EROSION APPRAISAL IN DIFFERENT AGRO- ECOLOGICAL REGION

P-1.1 Inventory and data base of erosion status using modern tools and procedures

Development of Intensity-Duration-Frequency Curves using Rainfall Data for Different Agro-ecological Regions of India (N.M. Alam, P.K. Mishra, D.R. Sena and Ms. C. Jana- D. Dun)

The objective of the project was to developing Intensity-Duration-Frequency (IDF) curves for different agro-ecological regions of India using recent rainfall breakpoint data (1990 onwards), which will help in strengthening the robust design criteria of such hydraulic structures. Rainfall Energy Calculator, software to calculate rainfall energy as well as rainfall intensity at different intervals (5 minute to 24 hour) have been developed. IDF curves of 31 meteorological stations located at different agro-ecological regions of India have been developed using recent rainfall data (data up to 2014). The IDF curve and the intensity of rainfall at 10 and 100 years at different duration for DehraDun has been shown in Fig. 1.

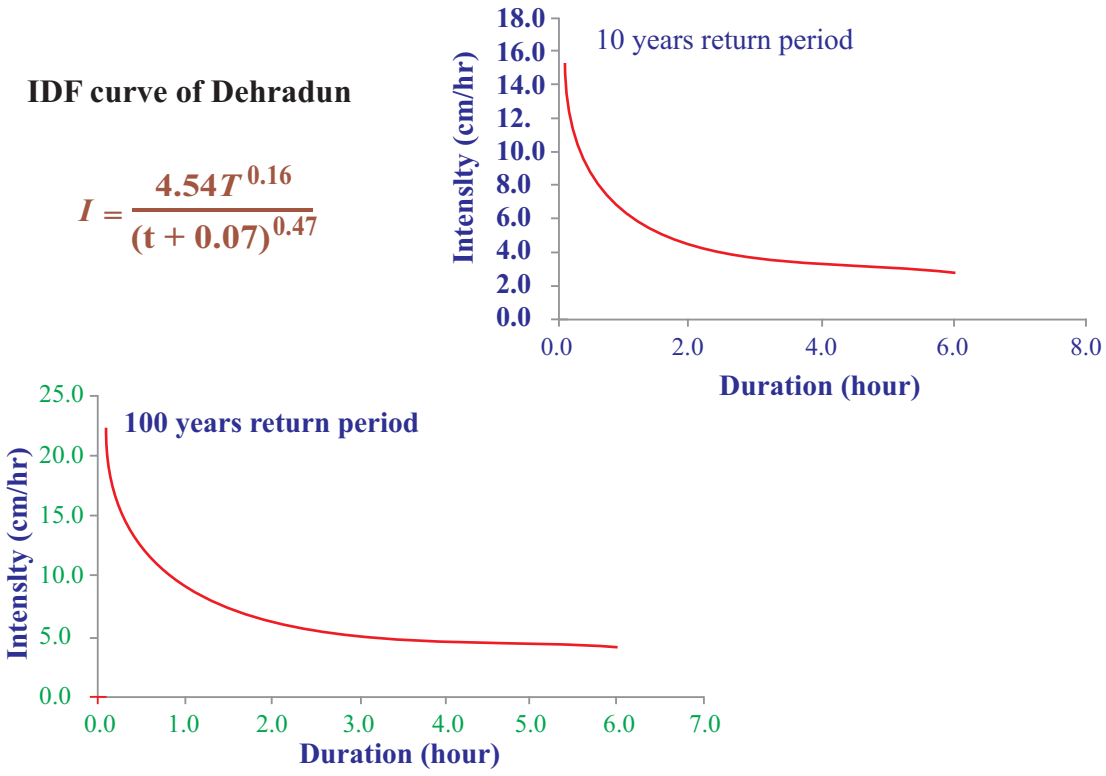


Fig. - 1. IDF curve of D. Dun

Assessment of soil erosion fluxes of Uttarakhand (P.R. Ojasvi-D. Dun)

Study on soil erosion fluxes is undertaken by employing high resolution geo-spatial data on topography, LULC, and rainfall erosivity. Besides hill slope erosion, contribution from stream bank and other major erosion processes are being estimated for the Uttarakhand State. Estimation of potential erosion rate with 30 m resolution data showed that 21.6% area of Uttarakhand is under >10 t ha^{-1} yr^{-1} rate as compared to previous estimate of 55.6% [Fig- 2]. Besides improving erosion estimates this also shows that stream bank and other mass erosion processes contribute significantly to total sediment load of hilly streams. The data required to estimated other forms of erosion is being compiled.

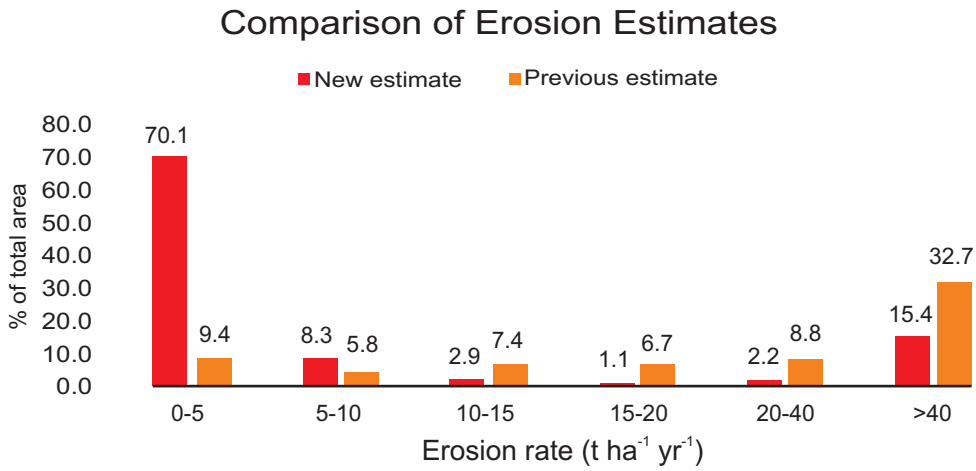


Fig.-2: Comparison of new and old erosion estimates for the state of Uttarakhand.

Impact of land use land cover changes on soil erosion susceptibility in Bundelkhand region using remote sensing and GIS technique (Rajeev Ranjan, Monalisha Pramanik and RS Yadav-Datia)

To quantify the spatio-temporal variability in land use - land cover changes, estimation of soil erosion and to prepare suggestive treatment plan/map for vulnerable area of Bundelkhand region using remote sensing and GIS the RS imageries (Landsat, LISS III and ASTER 30 m DEM) were used. The digitized map of all 13 districts of Bundelkhand region and Digital Elevation Model (DEM) map with stream network were prepared using ArcGIS 10.1 The land slope map of the region is prepared using the DEM and the slope is categorized into five classes (0-3, 3-5. 5-8, 8-16 and > 16 per cent). Rainfall erosivity factor (R) map was prepared (Fig. 3). The R factor varies from the value of 402 to 607

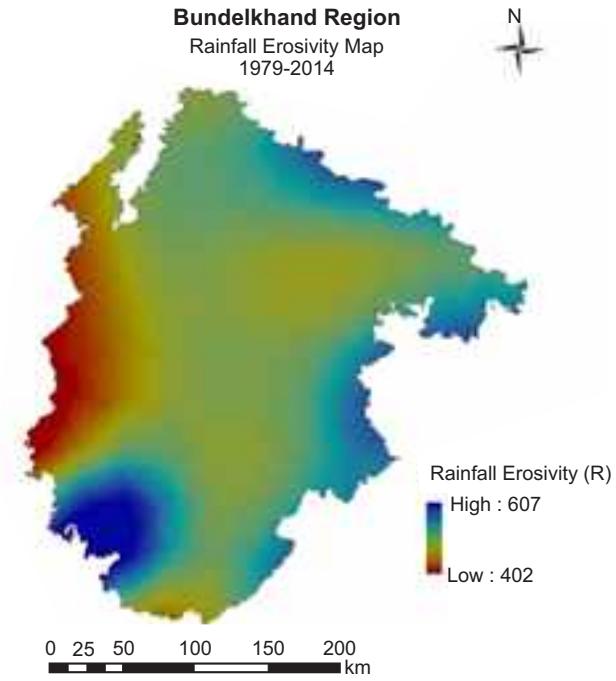


Fig.- 3: Rainfall erosivity factor map of Bundelkhand region

For assessing the impact of NRM structures, constructed under Bundelkhand package in Datia district, three stop dams (Fig. 4) were identified. A detailed questionnaire was prepared to assess the impact on productivity, water availability and socio-economic conditions of the beneficiary farmers, and data is being analysed.

Fig.- 4: Identified Stop dams constructed under Bundelkhand package, Datia

P- 1.2: SOIL EROSION PROCESS MODELLING AND CLIMATE CHANGE STUDIES

National Mission on Sustaining Himalayan Eco-systems (NMSHE) – Task force on Himalayan agriculture for lower and middle Himalayan region

DehraDun

Web portal www.haku.n has been developed knowledge networking of Himalayan region.

Compilation of database content and its structuring for web pages has been carried out and is an ongoing process.

Suitability maps for the year 2050 were prepared for the Indian Himalayan Region of maize crops**.** The shift matrix shows the shift in areas suitable for growing Maize in Base period (1950-2000) to the years 2050 for different RCPs.

Land use land cover, slope (percentage and degree) and contour maps for Kotha-Tarli village were prepared.

50 vulnerability parameters have been identified and a list has been circulated among the partner institutes for compilation.

The Land use and Land cover map of Kotha-Tarli Watershed (Dehradun, Uttarakhand) was created and the area for each LULC class was calculated. The highest area was occupied by Dense forests (85.22 Ha) followed by cultivated fallow land (84.53 Ha) and agriculture (25.28 Ha) respectively.

A total of 200 plants of Pomegranate with an average height of 50-55 cm were planted in 8 farmer's field, in the village Kotha-Tarli, Dehradun on 6th August, 2017.

Micro-catchment with grass-mulch was made for improving the productivity of pomegranate.

A total of 50 plants of lemon with an average height of 40-45 cm were planted in 13 farmer's field were planted in the village, Kotha-Tarli, Dehradun.

Organic manures with bio-fertilizers were used for improving crop yield and productivity of **lemon.**

Wheat VL892 seeds were distributed to 28 farmers for plantation in the village, Kotha-Tarli, Dehradun in the month of Nov17.

In order to protect the eroded area from splash erosion, 1000 rooted slips of Lemongrass were planted at 50 * 50 cm spacing to develop as vegetative barrier for stabilizing the eroded torrents in the village Jur Kafun.

Introduction of interventions such as plantation of bamboo has been carried out in Jur Kafun watershed. Bamboo varieties- *Dandrocalamus strictus*, *Bambusa balcooa, Bambusa vulgaris* and *Oxytenanthera parvifolia* were planted (20 plants of each variety) as a component of bio-engineering measures in October 2017. 70% survival has been observed in the month of January 2018.

A total of 250 plants of Peach (variety- Red June) in 10 farmer's field were planted in the village, Kotha-Tarli, DehraDun in the month of Feb18.

A meeting was organized on September 4, 2017 at ICAR-Indian Institute of Soil & Water Conservation (IISWC), DehraDun, Uttarakhand to review the progress and discuss the subsequent future work plans under the project.

All India Seminar on "Scientific Mining of River Bed Material and Environmental Impact in Hilly and Foot hill Region", organized by the Institute of Engineers (India), Dehradun in collaboration with Indian Association of Soil and Water Conservation and ICAR-IISWC, Dehradun on 24th-25th October, 2017 at Institute of Engineers (India), Dehradun.

One animal health check-up camp cum awareness programme was organized at Kotha-Tarli watershed by IVRI, Mukteshwar in collaboration with ICAR-IISWC, Dehradun on 27th December, 2017.

A review meeting was organized on January 5, 2018 at Jyur Kafun Village, Almora Uttarakhand to review the progress and discuss the subsequent future work plans under the project was organised.

National Science Day was organised on February 28, 2018 at Guru Nanak Girls Inter College, Khurbuda, Dehradun with event of Scientific Painting for Himalayan Ecosystem and Environmental Sustainability. The Prizes were conferred on the best performance for their outstanding contribution in awareness, creativity and for promoting scientific temper.

Chandigarh (P.Panwar,.K. Bhatt, S.L. Arya, Sharmistha Pal, R. Prasad,A.K.Tiwari and P.Sharma)

Meteorological data on five parameters *viz.* temperature, rainfall, humidity, wind speed and direction and Barometric pressure have been collected through Automatic Weather Station installed at project site in Kumhali District Shimla, Himachal Pradesh. Water discharge of two natural springs at Kumhali is being monitored after every 15 days interval. The discharge ranged from 5 liters/minute in first fortnight of April to 15 liters/minute in the month of November, 2017. Vulnerability of ten districts of Himachal Pradesh was assessed using the primary data collected by surveying the households. Exposure, Sensitivity and adaptive capacity indices were worked out separately for each district and overall vulnerability index was calculated. Mean household vulnerability index in the study area was 0.27. As indicated by the value of vulnerability index, Kullu (5.94) is the most vulnerable district while Hamirpur (-3.37) is the least vulnerable. Under SALT (Sloping Agricultural Land Technology), the construction work for the embankment type pond (5 X 2.7 X 2.1 cu.m) for water storage in village Kumhali has been completed.

Application of Integrated Spatial Science Tools for prediction of Soil Erosion map under Changing Climate Scenario for the Uttarakhand state (U. Mandal, C. Jana and D. R. Sena-D Dun)

Details land use land cover map was prepared for the year 2002 using LANDSAT ETM+ image (23.5 m spatial resolution) help of ERDAS Imagine software using supervised method of classification. LULC details are given in Table 1 and shown in Fig. 5. Rainfall and rainfall erosivity (R^2=0.95, using linear function) and Modified Fournier Index and rainfall erosivity (R^2=0.98, using power function) relationship has been developed based on past 20 years (1990-2010) of rainfall break point data of ICAR-IISWC DehraDun. For the capturing of the seasonal variation of rainfall erosivity calculation, Arnoldus (1980) equation has been modified and utilized for the prediction of rainfall erosivity from monthly and annual rainfall data for the Uttarakhand state.

$$R = \sum_{i=1}^{12} 98.0576 \times 10^{\left(0.7472 \times \log_{10}\left(\frac{p_i^2}{P}\right) - 0.001\right)}$$

Rainfall erosivity map has been generated using the equation 1for the Uttarakhand State and shown in Fig. 6. Soil erodibity map has been generated for the Uttarakhand State using Renard *et al*., 1997 (Soils having <10% Coarse fragments) and Wischmeier and Smith, 1978 (Soils having >10% Coarse fragments) (Fig. 7). LS-factor map has been generated from the 30-m resolution ASTER DEM for the Uttarakhand State using concept developed by Desmet and Govers, 1996 and also compared with previous one published by NBSS&LUP and IISWC DehraDun (Table 2). LS factor map of Uttarakhand State shown in Fig. 4.

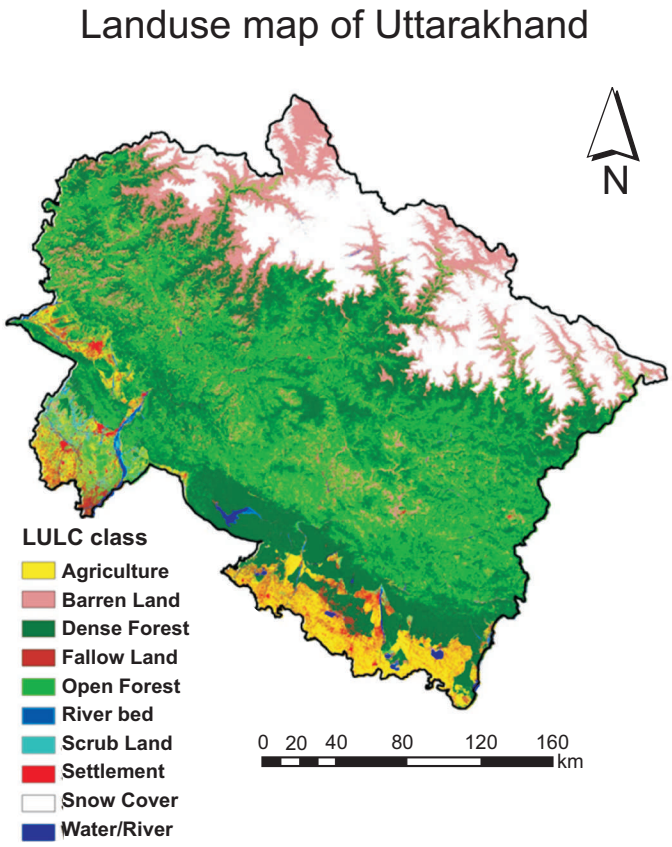


Fig. 5: Land use land cover classification of Uttarakhand State for the year 2002

Table 1: Land use land cover area statistics of Uttarakhand State

Land use classes	Area, Km^2	% area
Dense Forest	20763.49	38.65
Open Forest	9281.39	17.28
Agriculture	2583.62	4.81
Fallow Land	1833.75	3.41
Scrub Land	596.15	1.11
Barren Land	8818.61	16.41
Settlement	532.49	0.99
Water/River	403.19	0.75
River bed	434.14	0.81
Snow Cover	8479	15.75
Total Area ----	53725.83	

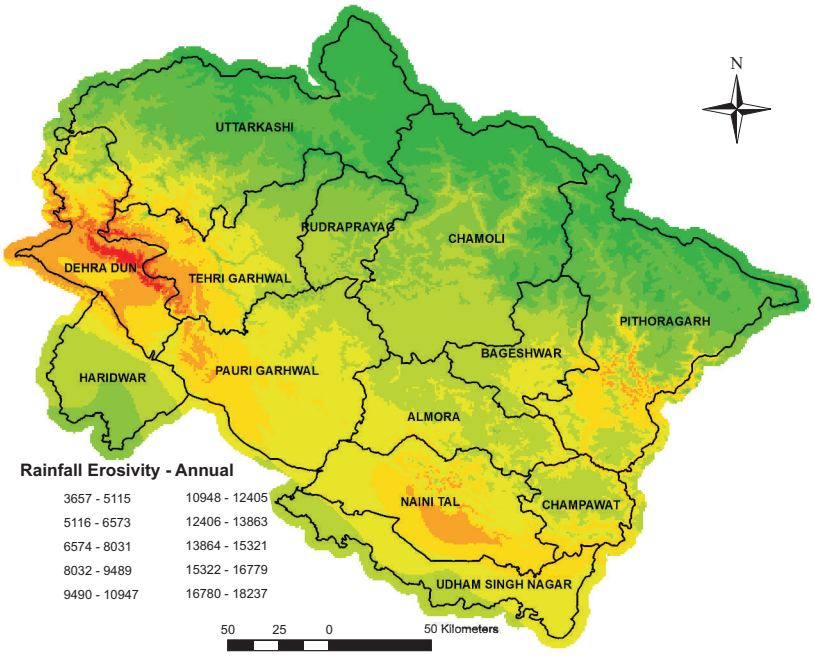


Fig. 6: Rainfall erosivity map of the Uttarakhand State

Table 2: Comparison of USLE (NBSSLUP) based data from RUSLE LS factor

LS-range	NBSSLUP-CSWCRTI [USLE] (% area)	RUSLE	Error (%)
<0.5	18.49	6.12	-66.89
0.5-1.5	16.57	4.83	-70.87
1.5-5.0	16.2	6.85	-57.69
5.0-10.0	7.23	6.68	-7.65
10.0-15.0	3.64	6.26	72.08
>15.0	8.65	40.04	362.86

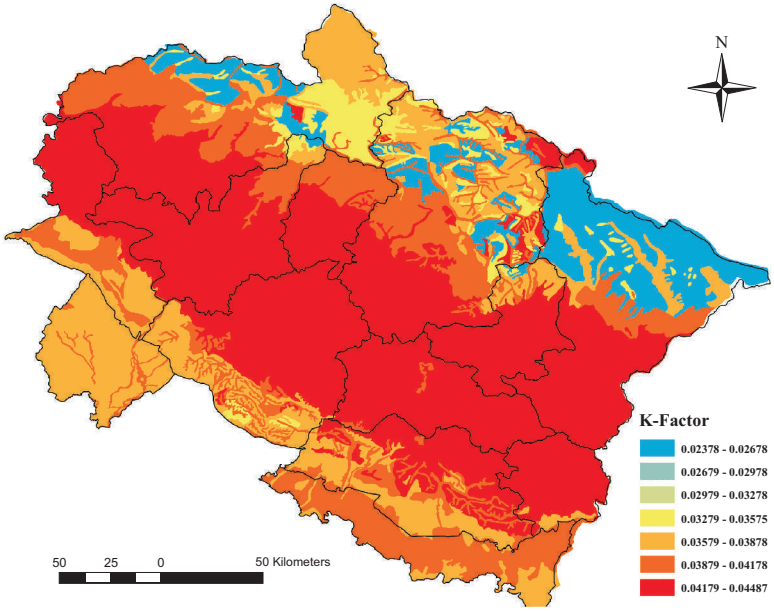


Fig. 7: Soil Erodibility Factor map of the Uttarakhand State

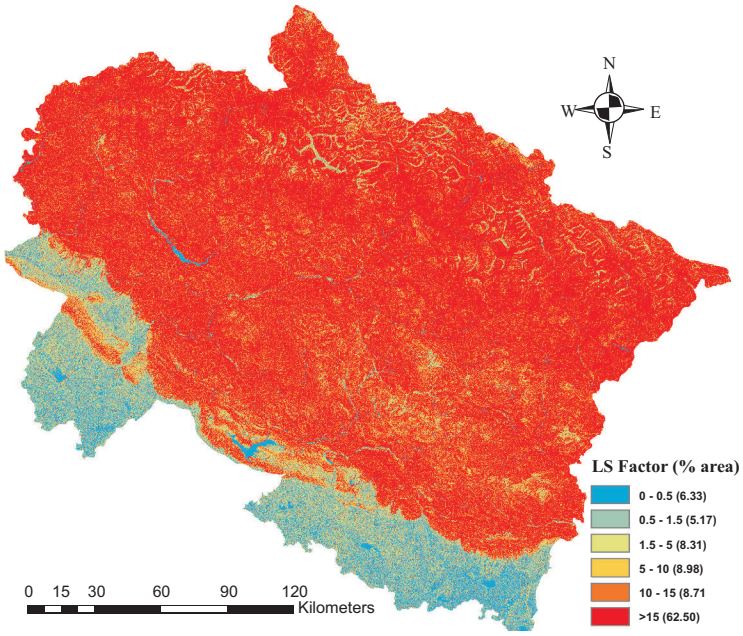


Fig. 8: Slope Length and Steepness Factor map of the Uttarakhand State

Study of atmospheric and soil carbon dioxide fluxes in temperate mountainous ecosystem of Western Ghats with reference to climate change impact assessment. Externally funded project (P. Raja, K. Rajan, K. Kannan and O.P.S. Khola- Udhagamandalam)

The collaborative study was initiated with the funding from National Remote Sensing Agency-ISRO in the temperate mountainous region of the Nilgiris which form a part of Western Ghats extended from latitude 11° 24' to 11° 43' and longitude 76° 41' to 77° 01'. GMP-343 atmospheric CO_2 sensor (Fig. 9) was installed at our Ooty Centre's research farm by the funding agency NRSC-ISRO, Hyderabad. Atmospheric CO_2 levels on every minute are recorded by data logger (Fig.10). The results indicate that maximum CO_2 level (420 ppm) was observed in atmosphere in the night time after 21 hrs and CO_2 level of around 400 ppm was observed in the day time between 10 to 17hrs. The high CO_2 level in the night time is attributed to vegetation effect. Using high precision Ultraportable green house gas analyzer (UGGA), observations on CO_2, CH_4 and H_2O were carried out in forest and agricultural areas cultivated for carrot and beet root (Fig. 11 a-c). The soil CO_2 ranges from 403 to 427 ppm and CH_4 in soil ranges from 1.88 to 1.90 ppm. Higher soil CO_2 could be due to respiration by soil microbes. Soil moisture determination at 15 cms interval up to the depth of 60cm are studies at 15 days interval are studied from seven different land

Fig.9.Atmospheric CO_2 Sensor

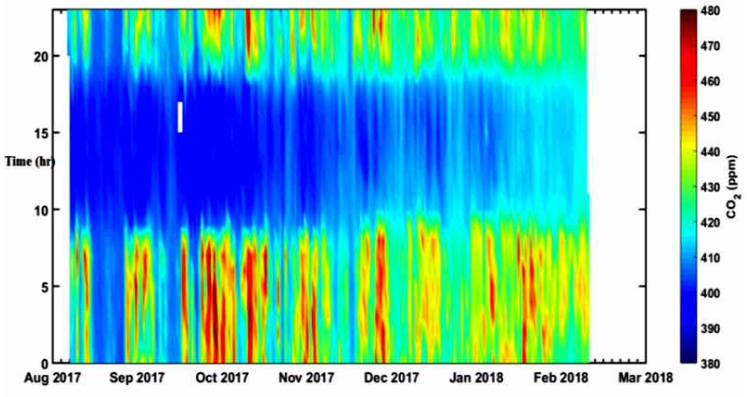


Fig.10 .Atmospheric CO_2 Dynamics

use systems viz., Shola, Wattle, Eucalyptus, Mixed, Pine forests and Tea and Agricultural lands(Fig. 12 a-b). The results indicate that the available soil moisture was less in the surface soil layer in all the land uses due to well developed stable macro aggregates that permits easy infiltration and the deeper soil have more effective volume per unit area for greater moisture storage. Maximum soil moisture in Shola forest followed by agricultural land and tea garden. High moisture content in soils under Shola forest is due to minimal evaporation due to shadow conditions. Estimation of CO_2 emission from the soils of various land use systems are under study. Future research activities will also focus towards the study on CO_2 exchange behaviour of different vegetation from different land use land cover after the procurement of relevant instruments under the project

Fig. 11 (a-c) Measurements of Green house gases in forest (a), beet root (b) and carrot cultivation (c)

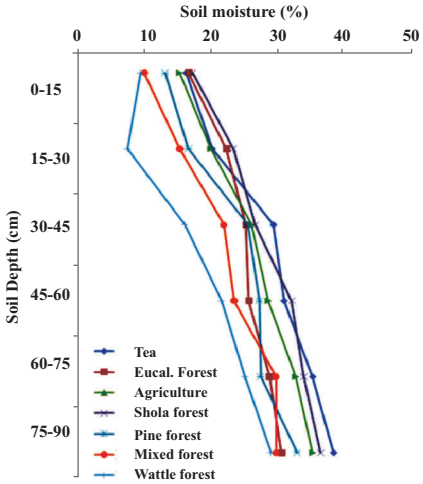


Fig.12a. Soil moisture dynamics-Aug.2017

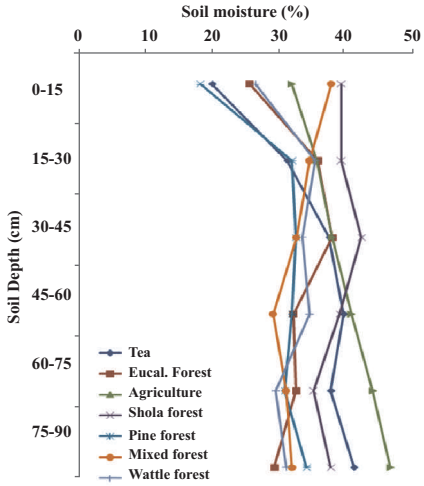


Fig.12b . Soil profile mean moisture -Aug.2017

P-1.3: Soil Carbon Dynamics and Erosion Productivity Studies

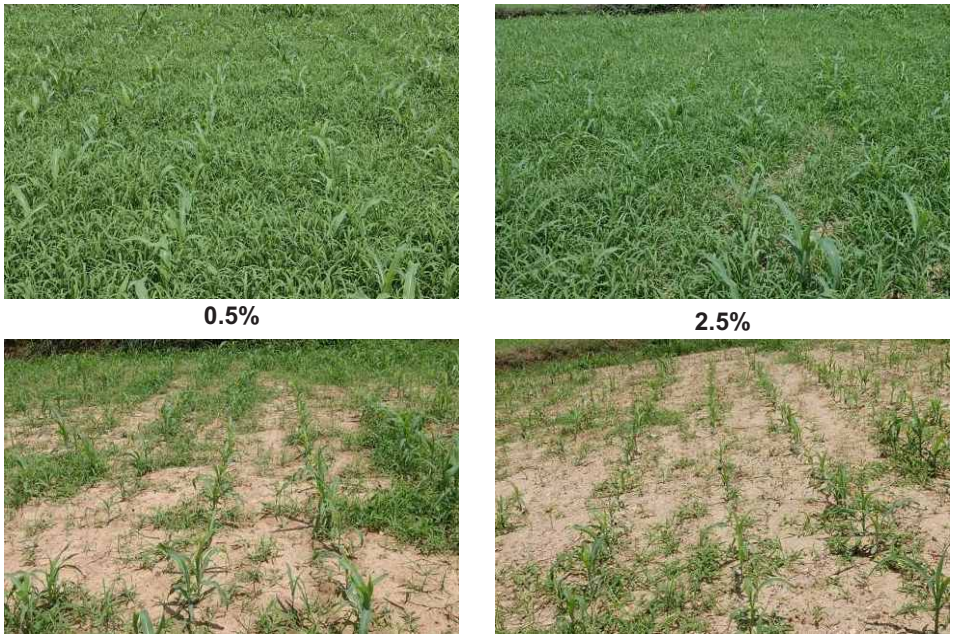
Erosion- productivity relationships for evaluating vulnerability and resiliency of soils under different agro-climatic regions of India

DehraDun (D. Mandal, Deepak Singh, N.K. Sharma and Pradeep Dogra)

The present study was carried out on four contiguous runoff plots (60m x 7m) with different degrees of erosion in the Doon valley region of the lower Himalayas. These are off plots were established on 0.5, 2.5, 4.5 and 9.5% slopes using the natural slope of the landform. The different slopes induce different levels or phases of erosion e.g. slightly, moderately, severely and very severely eroded phases, respectively for 0.5, 2.5, 4.5 and 9.5% land slopes. Thus, various phases of erosion were compared by taking the three composite samples as replicates within each runoff plot. Maize (Zea mays) and wheat (Triticum aestivum) were grown on each erosional plot under rainfed condition. Each plot was bermed with earth to prevent external runoff from entering the plots and to allow for easy passage of field equipment for determining runoff and soil loss.Analysis of data generated through comparative plot study during 2009-2016 revealed that soil loss varied from 4.80 to

41.6 t ha-1 depending on slope and fertilizer application. With respect to slightly eroded soil, soil loss increased by as much as 4.43 times, and runoff by 2.53 times in severely eroded plots. In general, runoff and soil losses were higher in unfertilized plots than fertilized plots. Higher soil loss in unfertilized plots as compared to fertilized plots may be attributed to the poor canopy cover of maize in unfertilized condition. Maize yield varied between 2.7 t ha-1 to 3.8 t ha-1 depending on variation of slope and application of manure and fertilizer. Surprisingly, without fertilizer treated plots resulted in no reportable grain yield during 2015. Highest yield was observed in 4.5% slope with fertilizer treatment. In case of wheat, the maximum yield (3.2 t ha-1) was recorded at 0.5% slope whereas minimum (2.6 t ha-1) was at 9.5% plots during 2015. Similar trend was obtained without fertilizer treatments as well.

Phytomass and crop growth at different slopes



Relationship between soil erosion and crop yield without fertilizer treatment was established as Y= -0.019X + 1.82. In case of manure and fertilizer treated plots, the relationship was Y= -0.010X + 4.51 where, X is soil erosion rate (t ha-1) and Y is system yield as a whole (t ha-1).Regression analysis of the data revealed that the impact of erosion had significant impact on crop yield when no manure and fertilizers are applied. However, the impact of erosion was statistically non-significant on crop yield when manure and fertilizers were applied.

AGRA (S.K. Dubey, A.K. Singh and R.K. Dubey)

The study was conducted on standard runoff plots of 0.5, 1.0, 2.0 and 3.0 per cent slope for developing erosion productivity relationship and quantifying the impact of erosion on productivity of pearl millet crop. Data on rainfall runoff soil loss and yield of pearl millet were recorded during monsoon season of 2017 (21/7/2017 to 06/10/2017). Total rainfall during entire crop period was just 153.6 mm in 22 events with daily rainfall ranging from 0.4 to 36 mm and only two numbers of daily rainfall events exceeding 20 mm (24/7/2017 and 07/8/2017) were recorded. The crop season was dominated by drought and in all six drought of more than one week duration were encountered which led to failure of crop and only marginal mean yields were realized over different slopes (improved practice: 43.06 kg/ha and Farmer practice: 22.07 kg/ha).Regardless of slope, zero productivity of pearl millet crop was noticed on top and middle portions of standard runoff plots while a very meagre mean productivity of 32.56 kg/ha was registered at bottom portion over different slopes. Only one runoff event was noticed on 07/8/2017 which clearly depicts that both runoff and soil loss increased with increase in slope from 1.56 to 9.0 percent. Runoff (mm) and soil loss (kg/ha) at 0.15 and 9.0 per cent runoff plots corresponded to 38.64,32.97 and 60.0 and 74.22, respectively.

Ballary (H. Biswas and S.L. Patil)

A field study was conducted on twelve standard runoff plots. The major crops i.e. sorghum (var. M35-1) and chickpea (var. A1) were cultivated with application of recommended rate of fertilizer (RRF) with farmyard manure and without

fertilizer application in 0.5%, 1.0% and 2.0% slopes runoff plots. Chickpea was cultivated with application of 10 kg N ha^{-1} and 25 kg P_2O_5 ha^{-1} along with application of 2.0 t FYM ha^{-1} and winter sorghum was cultivated with application of 30 kg N ha^{-1} and 30 kg P_2O_5 ha^{-1} along with 5.0 t FYM ha^{-1}. During 2017, a total of 709.5 mm runoff-producing rainfall was received in 14 storms. Runoff varied from 289 to 383 mm across all the treatments under sorghum, while soil loss ranged from 9.35 to 11.5 t ha^{-1} (Table 3). Both runoff and soil loss increased with increase in slope. Higher amount of potassium was lost through runoff as compared to nitrogen and phosphorus. The organic carbon content lost through sediments varied from 37 to 56 kg ha^{-1}, and the clay content, from 29.9 to 39.8%. Chickpea yield varied from 176 kg ha^{-1} under 2% land slope without the application of fertilizers to 315 kg ha^{-1} when recommended rate of fertilizers was applied to the crop under 0.5% slope (Table 4). Runoff varied from 238 to 344 mm across treatments, while soil loss varied from 6.83 to 8.29 t ha^{-1} for chickpea. Better soil aggregation leading to favourable physical properties (water retention and movement) and closer plant spacing has resulted in lower runoff and soil loss under chickpea as compared to sorghum.

Table 3. Effect of land slope and fertilizer application on runoff, soil loss and sorghum yield

Slope %	Fertilizer	Sorghum Yield (kg ha^{-1})		Runoff (mm)	Soil loss (t ha^{-1})	Clay (%)	OC (kg ha^{-1})
		Grain	Straw				
0.5	With	727	1484	289	9.35	29.9	37.4
	Without	586	1236	345	9.86	32.1	42.4
1.0	With	726	1484	318	9.75	33.5	43.9
	Without	482	1236	364	10.42	36.7	49.0
2.0	With	669	1484	357	10.51	35.2	50.4
	Without	246	742	383	11.48	39.8	58.5

1. with fertiliser; 2. Without fertiliser

Table 4. Effect of land slope and fertilizer application on runoff, soil loss and chickpea yield

Slope %	Fertilizer	Chickpea grain yield (kg ha^{-1})	Runoff (mm)	Soil loss (t ha^{-1})	Clay (%)	OC (kg ha^{-1})
0.5	With	315	238	6.83	28.3	22.5
	Without	240	272	7.11	30.1	26.3
1.0	With	267	269	7.09	31.5	28.4
	Without	204	295	7.57	34.7	32.6
2.0	With	235	311	7.76	33.3	32.6
	Without	176	344	8.29	35.6	38.1

1. with fertiliser; 2. Without fertiliser

Chandigarh (Sharmistha Pal and V.K.Bhatt)

Eight runoff plots of standard size (22.13m x 1.83m) with four slopes of 0.5, 1.0, 2.0 and 4.0 % slopes were employed for the experimentin duplicate (table 5). In one set of four slopes, maize crop was sown without any fertilizer addition. Under second set, crop was grown with improved package of practices. Maize was sown on contour across slope and with fertilizer doses of 100:40:20:: N: P_2O_5: K_2O. Half of nitrogen, full phosphorus and potassium applied before sowing and 50 % nitrogen was applied 21 days after sowing. Maize var. Pioneer 3377 was sown during *kharif* followed by mustard (var. Dhara) during *rabi* under rainfed condition. Ramser's samplers were installed in each plot to monitor runoff and soil losses and determine clay and organic carbon in the sediments. During *kharif* (2017-18) season, runoff samples from all the events were collected and combined treatment wise and sediment was separated by decanting of clear water and drying it open. Soil loss showed variation from 0.80 to 4.20 t ha^{-1} having minimum value at 0.5 per cent and maximum with 4.0 per cent slope. The organic carbon content in the sediment ranged between 1.15 and 2.60 per cent. Clay content sediment was 16.2 to 21.5 percent. Maize (*kharif* 2017-18))grain yield ranged from 17.00 to 24.00 q ha^{-1}, under different treatments. Improved management practice of contour sowing with recommended doses of fertilizers caused increase in grain yield.

Table-5: Impact of erosion on productivity of soils.

Slope (%)	Management practice	OC (%)	Textural analysis			
			Clay (%)	Silt (%)	Sand (%)	Texture
0.50	No fertilizer	1.21	17.65	21.45	60.90	Sandy loam
	Recommended dose	1.15	16.20	21.00	62.80	Sandy loam
1.00	No fertilizer	1.52	18.50	18.15	63.35	Sandy loam
	Recommended dose	1.47	17.00	19.65	63.35	Sandy loam
2.00	No fertilizer	2.20	20.00	21.00	59.00	Sandy clay loam
	Recommended dose	2.32	18.65	19.20	62.15	Sandy loam
4.00	No fertilizer	2.60	21.50	17.15	61.35	Sandy clay loam
	Recommended dose	2.42	20.50	16.00	63.50	Sandy clay loam

Datia (Dev Narayan, SP Tiwari and Monalisha Pramanik)

During the year 2017, rainfall received during crop period was 421 mm, of which 262 mm contributed to five runoff producing storms. The data recorded suggested that erosion losses increased with increasing slope gradient (Table 6 & 8). Plot having 0.50 per cent slope produced minimum runoff (16.9 per cent), soil loss (0.42 t ha^{-1}), loss of organic carbon (1.3 kg ha^{-1}) and clay content (40.3 kg ha^{-1}) under fertilized plots. However, maximum losses in term of runoff, soil loss, organic carbon and clay were of the tune of 27.5 per cent, 1.41 t ha^{-1}, 5.10 kg ha^{-1} and 142 kg ha^{-1}, respectively on the plot having 3.50 per cent slope under without fertilizer. Grain yield of sorghum followed trend contrarily to runoff, soil, and organic carbon and clay content losses. Sorghum grain yield recorded higher (5.80 q ha^{-1}) at lower (0.50 per cent) slope than yield (2.80 q ha^{-1}) from plot having higher (3.50 per cent) slope under fertilized plots. The magnitude of yield under unfertilized plots was lower than that of fertilized plots but recorded the similar trend as that of fertilized plots concerning to slope.

Table 6: Runoff as influenced by different treatments

Slope (%)	Runoff							
	(mm)				(As % of rainfall)			
	2017		Mean		2017		Mean	
	With fertilizer	Without fertilizer	With fertilizer	Without fertilizer	With fertilizer	Without fertilizer	With fertilizer	Without fertilizer
0.50	44.3	72.0	37.0	50.1	16.9	27.5	14.5	19.6
1.50	64.3	83.7	49.1	63.0	24.6	32.0	19.3	25.2
2.50	75.5	98.6	63.1	79.7	28.9	37.7	25.2	32.3
3.50	88.9	107.9	77.8	96.4	34.0	41.3	31.5	39.4

1. with fertiliser; 2. Without fertiliser

Table 7: Soil loss and organic carbon as influenced by different treatments

Slope (%)	Soil loss (t ha^{-1})				O C (kg ha^{-1})			
	2017		Mean		2017		Mean	
	With fertilizer	Without fertilizer	With fertilizer	Without fertilizer	With fertilizer	Without fertilizer	With fertilizer	Without fertilizer
0.50	0.42	0.48	0.38	0.55	1.30	1.40	1.20	1.70
1.50	0.63	0.72	0.60	0.89	2.00	2.20	2.00	2.80
2.50	0.64	0.99	0.80	1.37	2.00	3.30	2.70	4.60
3.50	1.02	1.41	1.31	2.02	3.40	5.10	4.60	7.30

1. with fertiliser; 2. Without fertiliser

Table 8: Clay loss and grain yield of sorghum as influenced by different treatments

Slope (%)	Clay content (kg ha^{-1})				Grain yield (q ha^{-1})			
	2017		Mean		2017		Mean	
	With fertilizer	Without fertilizer	With fertilizer	Without fertilizer	With fertilizer	Without fertilizer	With fertilizer	Without fertilizer
0.50	40.3	44.5	39.7	56.5	5.80	4.40	8.80	6.10
1.50	62.4	68.0	64.8	92.0	4.80	4.30	7.50	4.60
2.50	64.4	99.0	87.1	142.3	4.00	3.50	5.80	3.60
3.50	105	142	142	215	2.80	2.30	4.50	2.70

1. with fertiliser; 2. Without fertiliser

Kota (R. K. Singh, Kuldeep Kumar and B. L. Mina)

For developing erosion-productivity relationships for medium-deep black soils of South-eastern Rajasthan erosion status and crop productivity levels are being monitored on 12 standard size runoff plots having 0.5, 1.0, 2.0, and 4.0% slopes. These plots were cultivated for rainfed soybean with 0, 100% and 150% recommended doses of fertilizers. Data collected on runoff, soil loss and soybean yield in the year 2017 are summarized in Table 9. During monsoon 2017 the Kota region received total 463 mm rainfall which is slightly higher than half of the mean rainfall of this region. The rainfall consisted of 3 intense storms in the month of August.Land slope has near about linear relationship with soil loss during Kharif season of 2017 in Vertisols of Rajasthan. The mean effect of land slope on soil loss varied from 0.69 t/ha in 0.5 % slope to nearly double (1.24 t/ha) on the highest land slope of 4 percent. The fertility effect also had positive influence on reduction of soil erosion parameters like runoff and soil loss. Soybean grain and stover yield also influenced by land slope and fertility level. Maximum yield was obtained at 0.5 per cent land slope when the crop fertilized with 150 percent of recommended dose of fertilizers. Increase in land slope resulted in drastic reduction in soybean yield which may be due to the increased loss of rain water in the form of runoff and deficient rainfall during the Kharif 2017.

Table 9: Runoff, soil loss and yield of soybean as influenced by land slope and fertility level during Kharif season of 2017

Slope (%)	Fertilizer Application*	Runoff (%)	Runoff (mm)	Soil loss (t/ha)	Soybean Grain Yield (kg ha^{-1})	Soybean Straw Yield (kg ha^{-1})
0.50	F_0	6.16	28.5	0.86	896	1304
	F_1	6.09	28.2	0.63	1202	1624
	F_2	5.64	26.1	0.58	1294	1744
	Mean	5.96	27.60	0.69	1130.7	1557.3
1.00	F_0	7.07	32.7	1.25	782	1372
	F_1	6.31	29.2	0.88	984	1424
	F_2	6.00	27.8	0.70	1081	1497.6
	Mean	6.46	29.90	0.94	949.0	1431.2
2.00	F_0	7.06	32.7	0.89	572	1008
	F_1	6.59	30.5	0.62	821	1318.4
	F_2	5.87	27.2	0.83	892	1492.8
	Mean	6.51	30.14	0.78	761.7	1273.1
4.00	F_0	7.45	34.5	1.37	516	980
	F_1	7.17	33.2	1.32	662	1288
	F_2	6.77	31.4	1.03	746	1472
	Mean	7.13	33.01	1.24	641.3	1737.3

Relationship between soil loss and yield versus land slope was developed from the mean data of 2012 to 2017. Land slope had near about linear relationship with soil loss. It was observed that yield enhancement was recorded up to 2 per cent slope and thereafter 4 percent slope resulted in reduction of the mean yield of soybean. In a relationship between fertility level versus runoff and yield it was observed that increase in fertility level from 0 percent RDF to 150 percent RDF enhanced yield and reduced soil loss. This may be due to better growth of the crop in well fertilized treatment better cover of the soil.

Koraput (P.P. Adhikary and M. Madhu)

In this experiment on Erosion productivity relationships in Eastern Ghats High lands(EGHL) region finger millet and upland paddy were cultivated under 4 slopes (2, 4, 8 and 10%) with 2 crop nutrient managements (0 and 100 % NPK). Therefore the treatment combinations were: 4 slopes (2, 4, 8 and 10%) X 2 crop nutrient managements (0 and 100 % NPK) X 2 crops (Finger millet and Upland paddy) = 16.Runoff, soil loss, profile soil moisture and crop yield data were taken from each treatment. The design of the experiment was randomized block design (RBD). With an increase in slope from 2 to 10 %, there was an increase in the runoff for both finger millet and upland paddy (Table 10). The similar trend was observed for soil loss also. Lowest runoff (9.1%) and soil loss (9.3 t ha^{-1}) was observed for finger millet crop grown at 2% slope under recommended dose of fertilizer. Upland paddy crop which was grown in 10% slope without fertilizer treatment showed highest runoff (27.9%) and soil loss (22.2 t ha^{-1}) (Fig. 13 and 14).

Table 10: Runoff and soil loss under finger millet and upland paddy cultivation on different slopes

Slope (%)	Fertilizer management	Runoff (%)		Soil loss (t ha^{-1})	
		Finger millet	Upland paddy	Finger millet	Upland paddy
2	100 NPK	9.1	11.5	9.3	10.8
	0 NPK	11.8	12.1	10.9	11.6
8	100 NPK	19.5	19.8	14.2	16.4
	0 NPK	20.9	21.2	14.9	17.8
10	100 NPK	24.3	25.7	16.2	20.9
	0 NPK	26.1	27.9	17.5	22.2

The runoff and subsequent soil loss were more on upland paddy crop than finger millet crop and the use of fertilizer reduced runoff and subsequent soil loss over unfertilized plots for both the crops and all the slope conditions.

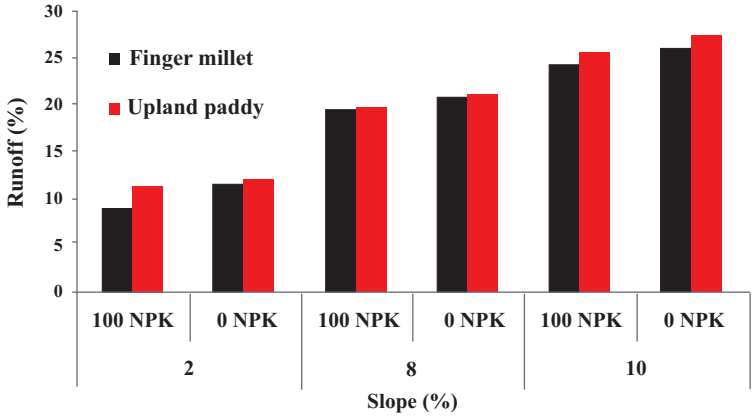


Fig. 13: Runoff under finger millet and upland paddy cultivation on different slopes with and without fertiliser.

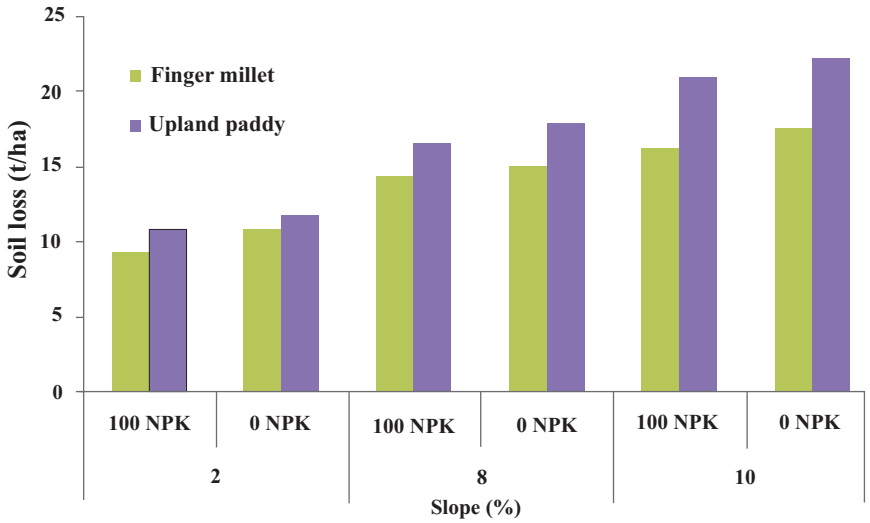


Fig. 14: Soil loss under finger millet and upland paddy cultivation on different slopes under with and without fertiliser.

The distribution of soil moisture in the soil profile of finger millet and paddy field was analyzed. During sowing, the surface (0-20 cm) soil moisture content varied between 17.8 and 19.5 %. During harvest of the crops, the surface soil moisture varied between 15.5 and 15.7 %. With the increase of soil depth the soil moisture content also increases and up to 60 cm depth, there was an accumulation of moisture and below that the moisture content decreases. The shift of profile soil moisture curve to the lower side for the paddy crop during the crop growth period (Fig. 15) indicated that paddy removed more soil moisture for its growth and development. Hence, paddy needs more water than finger millet.

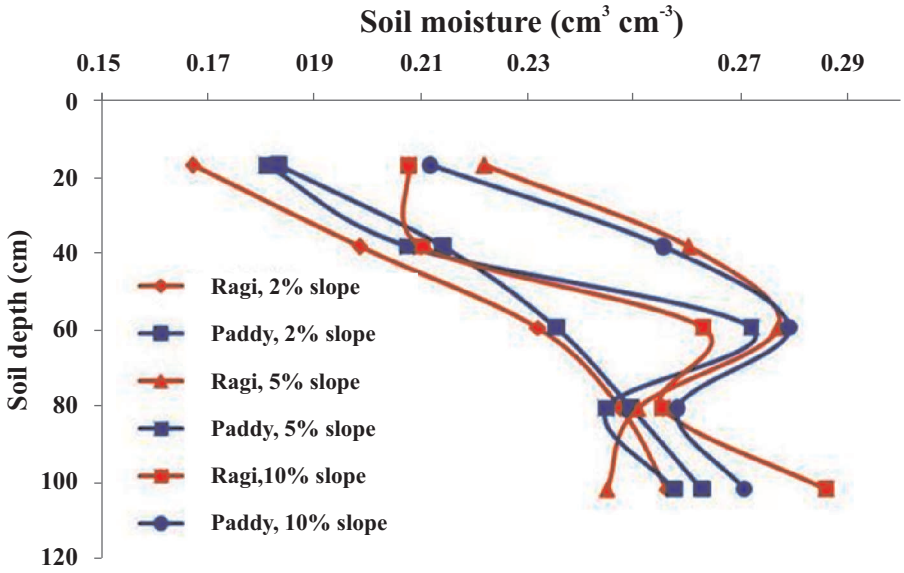


Fig. 15: Profile soil moisture distribution pattern during initial and harvesting stage of ragi and upland paddy crops

Soil moisture content under different slopes of finger millet and upland paddy crops is presented in Fig. 16. Soil moisture content is relatively better at subsoil (15-30 cm) on all the slopes compared to the surface soil (0-15 cm) and this difference is highly prominent at higher slopes. With the increase of field slope from 2 to 10%, surface and sub-surface soil moisture content decreased by 1.8-6.8% and 3.1-4.7%, respectively. Availability of moisture at 20-40 cm soil layer is higher than 0-20 cm soil layer. Finger millet conserves more water than upland paddy within 40 cm soil profile. Surface drying is more pronounced in upland paddy crop.

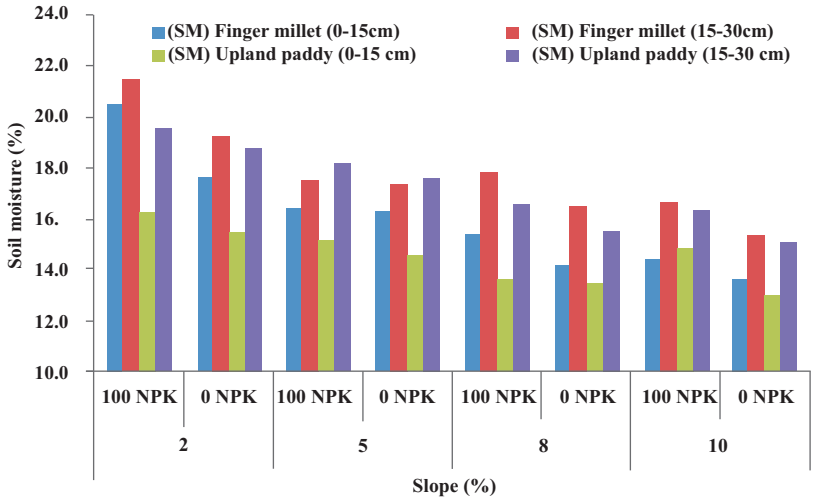


Fig. 16: Soil moisture distribution pattern in the surface (0-15 cm) and sub-surface (15-30 cm) soils of finger millet and upland paddy crops

Highest yield of finger millet (2802 kg ha^{-1}) and upland paddy (1392 kg ha^{-1}) was observed under 2% slope with 100% NPK. Lowest yield of finger millet (1332 kg ha^{-1}) and upland paddy (1011 kg ha^{-1}) was observed under 10 % slope grown without NPK (Fig. 17). With the increase of field slope from 2 to 10%, finger millet and paddy yield was decreased by 40.1-45.9% and 25.0-25.1%, respectively. In finger millet plots, the grain yield decreased by 18.2% in the unfertilized plots in comparison to the fertilized plots. The same for upland paddy crops was only 5.2%. Under both fertilized and unfertilized plots finger millet yield was always more than paddy yield. This was an indicator of high adaptive capacity of finger millet to the degraded condition.

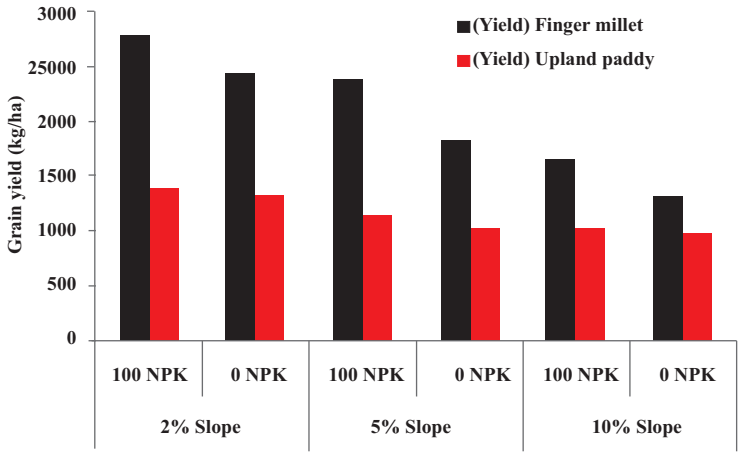


Fig. 17: Grain yield under finger millet and upland paddy crops grown on different slopes under with and without fertiliser.

Rain water use efficiency (RWUE) of finger millet and upland paddy crops grown under four different slopes was calculated and presented in Fig. 18. In fertilized plots, RWUE of finger millet and upland paddy varied between 2.17-2.82 and 0.58-1.15 kg/ha-mm, respectively. In the unfertilized plots, the RWUE of finger millet and upland paddy varied between 1.65-1.87 and 0.42-1.15 kg/ha-mm, respectively. RWUE of both the crops decreases with increase in slope. Fertilizer application has a positive impact on RWUE. In both fertilized and unfertilized plots, finger millet showed higher RWUE than paddy.

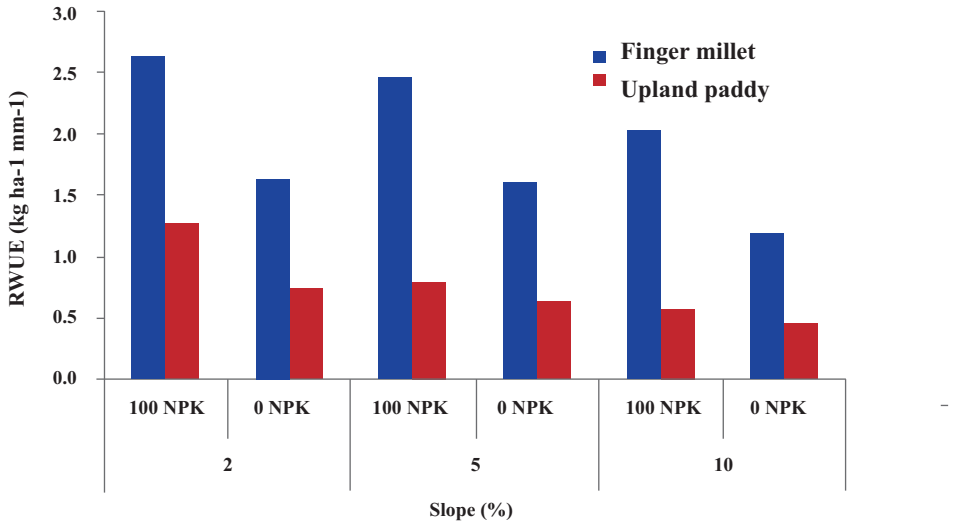


Fig. 18 : Rain water use efficiency of finger millet and paddy grown under different slopes

Udhagamandalam (K. Kannan, P. Raja and V.Selvi-)

A field experiment was conducted under rainfed condition to assess the impact of erosion on crop productivity for principal crops (potato-cabbage) in the Nilgiris. Runoff plots (18 m length and 2.5 m width) have been constructed at the Research Farm with six different slopes (5, 9, 14, 20, 24 and 28%) in order to induce different levels of erosion in the study. Three levels of fertilizer application (No fertilizer, 50 and 100% of the recommended dose of fertilizers) have been followed in each slope category. Recommended dose of nutrients is 120:240:120 kg NPK/ha and 135:135:135 kg NPK ha^{-1} respectively for potato and cabbage crop. Data recorded on runoff and soil loss during 2017-18 is presented in Table 11 which reveals that runoff and soil loss increase with increase in slope. Runoff varied from 51 mm in 5 per cent slope to 92 mm of rainfall) in 28 per cent slope, while soil loss varied from 3.6 tha^{-1} under 5 per cent slope to 22.6 tha^{-1} under 28 per cent slope categories .The highest average soil loss across slope (15.5 tha^{-1}) was observed under no fertilizer treatment. The highest loss of clay (15.4 tha^{-1}) and organic carbon (513 $kgha^{-1}$) was recorded under 28% slope. Among the fertilizer level, the highest loss of clay (9.5tha^{-1}) and organic carbon (337 $kgha^{-1}$) was observed under no fertilizer treatment (Table 12). There was no trend in potato yield in slope group. The highest potato yield (16.4 tha^{-1}) was recorded under 100 % RDF (Table 13).

Table 11: Runoff and soil loss under different slope and fertilizer levels

Attributes	Runoff (mm)				Soil loss (t ha^{-1})			
F rate/ Slope (%)	O%	50%	100%	Mean	O%	50%	100%	Mean
5	51.9	51.2	51.0	51.4	5.1	2.0	3.6	3.6
9	76.0	68.8	76.6	73.8	7.5	8.0	9.5	8.3
14	84.5	76.0	78.2	79.6	13.2	12.2	11.7	12.4
20	86.3	89.5	63.3	79.7	21.7	16.3	14.8	17.6
24	90.7	75.9	78.4	81.7	19.1	14.2	15.1	16.2
28	92.0	78.5	82.5	84.3	26.2	20.7	20.8	22.6
Mean	80.2	73.3	71.7		15.5	12.2	12.6	

Table 12: Clay and organic carbon loss under different slope and fertilizer levels

Attributes	Clay loss (t ha^{-1})				Organic carbon loss (kg ha^{-1})			
F rate/ Slope (%)	O%	50%	100%	Mean	O%	50%	100%	Mean
5	3.5	1.3	2.1	2.3	94	34	69	66
9	4.2	4.2	4.9	4.4	201	168	190	186
14	4.5	5.0	6.6	5.4	210	336	261	269
20	13.2	10.4	6.9	10.2	553	285	348	395
24	12.8	9.4	10.9	11.0	426	316	292	345
28	18.6	15.1	15.4	16.4	537	495	513	515
Mean	9.5	7.6	7.8		337	272	279	

Table 13: Potato yield under different slopes and fertilizer levels

Attributes	Potato yield (t ha^{-1})			
F rate/ Slope (%)	O%	50%	100%	Mean
5	5.5	14.0	18.0	12.5
9	4.0	16.3	15.5	11.9
14	2.4	14.9	18.7	12.0
20	2.0	14.0	18.3	11.4
24	1.8	14.9	17.4	11.3
28	1.2	10.9	10.4	7.5
Mean	2.8	14.2	16.4	

Soil moisture was monitored at three soil depths (0-15 cms, 15-30 cms and 30-45 cms) on fortnightly basis in eighteen experimental plots. Soil moisture was found to be highest in the plots pertaining to 20% in all three soil depths closely followed by the moisture in the plots of 24% and 14% slopes. It was found to be lowest in the plots with 5% slope in all three soil depths.

Vasad (D. Dinesh and V. Kakade-)

During 2017-18 total annual rainfall received around 654 mm. Runoff and soil loss of Kharif season average data summarized in Table 14-16. The Experimental data recorded as runoff and soil loss under different slope and slope length were in the range of 18.6 to 76.4 mm and 1.82 to 7.67 t ha^{-1} respectively. Highest soil loss was recorded at the slope of 9%. At higher slope and slope length, runoff and soil loss were higher but with increase in slope, soil loss increased at higher rate as compared to runoff. Pearl millet grain yield was observed between 7.94 and 15.5 q ha^{-1} Highest grain yield was recorded at slopes 6%; 2% with 22m length, however no clear trend could be established as crop yield at 9% was higher than 3% and 6%. In other set of experiment (Fig.19-20)pearl millet was grown with: T1: no application of manure or fertilizer, T2: FYM@5 t/ha/year, T3: FYM@5 t/ha/year and N:P:K@100:60:40, T4: FYM@10 t/ha/year and N:P:K@100:60:40. Runoff during Kharif 2017 was in the range of 18.8 to 35.3 mm and soil loss in the range of 0.35 to 2.05 t/ha, highest under T1 and lowest under T2. With respect to pearl millet grain yield resulted range from 8.02 to 25.9 q ha^{-1}. Among treatments T4 registered highest grain yield (25.9 q ha^{-1}) followed by T3 (21.7 q ha^{-1}) and T2 (8.61q ha^{-1}). The lowest grain yield recorded in T1 treatments. Similarly biomass yield also followed same trend as like of grain yield. The poor performance of T1 treatments might be due to this plot not received any manures and fertilizers; Organic carbon Enrichment Ratio (ER) of sediment was in the range of 1.60 to 1.97. ER ratio lower for higher FYM applied treatments.

Table 14: Runoff and soil loss on different slope and slope length during 2017

Plot details		Runoff (mm)			Soil loss (t ha^{-1})			Pearl millet yield (q ha^{-1})	
L (m)	Slope (%)	Min	Max	Total	Min	Max	Total	Grain	Stover
11	2	2.23	10.20	47.5	0.11	0.47	1.95	13.4	10.9
22	2	6.39	13.87	61.5	0.25	3.86	6.43	9.62	23.1
44	2	4.44	5.39	30.0	0.17	1.03	3.05	8.83	42.8
66	2	2.06	4.21	18.6	0.11	0.57	1.82	7.94	32.2
22	3	5.35	11.50	55.3	0.27	2.04	5.63	11.4	15.5
22	6	9.44	14.56	66.8	0.22	1.83	5.91	15.5	18.7
22	9	11.12	13.81	76.4	0.33	1.69	7.67	11.9	29.5
SD ±		3.43	4.19	20.5	0.08	1.15	2.33	2.66	11.0

Table 15: Silt, clay and organic carbon in sediment and surface soils (15 cm) on different slope and slope length.

Plot Length (m)	Slope (%)	Silt (%)		Clay (%)		OC (%)	
		Soil	Sed	Soil	Sed	Soil	Sed
11m	2	14.72	36.11	22.66	27.26	0.45	1.08
22m	2	16.10	40.37	23.35	28.52	0.51	1.20
44m	2	16.91	38.18	23.00	31.17	0.45	1.13
66m	2	16.91	35.19	23.46	30.82	0.45	1.16
22m	3	15.76	34.96	22.77	27.95	0.51	1.34
22m	6	14.95	25.99	23.12	29.56	0.53	1.03
22m	9	16.45	25.88	23.46	27.14	0.47	1.07
SD ±		0.88	5.70	0.33	1.64	0.03	0.11

Table 16 : Runoff, soil loss and pearl millet yield under different dose of farm yard manure and fertilizer along with organic carbon in soil and sediment

Treatment	Runoff (mm)			Soil loss (t ha^{-1})			Grain yield (qt ha^{-1})				
	Min	Max	Total	Min	Max	Total	Min	Max	Total	Soil	Sed
T1	3.27	12.0	35.3	0.16	0.65	2.05	7.51	8.55	8.03	0.49	0.97
T2	2.22	7.17	26.3	0.09	0.27	0.85	7.46	9.76	8.61	0.56	1.01
T3	3.48	7.29	23.7	0.07	0.26	0.66	21.1	22.2	21.72	0.67	1.21
T4	1.64	5.91	18.8	0.02	0.12	0.35	24.6	27.1	25.87	0.74	1.19

Fig 19: Pearl millet experiment on different slope length and degree of slope

Fig. 20: Pearl millet experiment with Different dose of FYM and fertilizer

Assessment of soil organic carbon in transit under erosion processes: A source or sink for atmospheric CO_2 (M.Sankar, Lekh Chand and D.R.Sena-D. Dun)

All the treatments implemented in our field and collected runoff sample during kharif and Rabi season. Collected sediment processed and measured sediment loss, and net soil loss estimation from each treatment under process. Soil CO2 release measurement conducted from different slope position and tillage practice and this initiated before sowing of maize crop and continued measurement upto now during different crop growth period and management practice adoption (Fig. 21). The measurement of soil CO_2 release conducted before tillage and after tillage in all slope position continuously for a week. Similarly this measurement also conducted before and after sowing and fertilizer application in wheat crop. Collected soil

samples from few treatments analysed for Soil texture, potassium, aggregate and Soil PH. Remaining analysis of Soil carbon, Nitrogen and P, under process. We have measured Maize yield parameters in all the treatments. When compare to all field, no till observed higher yield than others and particularly this year maize yield shows higher than previous year. Conventional and Minimum tilled fields almost similar yield level obtained. After Maize harvest to end of Wheat crop, we have collected Soil samples for measuring moisture from the entire field and the dry biomass weight of Maize and Wheat, and root mass recorded.

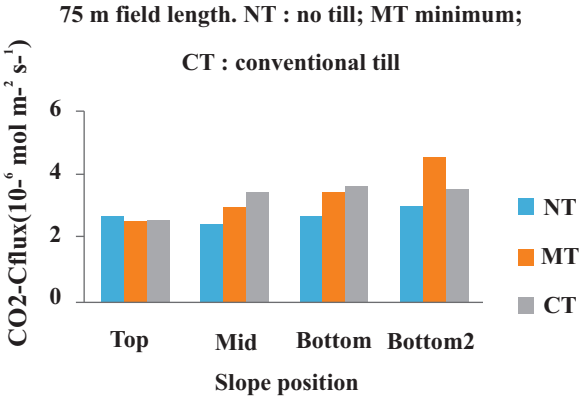


Fig. 21. Soil CO_2 release from different tillage practices and slope positions

Development and validation of a spatially explicit simulation framework to quantify runoff-erosion-carbon flux at watershed scale (Deepak Singh, A.C. Rathore, C. Jana, Trisha Roy and N. M. Alam- D. Dun)

To study the interaction between runoff, soil erosion and carbon dynamics on watershed scale in different land-uses viz., S1 (Agricultural land), S2 (Pine tree), S3 (Citrus plant), S4 (Grass land), S5 (Agro-Forest terraced land), S6 (Araucaria tree), S7 (Watershed outlet).In 2017-18, the average yield of maize crop in agricultural field was observed 12.62 Q/ha, while 4.5 Q/ha was observed in terraced field (Fig.22). Organic carbon was monitored from different land use systems in the micro-watershed before Kharif crop (Fig.23). The highest organic carbon was observed in pine forest (0.9 %) and lowest organic carbon was observed in grass land (0.39 %).

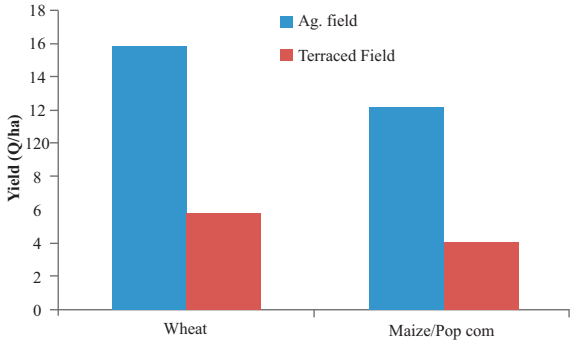


Fig. 22 Yield of Wheat and Maize Crops

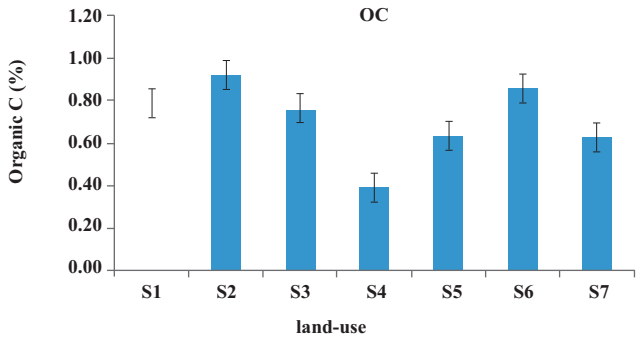


Fig. 23 Organic Carbon in different land use system

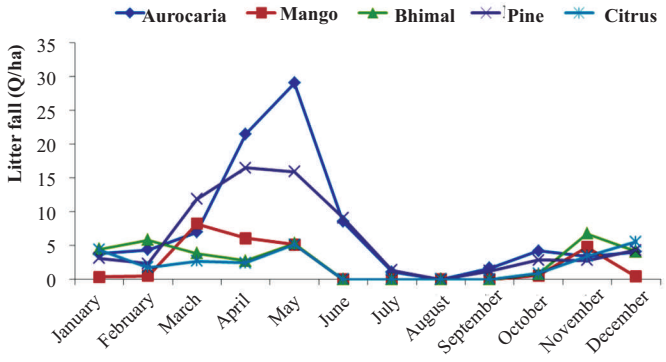


Fig. 24 Litter-fall of different tree species in watershed

Litterfall was monitored from five different tree species in the micro-watershed during 2017-18 (Fig. 24). In *Aurocaria*, litterfall was highest (28.095 q ha^{-1}) in May. In case of *Pinusroxburghii*, maximum litterfall of 16.63 q ha^{-1} was observed in April.In *Grewiaoptiva*litterfall showed maximum litter fall in November (6.57 q ha^{-1}). In Mango maximum litterfall was observed in March (8.34 q ha^{-1}). In citrus, maximum litterfall (5.63 q ha^{-1}) was recorded in January.The Water Erosion Prediction Project (WEPP) model was tested using data on runoff, soil water and sediment together with weather information collected from experimental plots. WEPP was first applied to simulate the surface runoff, soil water and erosion. Results indicated (Table 17) that WEPP could adequately simulate the relationship between runoff and soil loss for the model plot. Comparison between model predicted data and observed data indicates that WEPP tends to predict runoff as well as soil erosion with absolute error-7.2% and -16.6%, respectively. The Average simulated runoff and soil erosion in micro-watershed was about 254.1 and 5.04 t/ha, respectively.

Table 17: Output of WEPP Model

Parameters	Observed Data	Simulated Data	Abs error (%)
Rainfall	1132	1132	
Runoff	272.5	254.1	**-7.2**
Soil erosion (t/ha)	5.88	5.04	-16.6

Assessing the vegetation and SOC recovery potentials of abandoned / fallowed Shifting cultivated sites in Central Eastern Ghats (H.Gowda, P.Jakhar and Karma Beer-Koraput)

To develop relationships between fallow duration and recovery / build up rate of vegetation and soil organic carbon (SOC) in shifting cultivated areas in India, the study has been initiated in the Eastern Ghats region of Odisha. The present study is proposed at 5 locations in Eastern Ghats and two locations in North Eastern States. Each location/ cluster consists of 11 treatments *viz.* Current shifting cultivated site, 5 year, 10 year , 20 year, 30 year, 40 year, 50 year, above 50 year fallow period sites. These sites are compared with three reference land use such as settled agriculture, natural forest and the existing plantations in each cluster. Deforestation for shifting cultivation resulted in sharp decline in the SOC stocks across the three locations, creating a loss of 57 to 70 % of the original SOC stock. After slash and burning, cultivation for a period of 3-6 years caused a strong decrease in the original SOC stocks. In Lilliguma cluster 22.1 t/ha carbon stock was lost during the first year cultivation (Fig. 25). Among the different land-uses, SOC stocks were highest in natural forest, lowest in agriculture and intermediate for different fallow periods of shifting cultivated lands (Fig. 26). Among the SOC stock of current shifting cultivated sites, the lowest level of SOC stock is reached at Jeypore Ghats area in reference to forest. Whereas, the current shifting cultivated sites in Lilliguma and Sunki Ghats cluster, SOC stocks are at nearly half of the forest reference .

The build-up of SOC stocks during fallow period however dependent on the duration of fallow. In all the clusters, soil organic carbon (SOC) showed a positive relationship with the fallow duration but the rate of recovery is varied. After the fallow period, the gains in SOC stocks are slow in the initial years. The vegetation establishment on shifting cultivated lands in all three locations caused SOC stock build-up significantly in all three locations (Fig. 27). In the beginning years (up to 40 years) the build-up rate of SOC stock is at marginal level. In all three clusters, the highest SOC stock gain was recorded between 40 to 50 years of fallow duration. Hence SOC stock in 50 year fallow period reached nearly 79% of the forest values, but the stocks in less fallow duration increases just over the current shifting stocks. Among the three locations, the highest gain of 26 t/ha carbon ^{was} achieved in Jeypore Ghats during the 40-50 year duration.

Of the different years fallow period, SOC stocks in the top half meter of soil were highest in over 50 years in Jeypore Ghats (102 t/ha of carbon) fallowed by 50 years plot (92.6 t/ha). The total SOC stock gains over current shifting cultivation sites were different. The total stock gain was highest in Jeypore (63 t/ha), lowest in Lilliguma (26 t/ha) and intermediate in Sunki Ghats (49 t/ha).

Semi-arid ravine ecosystems, as in Mahi, are fragile due to physiography and erratic rainfall pattern. Total river bed area of Mahi River within Gujarat is about 20,000 ha. Where in average elevation difference between bed and hump of ravine were found less than 1 to 4 m. Slope (angle) at active head cuts were found between 78° to greater than 90°. River bank on north side have higher elevation and sharper slope thus less stable. Two categories of ravine according to hump area are identified, i.e. ravine with well-defined hump and ravine with poorly defined hump. Total hump area is about 6,000 ha. Soils of active ravine area were poorly consolidated with sandy/loamy sand texture in nature. Keeping in the above information, present soil condition is being studied quantitatively through soil quality index. Current year 2017-18,we finalised the activities Chart with NBSSLUP Regional centre Udaipur, MOU signed between IISWC and NBSSLUP, Regarding secondary data collection ten

year Cropping area data of Anand district was collected from District Agricultural Office, While Vadodara district data collection and analysis is under progress, we purchased the Soil Resource Map (SRM) of Anand and Vadodara District purchased from Soil and Land Use Survey of India, New Delhi by, Land use and land cover spatial data set purchased from BISAG - Bhaskaracharya Institute for Space Applications and Geo-informatics, Gandhinagar by Udaipur Centre, LULC Spatial Data set analysis is under progress by NBSSLUP Udaipur Centre.

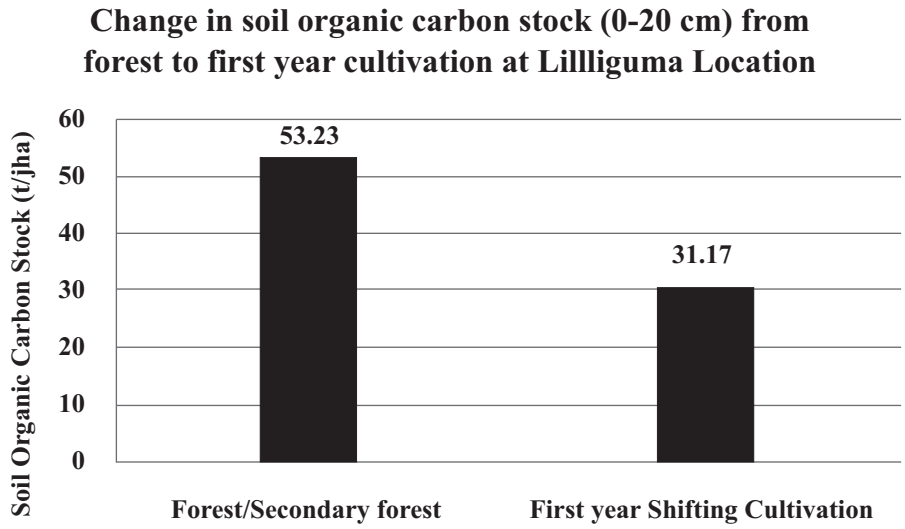


Fig. 25: Trend of SOC stock change from forest to first year of cultivation in

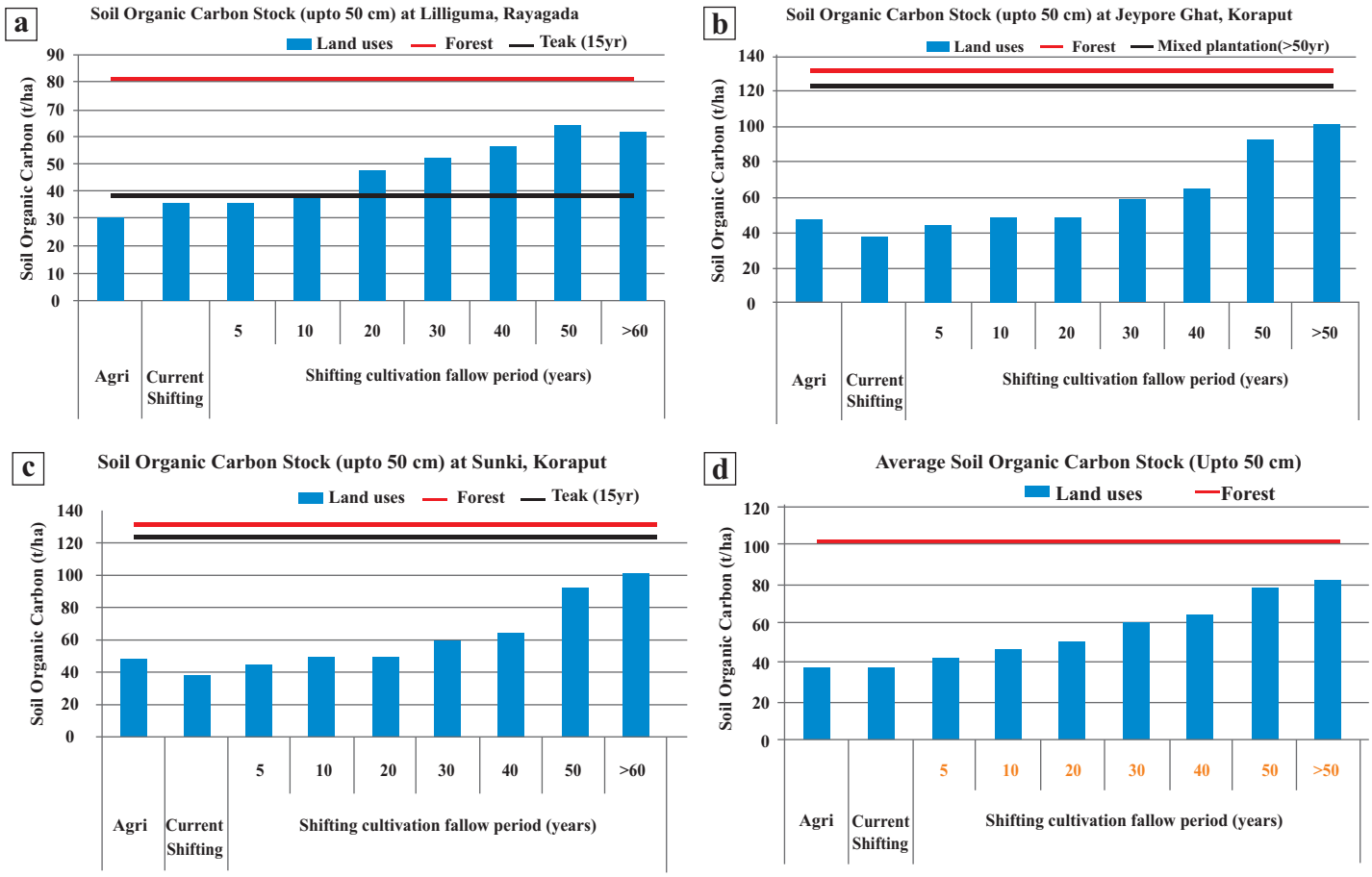
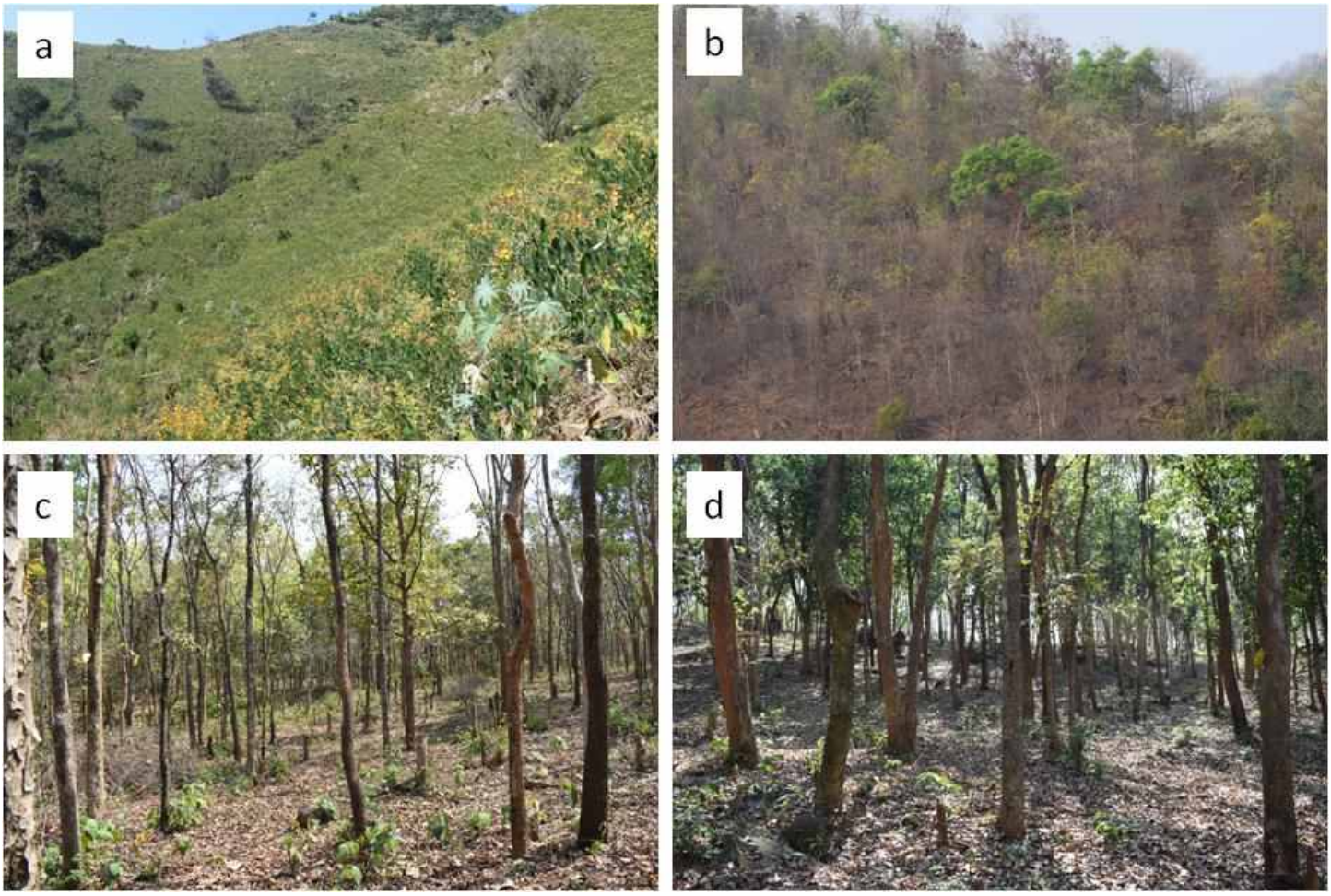


Fig. 26. Soil organic carbon stock (SOC) recovery trend during different fallow period and other land-use systems at a) Lilliguma cluster and b) Jeypore Ghat, c) Sunki Ghat and d) average of three clusters.



Land use effect on soil carbon stock and soil quality in Mahi ravine ecosystem of semi-arid tropics (D. Dinesh, Gaurav Singh and V. Kakade-Vasad)

Semi-arid ravine ecosystems, as in Mahi, are fragile due to physiography and erratic rainfall pattern. Total river bed area of Mahi River within Gujarat is about 20,000 ha. Where in average elevation difference between bed and hump of ravine were found less than 1 to 4 m. Slope (angle) at active head cuts were found between 78° to greater than 90°. River bank on north side have higher elevation and sharper slope thus less stable. Two categories of ravine according to hump area are identified, i.e. ravine with well-defined hump and ravine with poorly defined hump. Total hump area is about 6,000 ha. Soils of active ravine area were poorly consolidated with sandy/loamy sand texture in nature. Keeping in the above information, present soil condition is being studied quantitatively through soil quality index. Current year 2017-18,we finalised the activities Chart with NBSSLUP Regional centre Udaipur, MOU signed between IISWC and NBSSLUP, Regarding secondary data collection ten year Cropping area data of Anand district was collected from District Agricultural Office, While Vadodara district data collection and analysis is under progress, we purchased the Soil Resource Map (SRM) of Anand and Vadodara District purchased from Soil and Land Use Survey of India, New Delhi by, Land use and land cover spatial data set purchased from BISAG - Bhaskaracharya Institute for Space Applications and Geo-informatics, Gandhinagar by Udaipur Centre, LULC Spatial Data set analysis is under progress by NBSSLUP Udaipur Centre.

02 RESEARCH ACHIEVEMENTS

P-2 : CONSERVATION MEASURES FOR SUSTAINABLE PRODUCTION SYSTEM

P-2.1: RESOURCE CONSERVATION MEASURES FOR ARABLE LANDS

Evaluating the effect of organic amendments on resource conservation and productivity of rainfed semi-arid vertisols (M. Prabhavathi and S.L. Patil-Ballay)

The field experiment was laid out during 2017-18 to know the effect of organic amendments on resource conservation and productivity of winter sorghum under rainfed semi-arid Vertisols. The experiment consists of five treatments, viz. T_1: Recommended rate of fertilizers (RRF) + FYM @ 5 t ha^{-1} (control/farmer's practice), T_2: T_1 + Biochar at 2.5 t ha^{-1}, T_3: T_1 + Biochar at 5.0 t ha^{-1}, T_4: T_1 + Biochar at 10 t ha^{-1} and T_5: T_1 + Biochar at 20.0 t ha^{-1}, was laid out in an RBD (plot size: 8 m × 5.4 m) with four replications. The soil is clayey, with pH 8.52, EC 0.25 dS m^{-1}, and available N, P and K contents being medium, medium and high, respectively. During 2017, a total of 709.5 mm runoff producing rainfall was received in 14 storms. Runoff varied from 151 to 319.8 mm across all the treatments, while soil loss ranged from 4.07 to 7.19 t ha^{-1} (Table 1). Both runoff and soil loss were lower under the treatment with biochar applied at 20 t ha^{-1}. Higher amount of potassium was lost through runoff as compared to nitrogen and phosphorus. Sorghum was sown on 19.9.2017 and harvested on 22.1.2018. Higher grain yield was recorded under the treatment T_4 (1.29 t ha^{-1}), wherein biochar was applied at 10 t ha^{-1} along with RRF, which was about 75% higher than T_1 (control, RRF). Similar was the trend observed in straw yield with 25.0 t ha^{-1} straw yield recorded under T_4. The organic carbon content in the sediments varied from 14.2 to 34.5 kg ha^{-1}, and the clay content also varied from 24.6 to 32.4% under different treatments.

Table 1: Effect of different rates of biochar application on runoff, soil and nutrient losses and sorghum yield

Treatment	Runoff (mm)	Soil loss (t ha^{-1})	Nutrient loss (kg ha^{-1})			Sedimentcontains		Sorghum yield	
			N	P	K	clay (%)	OC (kg ha^{-1})	Grain	Straw
								(kg ha^{-1})	
T_1	319.8	7.19	3.2	1.05	26.4	32.4	34.5	728	1688
T_2	265.0	6.84	2.9	0.96	23.2	30.5	29.4	982	2063
T_3	217.7	6.15	2.4	0.72	19.1	28.1	25.2	1141	2313
T_4	192.4	5.23	2.3	0.60	15.5	26.3	20.4	1287	2500
T_5	151.0	4.07	1.8	0.47	11.7	24.6	14.2	1175	2375
							CD (*P = 0.05*)	360	384

Effect of varying water regimes on Zn and N dynamics and rice productivity in saline vertisols (M. Prabhavathi and H. Biswas-Ballary)

A field experiment was conducted to study the effect of water regimes and nutrient combinations (Zn & N) on rice (cultivar - TRY 3 with high Zinc use efficient index) productivity and quality in saline Vertisols during 2017-18. The soil was clayey with pH 8.3, electrical conductivity (EC) 5.3 dS m^{-1}, organic carbon 0.24%, available N 194 kg ha^{-1}, available P 20.2 kg ha^{-1}, available K 414 kg ha^{-1} and available Zn 0.58 mg kg^{-1}. Fertilizer treatments consisted of Zn and N each at 3 levels which were applied in the form of $ZnSO_4$ and Urea. Three irrigation regimes *viz.,* continuous flooding (CF), Alternate wetting and drying (AWD) and saturated soil culture (SSC) were treatments that were imposed from 10 days after transplanting to maturity. The AWD regime plots were irrigated when water levels in field water tube (perforated PVC tube) drops below 15 cm from the surface whereas in SSC regime, plots were maintained at 1 cm of ponded water depth a day after the disappearance of water. The experimental design was a split plot with three replications. Results show that Greater plant height of 57.4 cm was recorded in continuous flooding (M_1) and lower plant height of 52.2 cm was observed in saturated soil culture (M_3) (Table 2). Among different combinations of zinc and nitrogen application $Zn_{37.5}$ N_{150} (S_6) recorded greater plant height of 63.3 cm.

Among the different treatment combinations, AWD moisture regime with Zn $_{37.5}$ N_{150} (S_6) produced taller plants at tillering stage (72.9 cm). Higher leaf area index (LAI) of 2.47 and 3.72 was recorded in M_1 and S_6, respectively (Table 1). Among different treatment combinations, M_1S_6 recorded higher LAI of 4.73 and more number of tillers hill^{-1} (11.7). Water management practices had not showed any significant influence on chlorophyll index at panicle initiation stage. Among nutrient applications, S_6 treatment recorded significantly higher chlorophyll index (11.51) and lower chlorophyll index was observed in S_4 (3.68) treatment. Paddy yield was not significantly influenced by water management practices (Table 2). Greater yield was noticed with M_3 and was at par with M_1 and M_2. Among nutrient applications, S_6 treatment recorded significantly higher yield (6111 kg ha^{-1}) and lower yield was observed in S_4 (1667 kg ha^{-1}) treatment. Application of zinc and N and adoption of water saving irrigation techniques in place of continuous flooding in paddy cultivation improved plant growth and chlorophyll content index apart from saving water under water scarce situations in Tungabhadra canal area.

Table 2: Effect of moisture regime and nutrient application on Paddy yield and plant height and leaf area index at tillering stage

Treatments	Plant height (cm)				Leaf area index				Paddy yield (kg ha^{-1})			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	43.4	41.3	46.2	43.6	1.82	2.56	2.14	2.17	1800	2133	2467	2133
S_2	59.5	59.0	54.3	57.6	2.71	2.25	2.47	2.47	3733	4400	4867	4333
S_3	69.5	59.5	60.6	63.2	1.94	3.30	3.20	2.81	6467	4533	6733	5911
S_4	42.7	49.7	43.0	45.1	1.74	2.25	1.08	1.69	2000	1467	1533	1667
S_5	61.6	53.9	53.0	56.8	0.70	1.05	2.77	1.51	6467	5267	5733	5822
S_6	65.3	72.9	51.7	63.3	4.73	3.06	3.36	3.72	5867	6067	6400	6111
S_7	44.6	48.0	46.2	46.3	2.59	1.59	2.38	2.18	1533	2367	2333	2078
S_8	68.7	51.5	55.9	58.7	2.45	3.55	1.76	2.59	5200	6067	6267	5844
S_9	61.3	66.6	58.7	62.2	3.56	2.29	2.25	2.69	6467	5933	5267	5889
Mean	57.4	56.1	52.2		2.47	2.43	2.38		4393	4248	4622	
CD (*P=0.05*)	M=5.7 ; S=6.18; M×S=S				M= 1.51 ; S= 1.46; M×S= NS				M= 834 ; S= 1343; M×S= NS M at S= 2336; S at M= 2327			

M_1: Continuous flooding, M_2: Safe AWD, M_3: Saturated soil culture, S_1: Zn_0N_0; S_2: Zn_0N_{125}; S_3: Zn_0N_{150}; S_4: Zn $_{37.5}$ N_0; S_5: Zn $_{37.5}$ N_{125}; S_6: Zn $_{37.5}$ N_{150}; S_7: Zn $_{50}$ N_0; S_8: Zn $_{50}$ N_{125}; S_9: Zn $_{50}$ N_{150}

***In-situ* moisture conservation practices under aonla based agro-forestry system for sustainable production in red soils of Bundelkhand (**Dev Narayan, RS Yadav**-**Datia)

The study was initiated in 2010 to evolve a suitable for *in-situ* rain water harvesting practice for higher growth and yield of Aonla in agri-horti system in red soils of Bundelkhand. Four treatments viz. i) farmer's practice of aonla planting with 0.027 m^3 pit, ii) Pit filled up to 0.75 m with 1 m^3 pit, iii) crescent shape micro-catchment with 1 m^3 pit and iv) V- Shape micro-catchment with 1 m^3 pit at 2.00 per cent slope plots (14 m x 21 m) were laid in RBD with four replications. Six aonla plants (7m x 7m) in each plot were accommodated and black gram- Indian mustard cropping system was followed.During the year 2017, black gram was sown July 1 and harvested on September 26, 2017. The rainfall received during crop period was 421 mm, of which 308 mm with seven runoff producing storms occurred. The results of seven years indicated that the runoff, soil and nutrient losses (N, P and K) reduced significantly under different treatments over farmer's practice of aonla planting (Table 3). Runoff in terms of per cent of rainfall reduced by 2.00, 5.00 and 16.0 per cent under pit filled up to 0.75 m, crescent shaped and V-shaped micro-catchment respectively, over farmer's practice of aonla planting. Similarly, the soil loss reduced by 17.0, 28.0 and 55.0 per cent under pit filled up to 0.75 m, crescent shaped and V-shaped micro-catchment, respectively, over farmer's practice of aonla planting. While, Organic Carbon reduced by 32.0, 50.0 and 64.0 per cent, N reduced by 22.0, 39.0 and 39.0 per cent, P reduced by 11.0, 33.0 and 33.0 per cent and K reduced by 11.0, 22.0 and 33.0 per cent under pit filled up to 0.75 m, crescent shaped and V-shaped micro-catchment, respectively, over farmer's practice of aonla planting. The fruit yield of aonla and seed yield of inter crops increased under *in-situ* rain water harvesting practice (Table 4). The grain yield of black gram increased by 25.0, 54.0 and 73.0 per cent under pit filled up to 0.75 m, crescent shaped and V-shaped micro-catchment, respectively, over farmer's practice of aonla planting. The seed yield of Indian mustard increased by 38.0, 15.0 and 64.0 per cent under pit filled up to 0.75 m, crescent shaped and V-shaped micro-catchment, respectively, over farmer's practice of aonla

planting. The fruit yield of aonla also increased by 9, 4 and 36% under pit filled up to 0.75 m, crescent shaped and V-shaped micro-catchment, respectively, over farmer's practice of aonla planting. Irrespective of water conservation measures, soil analysis revealed that mean soil organic carbon (5.22 g kg^{-1} soil) at 0-15 cm soil depth under canopy of aonla found higher as compared to open canopy (4.62 g kg^{-1} soil). There was no perceptible impact of canopy cover of the tree on availability of P and K. Soil pH under canopy was found slightly lower by 0.07 units compared to open canopy.

Table 3: Runoff soil loss and Nutrient loss as influenced by different treatments during 2017 and mean of 7 years

Treatment	Runoff				Soil loss (t ha^{-1})		Nutrient loss (kg ha^{-1})							
	(mm)		(%)				OC		N		P		K	
	2017	Mean (7 yr)	2017	Mean (7 yr)	2017	Mean (7 yr)	2017	Mean (7 yr)	2017	Mean (7 yr)	2017	Mean (7 yr)	2017	Mean (7 yr)
Farmer's practice	61.2	122	19.9	26.7	1.21	2.66	4.40	11.5	1.80	4.10	0.90	1.90	2.70	5.70
Pit filled up to 0.75 m	60.3	106	19.6	22.6	1.03	1.99	3.00	8.60	1.40	3.40	0.80	1.60	2.40	5.00
Crescent shape	58.3	96.1	18.9	20.8	0.89	1.73	2.20	7.50	1.10	3.00	0.60	1.50	2.10	4.30
V shape	51.3	83.4	16.7	17.7	0.56	1.26	1.60	5.50	1.10	2.80	0.60	1.30	1.80	3.70
C.D. (P=0.05)	6.00	-	2.00	-	0.14	-	0.50	-	0.20	-	0.10	-	0.40	-

Table 4: Seed yield of inter crops (black gram and Indian mustard) and fruit yield of aonla as influenced by different treatments

Treatment	Yield of inter crops (kg ha^{-1})				Fruit yield of aonla (q ha^{-1})
	Black gram		Indian mustard		
	2017	Mean (7 yr)	2017	Mean (7 yr)	2017
Farmer's practice	109	265	523	985	70.0
Pit filled up to 0.75 m	136	316	719	1194	76.1
Crescent shape	168	347	599	1156	73.0
V shape	190	392	859	1412	95.3
C.D. (P=0.05)	NS	-	NS	-	NS




Restoration of shifting cultivated lands for resource conservation and sustainable production in Eastern Ghats.(D.C.Sahoo, P.P. Adhikary, Praveen and Karma Beer –Koraput**)**

The study conducted on restoration of shifting cultivated land to develop management/restoration strategy for resource conservation and sustainable production in Eastern *Ghats*. The experiment carried out with different treatment measures along with control (farmers practice) for two scenarios *viz*., currently under shifting cultivation and shifting cultivated area currently under fallow for restoration. Predominant crop of the region "*Ragi*" was transplanted as the test crop in the shifting cultivated area currently under cultivation. The results indicated that Better grain yield found among the treatments (11.1-13.5 q/ha) and significantly (CD (0.05) = 2.53) higher than control (7.1 q/ha). However, maximum grain yield is found in Earthen bunding + BP of *Gliricidia sepium* (13.5 q/ha) *followed by* Earthen bunding with vegetative barrier of sambuta + BP of *Gliricidia sepium* (12.3 q/ha) and Earthen bunding + Pigeon pea + BP of *Gliricidia sepium)* (11.9 q/ha) and found statistically non-significant among the treatments *may be due to the establishing phase of the conservation measures.* Similar result also found in biomass yield. Statistically non-significant with maximum biomass yield is found in Earthen bunding + BP of *Gliricidia sepium* (25.0 q/ha) *followed by* Earthen bunding + Sambuta + BP of *Gliricidia sepium* (23.3 q/ha) and Earthen bunding + Pigeon pea + BP of *Gliricidia sepium* (22.0 q/ha). Minimum runoff of 8.2% was observed in Earthen bunding with vegetative barrier of sambuta + BP of *Gliricidia sepium* followed by Earthen bunding with BP of *Gliricidia sepium* (10.4 %) and highest runoff of 18.8 % in control plot (Fig.1a) under the shifting cultivated plots. The wider difference between control and treated plots shows the positive impact of conservation measures in reducing runoff. Soil loss follows similar trend to runoff with minimum (6.4 t/ha) from the plot under *ragi* with vegetative barrier of sambuta and *Gliricidia sepium* on earthen bund. The soil loss (6.4-9.3 t/ha) from all the treated plots is in the decreasing trend over years and maximum (14.5 t/ha) in control (Fig.1b).

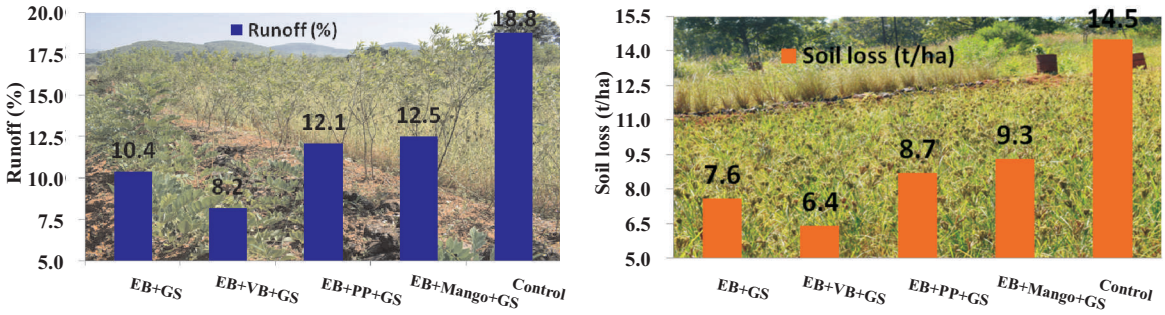


Fig.1a&b: Runoff and soil loss from cultivated plots

In the shifting cultivated fallow plots, runoff varies from minimum of 11.3% (Earthen bunding with vegetative barrier of sambuta + BP of *Gliricidia sepium)* to maximum of 19.3 % in control. The plots treated in combination of earthen bunding with *Gliricidia sepium and Gliricidia sepium* + mango also produced runoff close to minimum with 14.3 and 15.7 % respectively. The variation in soil loss among treatments (5.3-7.1 t/ha) is considerable less in comparison to the cultivated plots may due to undisturbed surface. The soil loss followed a similar trend to runoff with minimum (5.3 t/ha) in vegetative barrier of sambuta and *Gliricidia sepium* on earthen bund and maximum from control (11.5 t/ha) (Fig 2a&b).

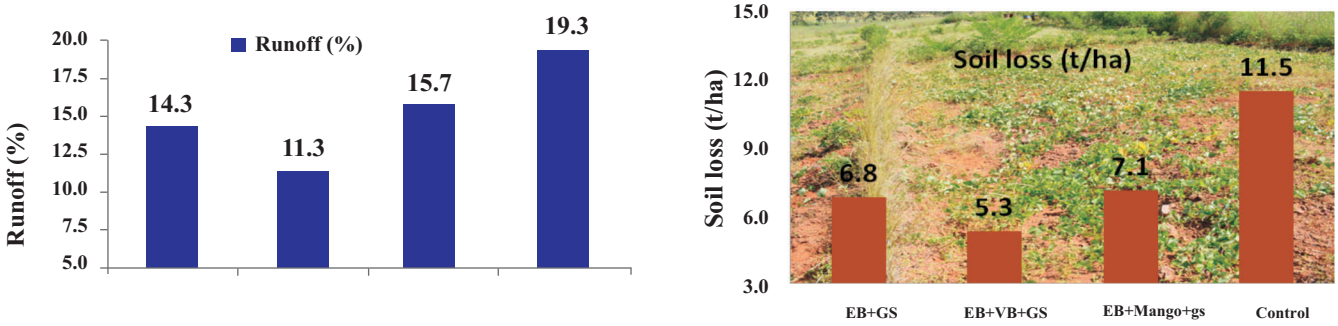


Fig.2a&b: Runoff and soil loss under fallow plots

***Jhola kundi* based vegetable farming with soil moisture conservation practices for increasing profitability of tribal farmers in Eastern Ghats High Land Region** (Karma Beer, Ch. J.P. Dash and P. Jakhar- Koraput)

Study was initiated during 2017 with the objective of assessing the water availability in Jhola kundi during the post monsoon seasons for cultivation of vegetables with soil moisture conservation practices in tribal belt of Odisha. *Jhola* kundis at different

location along the *Jhola* systems were selected and recuperation test of *Jhola* kundis have been conducted on monthly basis. From the recuperation study carried out during the month of December 2017 in jhola khundi with diameter of 4.5 m located at the research farm, it was observed that the total recovery period (up to depth of 2.68 m) was 18185 minutes (or 12.6 days). The initial water level depth was not obtained because of rainwater. The recuperation rate of *Jhola* kundi is 6.02 m^3/day, which is only 10 m away from *Jhola* (Fig. 3). In another recuperation test conducted at Rajbidai village having *Jhola* kundi of 2.1 diameters during December 2017, it was observed that the total recovery period (depth of 1.77 m) was 5772 minutes (or 4 days). The recuperation rate of *Jhola kundi* is 2.00 m^3/day (Fig. 4), which is about 75 m away from *Jhola* system.

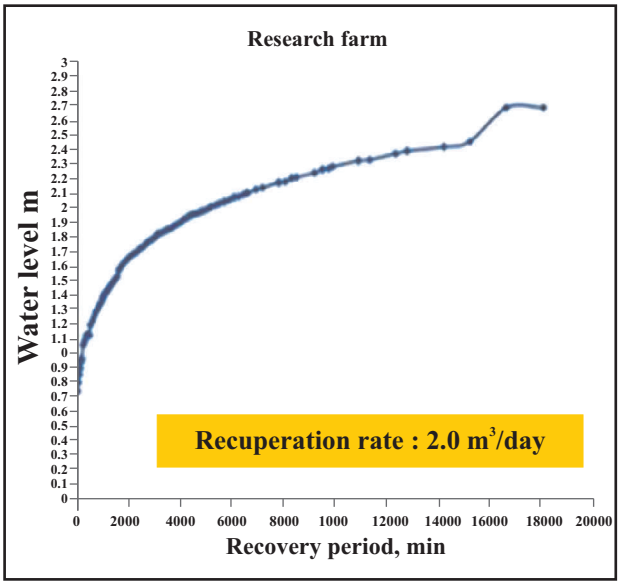


Fig. 3 : Recovery period of Rajbidai *Jhola* Kundi

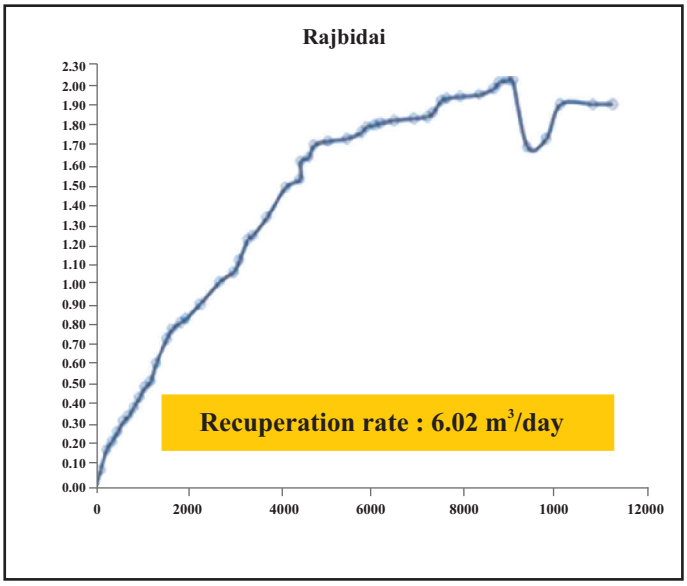


Fig. 4 : Recovery period of research farm *Jhola* Kundi

Conservation tillage systems for enhancing productivity and resource-use efficiency in rainfed area of South-eastern Rajasthan (Kuldeep Kumar, B L Mina, Shakir Ali and Ashok Kumar-Kota)

Conservation agriculture is generally referred to a way of practicing agriculture that primarily includes less tillage, incorporation of crop residue and follow-up of better crop rotation. The key features of these technologies include: (i) minimum soil disturbance by adopting no-tillage and minimum traffic for agricultural operations, (ii) leave and manage the crop residues on the soil surface, and (iii) adopt spatial and temporal crop sequences to derive maximum benefits from inputs and minimize adverse environmental impacts. When the residues are retained on soil surface in combination with zero-tillage, the enhanced biological processes lead to improved soil quality. A considerable amount of research work on conservation agriculture has been done in India and South Asia under irrigated ecosystem, but very little information is available in rainfed

Table 5: Mustard (*Rabi*) and soybean (kharif) yield, Runoff and soil loss during monsoon 2017 as affected by tillage and residue management

Treatments	Runoff (mm)	Runoff (% of rainfall)	Soil loss (t/ha)	Yield (kg/ha)	
				Mustard (2016-17)	Soybean (2017)
T_1. Conventional tillage (Farmer Practice)	36.8	7.94	1.46	1042	1085
T_2. Conventional tillage (Farmer Practice) + Residue Retention	30.8	6.65	0.68	1086	1061
T_3. Zero tillage	41.6	8.98	1.06	838	713
T_4. Zero tillage + Residue Retention	39.3	8.48	0.88	939	794
T_5. Reduced Tillage (No Primary tillage)	33.0	7.13	1.30	990	888
T_6. Reduced Tillage + Residue Retention	25.6	5.53	0.60	1027	924
T_7. Broad Bed and Furrow	38.9	8.40	1.68	1114	1079
T_8. Broad Bed and Furrow + Residue Retention	30.4	6.57	1.05	1134	1093
T_9. Permanent Broad Bed and Furrow	47.6	10.28	0.99	1029	904
T_{10}. Permanent Broad Bed and Furrow + Residue Retention	43.8	9.46	0.84	1106	869

conditions particularly in semi-arid situations. Therefore, a project has been initiated from 2015 at ICAR-IISWC, Research Centre, Kota to explore the feasibility of double cropping under rainfed ecosystem through resource-conserving practices. Soybean and mustard was grown as experimental crops during *Kharif* and *Rabi* season, respectively. The experiment was laid down in randomized block design with 10 treatments consisting of a combination of tillage, land configuration and residue management of previous crop. Residue of previous crops i.e. residue of soybean @1.5 t/ha in mustard crop and residue of mustard @ 3.0 t/ha in soybean crop was retained.

During monsoon 2017 the Kota region received total 463 mm *rainfall which is lower than* average seasonal rainfall of this region. The rainfall consisted of 2-3 intense storms in the month of August. Results show that reduced tillage with retention of residue of previous crop resulted in minimum runoff and soil loss. Permanent Broad Bed and Furrow produced maximum value of runoff while maximum value of soil loss was observed in broad bed and furrow treatment (Table 5). Rainfed mustard crop was raised on residual soil moisture after giving a light pre sowing irrigation to ensure proper germination just after harvesting of *Kharif* soybean. Maximum mustard yield was obtained with broad bed and furrow treatment while zero tillage recorded lowest yield among all the treatments. During Kharif season of 2017 maximum soybean yield was recorded with broad bed and furrow in combination with residue retention of previous crop while zero tillage with no residue retention recorded lowest soybean yield. Maximum mustard yield was obtained in BBF+residue retention treatment followed by Permanent BBF+residue while zero tillage recorded lowest mustard yield during Rabi season of 2016-17.

Resource conservation and productivity enhancement through organic and inorganic amendments in soybean-mustard cropping system (I.Rashmi, B.L.Mina, Kuldeep K, Shakir Ali, Ashok Kumar-Kota)

A field experiment was carried out in 2017-18 at Research farm, Kota to study the effect of organic and inorganic amendments in soybean mustard cropping system on resource conservation and crop productivity in soybean mustard cropping system. Eight treatments of soybean – mustard cropping system are T1: Control; T2: Recommended Dose of Fertilizer (RDF) (Soybean-Mustard); T3: RDF + Gypsum; T4: RDF + FYM (10t/ha); T5: RDF + Mulches (previous crop residues will be used as per requirement); T6: RDF+ Gypsum + Mulch; T7: RDF+ Gypsum + FYM; T8: RDF + Gypsum + Mulches + FYM. Results show that Among the different treatments soybean grain yield ranged from 728.5 to 1798 kg/ha and straw yield ranged from 1769 to 2744.3 kg/ha. Maximum grain production was observed in T6 treatment (RDF+ Gypsum + Mulch) as shown in the Table 6. Application of gypsum and mulch showed significant effect on soybean yield. Rainfall received during crop period was 495 mm of which 220 mm rainfall produced four runoff storm events. Meagre rainfall (<5mm) was received during the first two weeks after sowing, and after 4th week 3 runoff events were recorded. After 5th week of crop sowing again meagre rainfall (5-6mm) was received. Runoff varied from 5.8 to 6.8 % of rainfall produced by runoff (table 1). Similarly soil loss ranged from 85 to 116 kg/ha. Among the various treatments, T6: RDF+ Gypsum + Mulches followed by T8: RDF+ Gypsum + Mulches + FYM showed least runoff and soil loss. The highest runoff, soil and nutrient loss was observed in control plots with no application of amendments. Application of crop residue as mulch alongwith FYM and gypsum was effective in reducing runoff and soil loss over control treatment.

Table 6: Runoff, soil and nutrient loss under different treatments during 2017-18

Treatments	Runoff (mm)	Runoff (%)	Soil loss (kg ha^{-1})	Nutrient loss (kg/ha)			Yield(kg ha^{-1})	
				N	P	K	Grain	Stover
T1	14.9	6.8	115.6	0.86	0.02	2.9	728.5	1769.3
T2	14.2	6.5	98.5	0.72	0.02	5.2	1189.6	2033.0
T3	13.6	6.2	89.5	0.89	0.02	4.10	1319.5	2278.1
T4	13.3	6.1	92.1	1.1	0.02	5.17	1365.9	2339.1
T5	14.1	6.4	90.9	1.05	0.03	6.1	1542.5	2530.5
T6	12.6	5.8	84.5	0.81	0.02	4.11	1798.0	2744.3
T7	14.1	6.4	102.4	1.02	0.03	5.30	1396.0	2439.4
T8	13.3	6.1	85.5	0.74	0.01	4.27	1726.6	2578.0

Cover crops and reduced tillage for enhancing productivity and soil health in rainfed farming system in the hilly area (K. Kannan, V. Kasthuri Thilagam, P. Raja and O.P.S. Khola- Udhagamandalam)

A study was initiated during 2014 with objective of assessing the productivity of potato –carrot cropping sequence and soil health under reduced tillage and cover crop system with respect to climate resilience farming. The treatments included:

conventional tillage (M_1) and reduced tillage (M_2) in main plot and winter cover crops: No cover crops (S_1), Oats (S_2), Lupin (S_3), Buck wheat (S_4) and Mustard (S_5) as sub plot. During the reporting period, potato during I season (March to June) and carrot during II season (July to October) were taken up under two tillage treatments. Cover crops were sown during November 2017 and harvested during January to February, 2018 for cover crops.There was no significant effect on potato yield due to tillage treatment (Table 7). Higher yield of potato achieved with mustard followed by oats and buckwheat.

Table 7: Potato yield under tillage and cover crop treatments

Treatments	Potato yield (t ha^{-1})		
	Conventional tillage	Reduced tillage	Main plot Mean
No cover crop	19.1	18.1	18.6
Fodder oats	23.5	21.6	22.6
Lupin	22.7	18.8	20.8
Buckwheat	21.6	21.5	21.5
Mustard	22.8	22.4	22.6
Main plot Mean	22.0	20.5	
CD(P=5%) Tillage :NS Cover crop: 2.16			

The days to 50% flowering of different cover crops were 55, 62, 75 and 100 days for buckwheat, mustard, fodder oats and lupin. At 50 % flowering, cover crops were cut to the ground level and kept as mulch. The highest biomass at (3.2 t ha^{-1}) quickest time (55 days) was achieved with buckwheat and the highest biomass at flowering was recorded in oats(4.8 t ha^{-1}), followed by mustard (4.3t ha^{-1}). The highest N (76.8 kg), P (17.2 kg) addition per hectare due to cover crops incorporation was observed in fodder oats & K (27.5 kg) in mustard under reduced tillage (Table 8). Higher soil moisture was observed under reduced tillage and cover crops compared to the conventional tillage and without cover crop.

Table 8: Biomass Yield and nutrient addition by cover crops

Cover crops	Biomass Yield (t ha^{-1})		Nutrient addition (kg ha^{-1})					
	CT	RT	CT			RT		
			N	P	K	N	P	K
Buck wheat	2.9	3.2	46.4	14.9	9.5	51.2	16.3	10.5
Lupin	2.1	1.8	34.4	11.4	13.4	29.5	9.7	11.5
Mustard	4.1	4.3	61.5	15.9	26.2	64.5	16.7	27.5
Oats	4.5	4.8	72	16.2	24.3	76.8	17.2	25.9

The highest cover crop residue cover at the time of planting potato was found in mustard followed by fodder oats.

P-2.2: RESOURCE CONSERVATION MEASURES FOR NON-ARABLE LANDS

Improvisation of Soil Working Techniques for Enhancing Tree Establishment under Rainfed Conditions of North-Western Himalayas (D.V. Singh, J. Jayaprakash, D.M. Kadam and Vibha Singhal-D.Dun)

In North-Western Himalayas, majority of tree planting in degraded areas suffers from major problem of water scarcity during lean period. Also, farmers encounter the problem of low survival rate of fruit saplings due to moisture deficiency occurred during dry season. Therefore, a study was initiated during 2016-17 as an action research project in order to develop effective soil working technique which can counter water scarcity problem and enhance tree establishment under rainfed conditions of North-Western Himalayas. It has been widely reported that in sub-surface soil, moisture is retained even during dry period but there is restricted supply of oxygen and nutrients. These issues have been attempted to address through an

innovative method of sub-surface planting. In this method of soil working technique, planting has been tried, 20-30 cm below the soil surface through a low quality PVC pipe for keeping the saplings' stems not in contact with surface soil.In Dhanpau-Lakhwar area, two field experiments on forestry had conducted, one each on southern and northern aspects. These sites were selected in consultation with Eco-Task Force and *Van Panchayat Samiti*. Experiment on agri-horticulture was conducted at farmer's field in Pasauli village. For forestry species, *Ritha* was planted on northern aspect with seven treatments while *Bahera* on southern aspect was planted with eight treatments during last year. Under agri-horticulture, mango was planted with six treatments. These field experiments have been laid in Randomized Block Design (R.B.D.) with three replications.

Sub-surface planting of mango sapling

Sub- surface planting of Ritha sapling

During the period of report, data on tree survival, plant height and collar diameter have been recorded for both forestry species and depicted in Fig. 5 to 6. It is pertinent to note that *Ritha* had 100 per cent survival rate under all seven treatments due better moisture availability on northern aspect. Since *Bahera* is planted on southern aspect, the survival rate was varied from 94.4 to 100 % but the difference was not significant. It is also observed that application of hydrogel had shown negative effect on both plant height and collar diameter in *Ritha* whereas in case of *Bahera* only plant height was negatively affected by hydrogel application. Generally in both the plantations, higher values of survival rate, plant height and collar diameter were observed in treatments where sub-surface planting through PVC pipe was introduced.

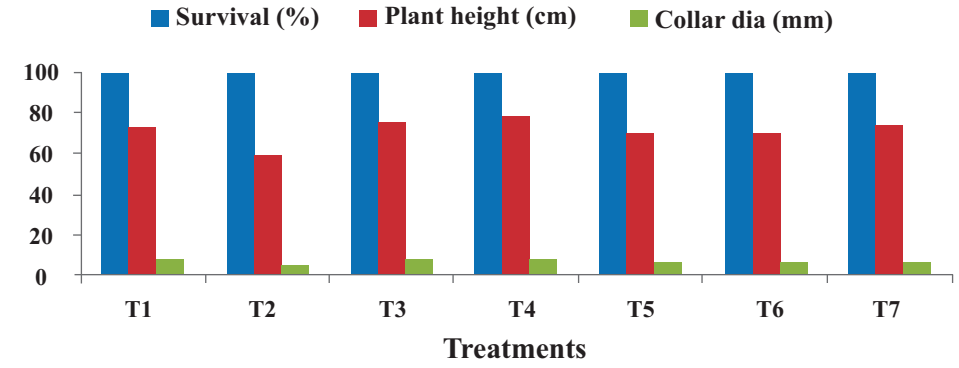


Fig- 5. Plant growth of *Ritha* after one year of planting under different treatments

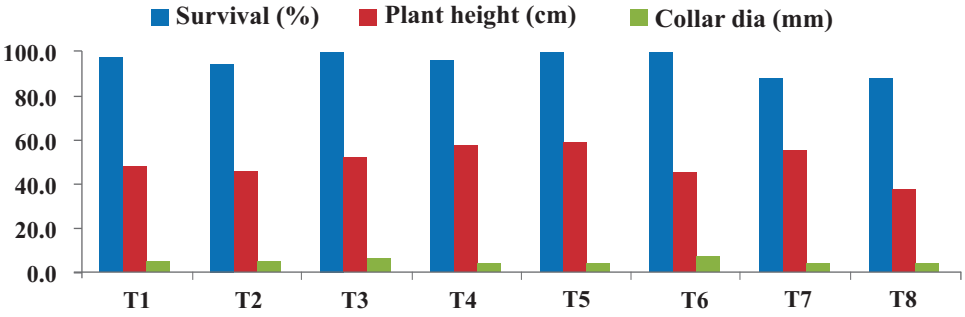


Fig -6: Plant growth of *Bahera* after one year of planting under different treatments

Data on different growth parameters like plant height, collar diameter, number of leaves, number of branches and plant survival have been recorded for mango planted under agro-forestry system and presented in Table 9. It could be seen from this table that significantly higher plant height, collar diameter and number of leaves were observed under all three treatments (T3, T5 and T6) where modified sub-surface planting through PVC pipe was adopted. Also, highest plant survival of 95.8 to 100 % was observed in these treatments but this parameter did not vary significantly.

Table -9: Plant growth and survival of mango under different treatments

Treatment	PlantHeight(cm)	Collar dia at 45 cm h (mm)	No. of leaves	No. of branches	Survival %
T1	67.2	10.3	55.3	4.7	85.6
T2	77.6	14.6	56.3	5.3	86.6
T3	100.1	18.9	93.3	9.3	100.0
T4	83.9	15.2	66.0	7.7	94.4
T5	97.3	15.8	92.7	11.3	100.0
T6	103.0	15.1	89.0	9.7	95.8
C.D. (at 5%)	16.3	4.2	10.7	NS	NS

Evaluation of traditional minor millet based agroforestry systems under recommended agri-silvicultural practices of North Western Himalayas: (Harsh Mehta, J.M.S Tomar and D.Mandal-D. Dun)

The experiment was laid out in August 2009 by planting 324 saplings of improved provenances of *Grewia optiva* and *Morus alba* which are the major agroforestry tree species of the North Western Himalayas primarily grown by small and marginal farmers for green tree fodder. High yielding provenances of bhimal viz. I.C. Bhaintan, I.C. Chamba and I.C. Malas were planted (54 each). Likewise 54 saplings of high yielding provenances of mulberry (S1, S146 and S1635) were planted in run off size plots 45x15 meter with uniform plant and row spacing of 5.0 x 4.25 m.Initial recordings were taken for 324 bhimal and mulberry plantations at the time of planting in respect of different growth parameters like plant height, collar diameter, as given in Fig 7&8. The mean annual increments in respect of plant height in Bhimal and mulberry were 95.88 and 104.63 cm respectively leading to very rapid growth of plants. Similarly the mean annual increments in respect of collar diameter in Bhimal and mulberry were **2.18** and 2.53 cm respectively.

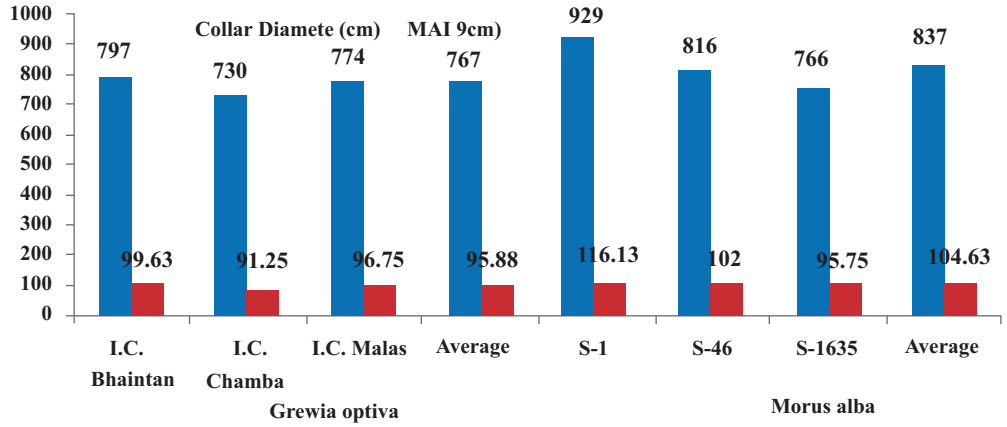


Fig- 7. Plant height and Mean Annual Increment (cm) of *Grewia optiva* and *Morus alba* in 2017.

The average productivity (Table 10) of improved varieties of finger millet and barnyard millet was 14.26 and 13.4 q ha^{-1} in comparison to 13.3 q ha^{-1} and 11.4 q ha^{-1} recorded in local varieties. The average productivity of finger millet and barnyard millet under *Grevia optiva* was 11.09 and 101.0 qha-1 while it was 9.40 and 8.54 q ha-1 under *Morus alba*, showing tree crop interactions.

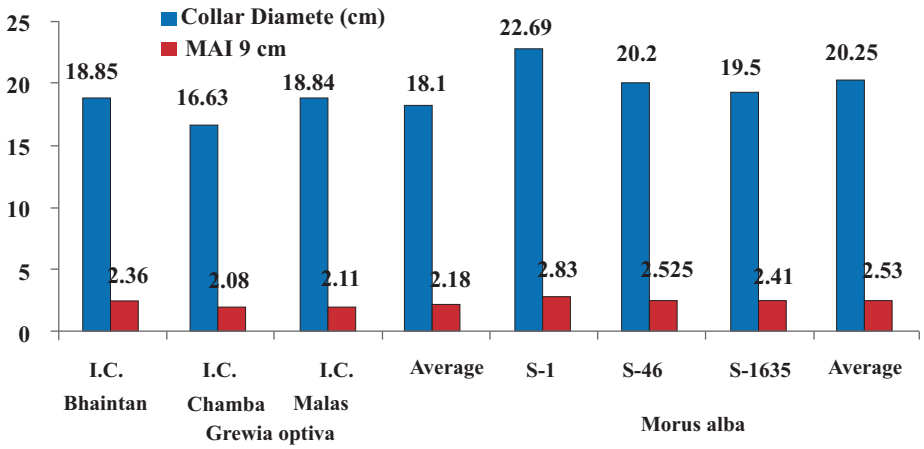


Fig -8. Collar diameter and Mean Annual Increment (cm) of *Grewia optiva* and *Morus alba* in 2017.

Table- 10. Average productivity of finger millet and barnyard millet under different agroforestry trees in kharif 2017

Crops →	FINGER MILLET	Yield (q ha^{-1})	BARNYARD MILLET	Yiel (q ha^{-1})
	Finger millet (PRM 1)	14.26(7.1 %)	Barnyard millet (PRJ 1)	13.4 (17.5%)
	Finger millet(Local)	13.3	Barnyard millet (Local)	11.4
	Av. productivity	14.25	Av. productivity	12.4
↓ Trees *Grewia optiva*	Finger millet (VR708) under *Grewia optiva*	11.85	Barnyard millet (VL Madira 207) under *Grewia optiva*	11.62
	Finger millet(Local) under *Grewia optiva*	10.32	Barnyard millet (Local) under *Grewia optiva*	9.57
	Av. productivity under *Grewia optiva*	11.09(22.2 %)	Av. productivity under *Grewia optiva*	10.10(18.5%)
Morus alba	Finger millet (VR708) under *Morus alba*	9.7	Barnyard millet (VL Madira 207) under *Morus alba*	8.67
	Finger millet (Local) under *Morus alba*	9.1	Barnyard millet (Local) *Morus alba*	8.40
	Av. Productivity Under *Morus alba*	9.40(34.0%)	Av. productivity under *Morus alba*	8.54(31.1%)

Recording of runoff and soil loss (Fig.9) in different land uses indicated that tree crop combinations were quite effective in controlling the runoff and soil loss. Mulberry and finger millet combination produced the minimum run off and soil loss followed by other tree crop combinations. Traditional crops alone were more effective than native trees.

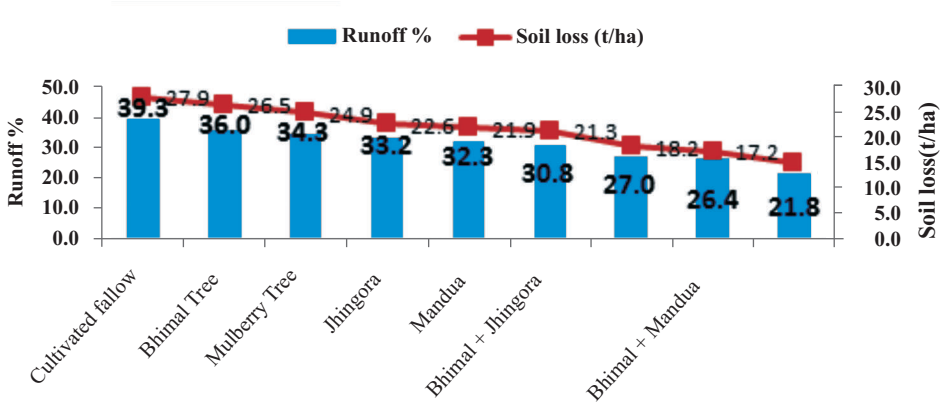
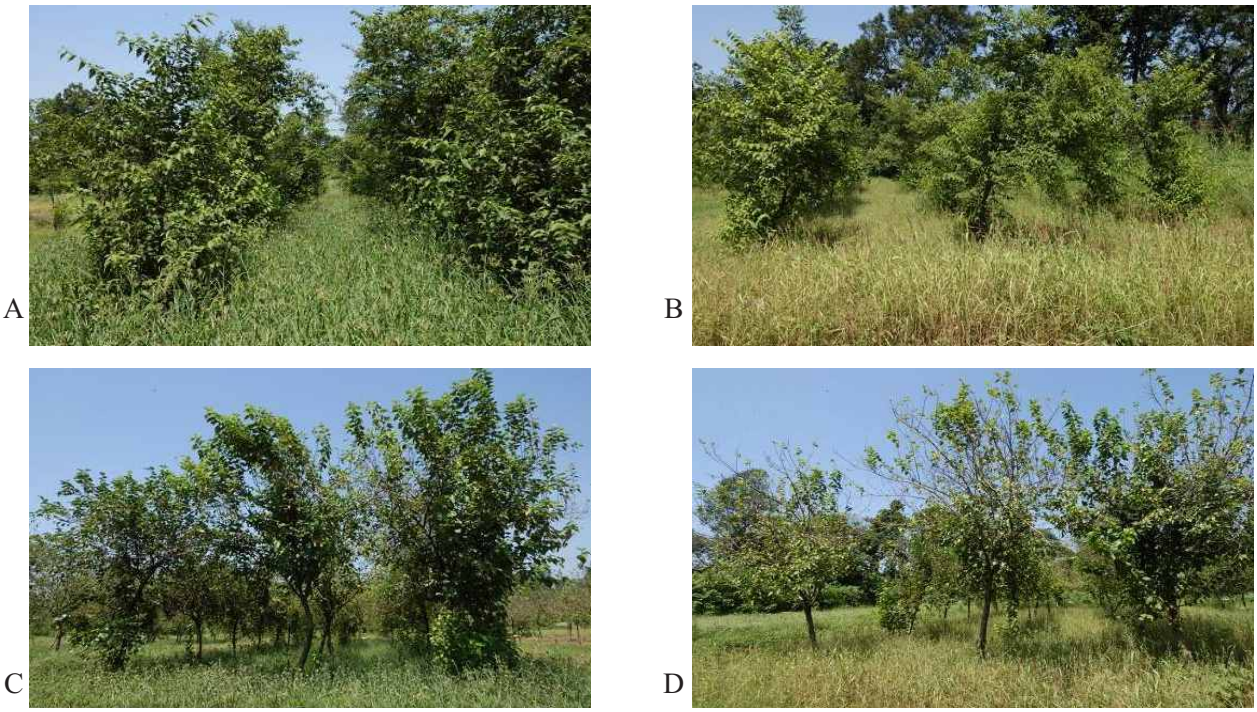


Fig- 9. Runoff and soil loss under different land uses



Finger millet grown in association with *Grewia optiva* (A) and *Morus alba* (B);
Barnyard millet grown in association with *Morus alba* (C) and *Grewia optiva* (D)

Efficacy of different soil and water conservation measures on bamboo productivity and resource conservation in Himalayan foothills (Rajesh Kaushal, Ambrish Kumar, J.M.S. Tomar and D.V. Singh-D. Dun)

The study was initiated in the year 2012 on steep sloping land (> 25%) in Timli Range of Kalsi Forest Divison near Mednipur village in District DehraDun for evaluating two species of bamboo - *D strictus* (DS) which is widely grown in foothills, while another *D hamiltonii* (DH) is being introduced as it has high productivity potential. Both the species were raised with soil conservation measures *viz*., Rectangular trenches (R), semicircular trench (S) and V-shaped ditches for improving soil moisture alongwith control (C). Growth parameters revealed that diameter and height growth were maximum in semicircular trenches in both the species (Fig 10). In DH height of clump varied from 10.8-12.7 m in different treatments while, culm diameter ranged from 5.7-6.4 cm. In DS height of clump varied from 4.5-6.0 m in different treatments while, diameter ranged from 4.03-4.99 cm. Number of new shoots were maximum 10.0 in *D. hamiltonii* when raised with S trenches. Biomass varied from 9.7 to 13.1 kg/culm in *D. hamiltonii* and 3.8-5.9 kg/culm in ***D strictus***. The maximum biomass was recorded in S trenches in both the species. Only one runoff event was recorded during the study period. Under different trenches, growth of lantana was significantly reduced. It was minimum under DH-S treatment. In 0-15 cm soil layer, soil pH, organic carbon and available P was reduced under all the treatments as compared to control. Available K however did not follow trend.

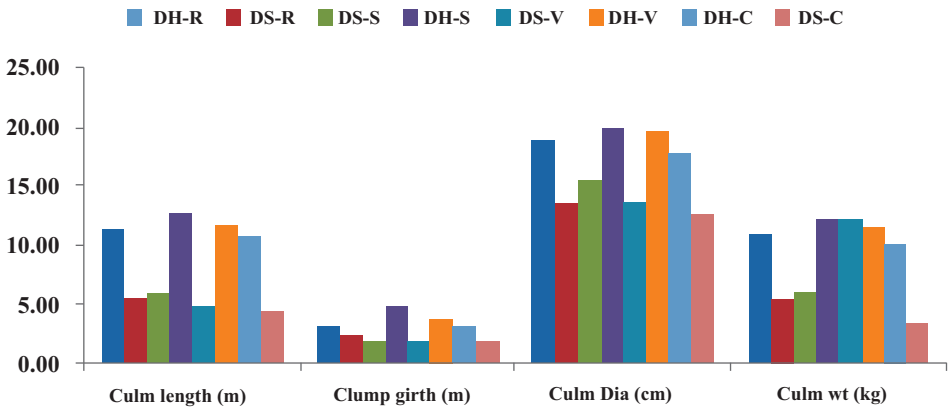


Fig-10: Effect of soil conservation measure on growth and biomass of bamboos

Development and characterization of quality planting material of MPT's for improving the productivity of degraded lands (Harsh Mehta, Rajesh Kaushal , Anand Gupta- D.Dun)

The study was initiated in the year 2012 with the aim of developing quality planting material of MPT's for improving the productivity of degraded lands. Screening provenances of Celtis australis and Bauhinia variegata under nursery and field conditions was initiated in 2013 and 2014. Planting materials of Celtis australis(Khirak) were collected from diverse locations of North-west Himalaya Uttarakhand, Himachal Pradesh and Jammu and Kashmir, from 10 districts viz., Kathua, Chamba, Kangra, Kullu, Shimla, Solan, Sirmour, Dehradun, Tehri, Almora and Nainital. Similarly for Bauhinia variegata (Kachnar), the planting materials were colleted from Uttarakhand and Himachal Pradesh with seven provenances viz., IC Ghatol, IC Sorus, IC Hamirpur, IC Bilaspur, IC Ranichauri and IC Dehradun. The healthy sapling of provenances were planted in the field conditions at the Selakui farm in randomized block design with three replications.Maximum plant height of 6.39 m was recorded in I.C. Solan. It was followed by I.C. Tehri (6.07 m) (Fig. 11). Maximum collar diameter of *Celtis australis* was recorded in I.C. Solan (12.77 cm) followed by I.C. Jammu (12.14 cm) (Fig. 12). Maximum DBH of *Celtis australis* was recorded in I.C. Tehri (8.05 cm) followed by I.C. Solan (7.85 cm) (Fig. 13). Likewise material of *Bauhinia variegata* is being evaluated. Under field conditions I.C. - Soras recorded the maximum plant height of 4.78 m followed by I.C. Ghatol (4.71). Maximum collar diameter of 10.1 cm was in I.C. Ghatol followed by I.C. Soras (9.68) (Fig. 14 &15). The maximum DBH of *Bauhinia variegata* was recorded in I.C. Ghatol (7.08 cm) followed by I.C. Soras (6.65 cm) (Fig. 16).

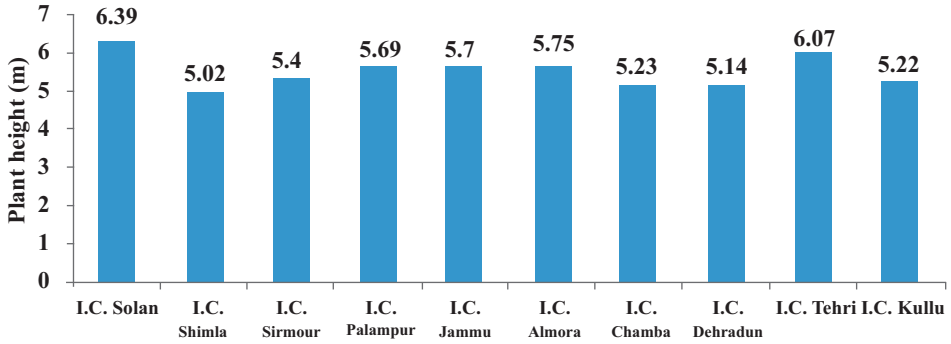


Fig- 11. Plant height (m) of different provenances of *Celtis australis* after three years of planting

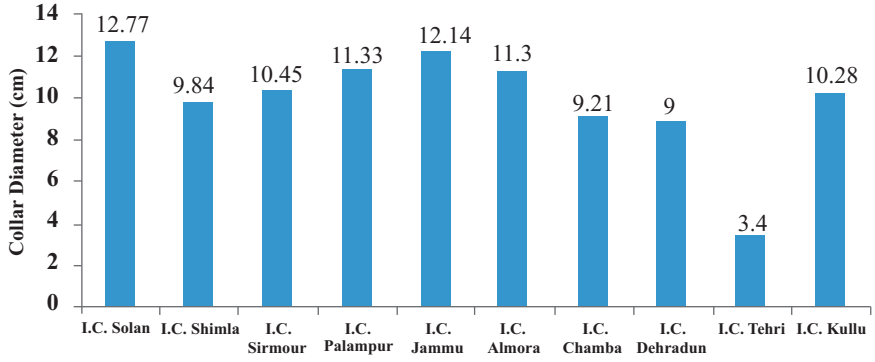


Fig- 12. Collar diameter (cm) of different provenances of *Celtis australis* after three years of planting.

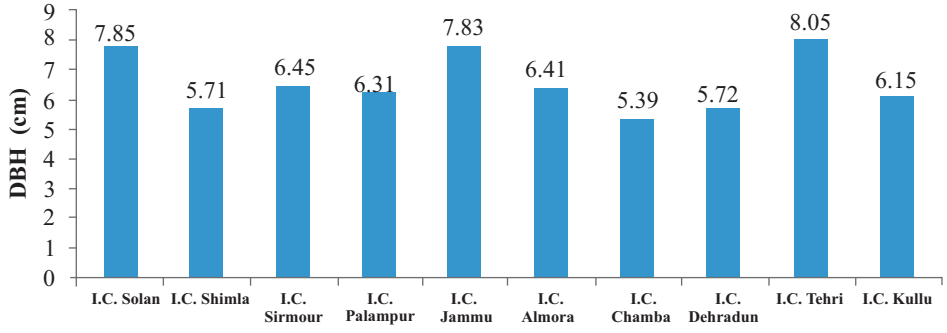


Fig-13. DBH (cm) of different provenances of *Celtis australis* after three years of planting.

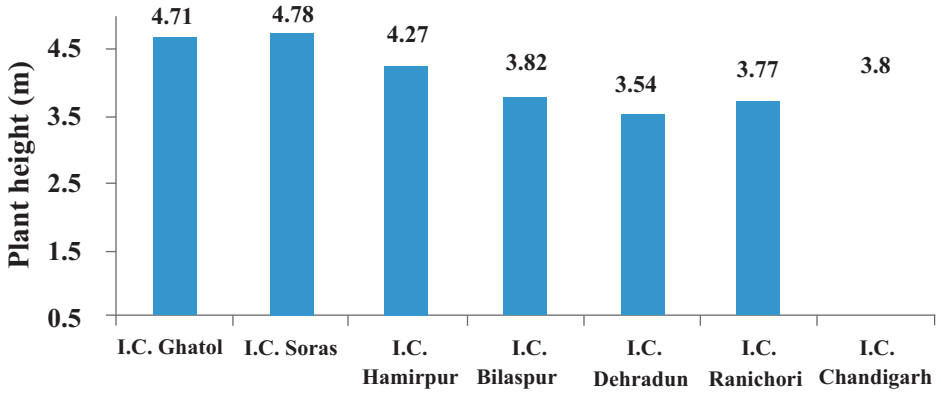


Fig-14. Plant height (cm) of different provenances of ***Bauhinia variegata*** after three years of planting.

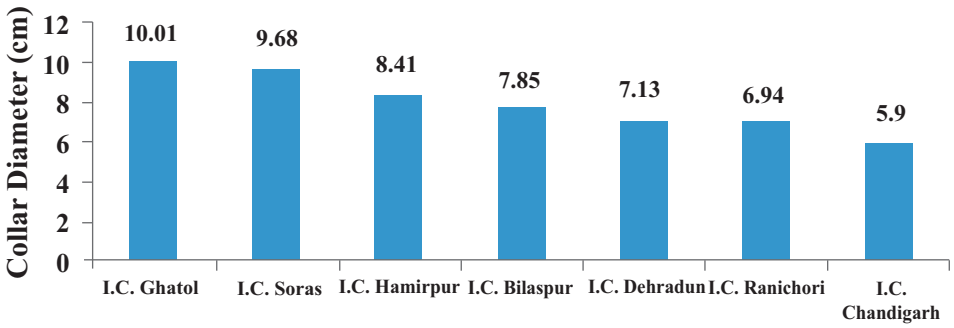


Fig-15. Collar diameter (cm) of different provenances of ***Bauhinia variegata*** after three years of planting.

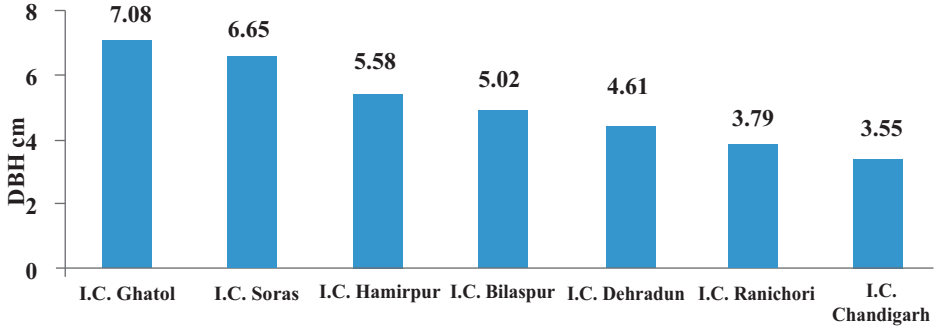


Fig-16. DBH (cm) of different provenances of ***Bauhinia variegata*** after three years of planting.

Evaluation of Bael and Olive Based Agro-forestry System with Soil Amendments in Doon Valley (J. Jayaprakash, A.C. Rathore, D.V. Singh and Harsh Mehta- D.Dun).

This experiment was started in 2015 with five objectives for production of fruit based land use system with various amendments under rainfed situation. Bael cv. NB-5 and olive cv. Barnea had been planted in 2015. The various treatment imposed were T1-Control, T2-Pressmud, T3-Rice husk, T4-Oil cake, T5-FYM, T6-Pressmud + stone mulching, T7- Rice husk + stone mulching, T8-Oil cake + stone mulching and T9-FYM+stone mulching. The results of the experiment are reported for 2016-17. Maximum plant height (65 cm) and collar diameter (1.8 cm) have been recorded in T_5 treatment which received only FYM application whereas minimum plant height (39.5 cm) and collar diameter (0.72 cm) under control treatment. Similarly, Bael plant recorded maximum plant height (73.5 cm with 1.45 cm collar diameter under T_8 treatment (Oil cake + stone mulching) and minimum plant height and collar diameter with control treatment (59.8 cm and 1.3 cm).

Soil fertility restoration and carbon sequestration potential of multipurpose indigenous tree species from western Himalayas (Vibha Singhal, Charan Singh and Trisha Roy-D.Dun**)**

The aim of the project is to to quantify the litter production of multipurpose agroforestry trees namely *Grewia optiva, Celtis australis*, *Bauhinia variegata* and *Ficus roxburghii* and to study the decomposition dynamics and its effect on the return

of nutrients to the soil. 5 trees of each species in good form and health were selected .Litterfall traps(75 X75 cm) (4-5) were kept under the canopy of each tree for leaf litter collection at the end of each month. 250 leaf traps were placed under selected trees. Litter decomposition studies is being carried out by Litterbag method. followed the order *Grewia optiva* > *Celtis australis* > *Bauhinia variegata* > *Ficus roxburghii* .A uniform decomposition pattern was observed for all the four species, initially, a slower phase which followed by a rapid phase. Decomposition rate was recorded to be highest in *Celtis australis* and minimum *in Ficus roxburghii*. Decomposition studies indicate that in one year leaf litter decayed to 89.75 % in *Celtis australis* wheresas, leaf litter of *Ficus roxburghii* decomposed to 65.35 % of its original mass in the same period

Evaluation of rooting media and rootstocks of major subtropical fruit spp. for raising quality planting materials on degraded lands (AC Rathore, H Mehta, Deepak Singh, J. Jayprakash, DM Kadam-D.Dun)

This externally funded HMNEH project was started during 2015-16 for evaluating rooting media and rootstocks for mass multiplication of grafts of mango, litchi, guava, aonla, pomegranate, bael, etc. Rootstocks of mango, guava and aonla have been raised using different combinations of soil, microbes and organic manures in pots comprising eight treatments. Higher growth has been recorded in T_4 treatment (10 g AZB + 10 g PSB + Soil +FYM) for all rootstocks of mango, guava and aonla after 6-8 months (Fig.17). Seedlings of mango and aonla collected from different blocks of Dehradun have also raised in pots to compare performance. Rootstocks collected from Kalsi block shown maximum root and shoot ratio. Rootstocks of mango, guava, aonla and bael have also been raised in pots with different moisture regime for assessing water requirement. Mango sapling has attained graftable diameter irrigated at 80% ET (Fig.18a) whereas guava sapling attained graftable diameter irrigated at 60-70% ET (Fig.18b).

Fig.-17: Performance of mango sapling in with various rooting media

Fig-18 Performance of sapling under different level of irrigation based on ET in mango (a) and guava (b)

Up-scaling research on assessment of productivity, hydrological behavior, resource conservation and intangible benefits of selected commercial bamboo species in Uttarakhand (R. Kaushal, Ambrish Kumar, D. Mandal, Pradeep Dogra, J.M.S. Tomar, D.V. Singh, Harsh Mehta, N.M. Alam, Anand Kumar Gupta-D.Dun)

The collaborative project funded by International Network for Bamboo and Rattan (INBAR) State Forest Department, Uttarakhand aims at generating scientific information on allometrics and environmental metrics of different bamboo species.

The project also envisages capacity building of African partners under South-South institutional strengthening programme of INBAR. The data on different bamboo species is being generated from different locations in Uttarakhand. At Dhulkot research farm, seven different species of bamboos *viz*., *Bambusa bambos, B. balcooa, B. nutans, B. vulgaris, Dendrocalamus hamiltonii, D. strictus, D. stocksii* were planted in randomized block design in the year 2012. At Selaqui, experimental site is gravelly and bouldery marginal land (class VI based on land capability classification) where eight species viz., *Bambusa bambos, B. balcooa, B. tulda, B. vulgaris, Dendrocalamus asper, D. hamiltonii, D. longispathus, D. strictus were planted in the year 2015* in randomized block design. To quantify runoff and soil loss, seven different bamboo species viz., *B. balcooa, B. vulgaris, Dendrocalamus giganteus, D. hamiltonii, D. stocksii, D. strictus Thyrosatchyus oliverii* were planted in the year 2016 on 9% slope. At GBPUAT, Pantnagar, *Bambusa bambos, B. balcooa, B. nutans, Dendrocalamus hamiltonii and D. strictus were planted in the year 2005 in* randomized block design, Data at all the locations is being recorded for growth, biomass, root distribution, rainfall portioning, runoff and soil loss and soil properties viz., bulk density, infiltration, organic carbon, NPK, soil microbial properties. At Dhulkot, after 5 year of study period, maximum bulk density was observed in *D hamiltonii* which was followed by *B. balcooa* and *D. strictus*. Lowest bulk density was observed in *D. stocksii.* Average number of number of coarse roots (CR) and fine roots (Fr) roots irrespective of soil depth (0-60 cm) were studied by trench method. Maximum CR and FR were observed in *Bambusa bambos* which was followed by *B. vulgaris*. Lowest coarse roots were recdorded in *D. stocksii* and fine rootys in *B. balcooa* (Fig. 19).

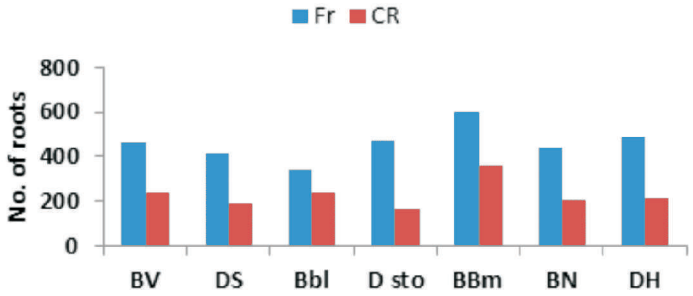


Fig-19. Number of coarse and fine roots in different bamboo species

Results on rainfall partitioning in different bamboo species (Fig 6a) revealed that maximum stemflow was recorded in *D. hamiltonii* while minimum was recorded in *B. nutans.* Maximum throughfall was recorded in *B. vulgaris* while lowest was in case of *D. hamiltonii.* Interception of rainfall was highest in case of *D. hamiltonii.*At GBPUAT, Pantnagar, hydraulic conductivity was maximum in D. *hamiltonii* and minimum in open plot. Bulk density also showed similar pattern (Fig. 20)

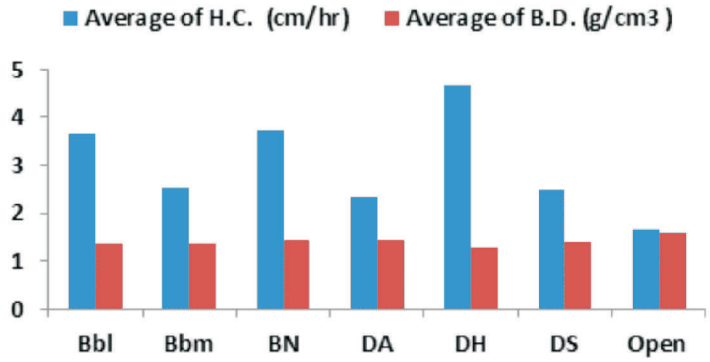


Fig-20: Hydraulic conductivity and bulk density in different bamboo species.

Under capacity building programme, short Term Training Course on Bamboo Allometrics and Environmental Metrics was conducted in Ethiopia, Tanzania and Madagascar from August 1-18, 2017 in which 62 trainees from different academic, research and development institutions participated.

Assessment and Improvement of Nutritional Quality of Horticultural Crops on Sloping Lands in North Western Himalayas (D.M.Kadam, M.Sankar, D.V.Singh-D. Dun**)**

Mango field of about 2 ha was selected in Badwala village for the study having 225 trees of Dashehari variety at 9 m X 9 m spacing. It lies between latitudes of 30°29'49.5" and 30°29'56.7" N and longitudes of 77°50'8.6" and 77°50'15.3" E. mango

plantation was established 20 years ago on mildly sloping land which is truly representative of foot hills of North Western Himalayas. Initial soil sampling was done before tomato transplanting to assess the soil quality; total 27 samples were collected from 0-15 cm depth, 9 samples from each slope. The soil parameters are presented in Table -11

Table -11: Initial soil chemical parameter (average)

	pH	EC(dSm^{-1})	P(ppm)	K(ppm)	Cu(ppm)	Zn(ppm)	Fe(ppm)	Mn(ppm)
Up slope	5.18	0.088	8.14	119.68	0.99	3.59	25.26	52.45
Mid slope	4.71	0.080	8.51	99.84	0.85	2.01	34.97	109.68
Down slope	4.66	0.112	6.11	81.08	0.84	1.79	36.97	128.10

Phyto-rehabilitation of saline – sodic vertisols through *Prosopis juliflora* based silvipastoral system (H. Biswas and A.S. Morade-Ballary)

The long-term project at the Research Farm, Ballari, was initiated to evaluate the phyto-rehabilitation of saline-sodic Vertisols through *Prosopis juliflora* based silvi-pastoral systems. The experiment was laid out in a spilt plot design with time replication of five years during 2015-16. The study comprises of two tree species, viz., *P. juliflora* and *P. pallida* and two grass species viz., *Leptochloa fusca* and *Cenchrus ciliaris*. The soil of the experimental field is alkaline, with pH ranging from 7.5 to 8.5 and saline, with EC ranging from 0.78 to 11.0 dS m^{-1}. The soil is low in organic carbon.*P. pallida* were planted at two spacing's – 3 × 3 and 6 × 6 m. Seedlings were established and maintained with life-saving irrigation during the dry season. Pruning was carried out during September, 2017 in order to avoid excessive overlap of *P. juliflora* and *P. pallida* and shading to grass species. The growth parameters of *P. pallida* after two years of the study revealed that trees planted at 3 × 3 m attained more height compared to those planted at 6 × 6 m. This could be attributed to the lesser space available for lateral spread. Higher collar diameter and DBH were also recorded under trees planted at 3 × 3 m spacing (Table.12).

Table -12: *P. pallida* growth parameters at two spacings

Spacing levels / Growth Parameters	Main plots: spacing (m)	
	3×3	6×6
Height (cm)	511 ± 30	422 ± 49
Collar diameter (mm)	91 ± 23	71 ± 23
DBH (mm)	64 ± 17	51 ± 20
Canopy spread (N-S)	3.12 ± 0.30	3.08 ± 0.50
Canopy spread (E-W)	3.09 ± 0.20	3.06 ± 0.60

Regulated deficit irrigation and canopy architecture management for fig (*Ficus carica* L.) in semi-arid vertisols (A.S. Morade and M. Prabhavathi-Ballary)

Fig plants of cultivar 'Bellary' planted in July, 2016 at Research Farm, Ballari. Fig plants recorded 78% of survival. Canopy architecture treatments were imposed by training and pruning. Three tier plant canopies were developed by regulating the growth of primary and secondary branches. Nearly 50% of plants started fruiting in November, 2017. Variation in plant growth is observed due to intrinsic plant vigor and extrinsic environmental factors. Preliminary fruit quality analysis (n=49) revealed that, average fruit diameter ranged from 35 to 40 mm and fruit weight at harvesting varied from 20 to 25 g per fruit. The TSS of fully ripen fruits was varied from 19 to 23 degree brix at room temperature. Specific gravity of fig fruits at edible maturity was 1.03 (Plates 1 to 5).

Plate 1. Fig Plant orchard (18 months old) at Research farm, Ballary

Plate 2: Early vegetative growth

Plate 3: Three tier canopy and fruiting

Plate 4: Fig fruits at harvesting maturity

Plate 5: Vertical and transverse sections of fig fruits

Peach based agri-horticulture land use system for degraded Shivaliks (R. Prasad, S. Pal, and S.L. Arya-Chandigarh**)**

Peach based agri-horticulture land use system was established in 2008 in degraded lands in Shivalik foot hills near Chandigarh (UT) with the following objectives as (i) To study the growth performance of peach plants with fodder (inter) crops and vice-versa, (ii) To monitor soil health and moisture conservation, (iii) To estimate soil loss and runoff from different systems, and (iv) To study economic viability of the system. Grafted saplings of peach cultivar Shan-i-Punjab were procured from PAU, Ludhiana and planted in 3rd week of January,2008 in a pit size of 1 m^3 at a spacing of 6mx6m, consisting 278 plants/ha. The plantation was done in a square system and the study consisted of 12 treatments in all and replicated three times having 9 plants per treatment. Ramser samplers were installed in one replication for the estimation of soil loss and run off. The plot size was maintained as 18m x 18m. Recommended package of practices were followed for peach cultivation. The intercrops /fodder crops viz sorghum, pearl millet and cluster bean are sown during kharif season in the vacant space between peach plantation. Control plots for sole crops were also made (6m x6m). In this study, the following moisture conservation measures are made: -

i) Control (flat basins),
ii) Rectangular trench,
iii) Circular trench

Rectangular trenches are made on one side of the plant having a dimension of 1mx0.5x0.3m and the circular trenches made around plant trunk to conserve moisture. Soil loss and runoff was measured/ recorded from one replication. The study consisted of following 12 treatments as:

T-1: Pure Peach
T-2: Pure peach + Trench
T-3: Pure peach + Circular trench
T-4: Peach + Sorghum
T-5: Peach + Pearl millet
T-6: Peach + Cluster bean
T-7: Peach + Sorghum + Trench
T-8: Peach + Pearl millet + Trench
T-9: Peach + Cluster Bean + Guar + Trench
T-10: Peach + Sorghum + Circular Trench
T-11: Peach + Pearl millet + Circular Trench
T-12: Peach + Cluster bean + Circular Trench

Data showed that height (5.74m), spread (7.92m) and yield (137.0 kg) was found maximum in treatment Peach + Guar + Circular Trench (T_{12}) as compared to other treatments. Height ranged from 4.4m to 5.74m, spread from 5.9m to 7.92m, and yield from 103.25 kg to 137.0 kg per plant among various treatments. The fruit weight ranged from 76.28 to 88.63g, fruit length ranged from 5.75cm to 6.29cm, pulp weight ranged from 63.20g to 76.98g, stone weight ranged from 6.50g to 12.43g, and TSS from 10^0 to 12.75^o Brix. Mean fruit weight was 80.55g, mean fruit length was 6.10cm, mean stone weight was 9.99g, and mean TSS^0 was 11.39^o Brix respectively.

Evaluation of Moisture Conservation Techniques for sustainable production of Tree Borne Oil seeds (TBOs) in Bundelkhand (MonalishaPramanik and RS Yadav-Datia)

The experiment was laid down in the year 2010 in red upland soils of Bundelkhand, in split plot design.Three trees borne oil seed plantation was done namely Neem, Karanj and Mahua with four treatments, viz. T-1: Double Trench, T-2: Single Trench T-3: V-shape catchment and T-4 Farmers practice (Ordinary Pit) as control. The growth of Karanj has been found better than other two species. Maximum average collar diameter was recorded in case of Karanj (11.36 cm) under Double trench treatment. There was 100% survival of all the species during the current year, thus no replacement of any species was done under any moisture conservation treatment imposed (Table 13). The average soil moisture content was higher irrespective of species in double trench treatment during the monsoon (Fig.21). It was also observed that there is not much difference in soil moisture content in double trench and V shape during the post monsoon season. Mean soil moisture content recorded under "double trench treatment" was 15.7 per cent and 6.92 per cent during months of July and December respectively against 14.1 per cent and 5.26 per cent under control. Growth of Karanj has been found better than other two species. Maximum average collar diameter was recorded in case of Karanj (11.1 cm) followed by Mahua (6.00 cm). The highest growth with respect to height (427 cm) was found in Karanj and followed by Neem (343 cm).

Table-13: Survival, height, collar girth, DBH, number of branches, crown diameter of TBOs seedlings and *in situ* soil moisture content during December 2017

Main plot Treatment	**Mahua**					**Neem**					**Karanj**				
Sub plot Treatment	ST	DT	V	OP	Mean	ST	DT	V	OP	Mean	ST	DT	V	OP	Mean
Survival per cent	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Avg. ht (cm)	288	244	253	246	258	383	336	353	339	353	474	433	443	406	439
Collar Dia. (cm)	6.5	5.7	6.0	5.7	6.0	6.7	5.6	5.8	5.5	5.9	11.0	11.3	11.0	10.6	11.1
DBH (cm)	4.1	3.1	3.0	3.0	3.3	5.0	3.6	3.9	3.6	4.0	7.1	7.4	6.2	6.2	6.7
Crown dia (cm)	102	79.7	78.3	77.7	84.4	171	115	123	147	139	481	455	395	392	4317

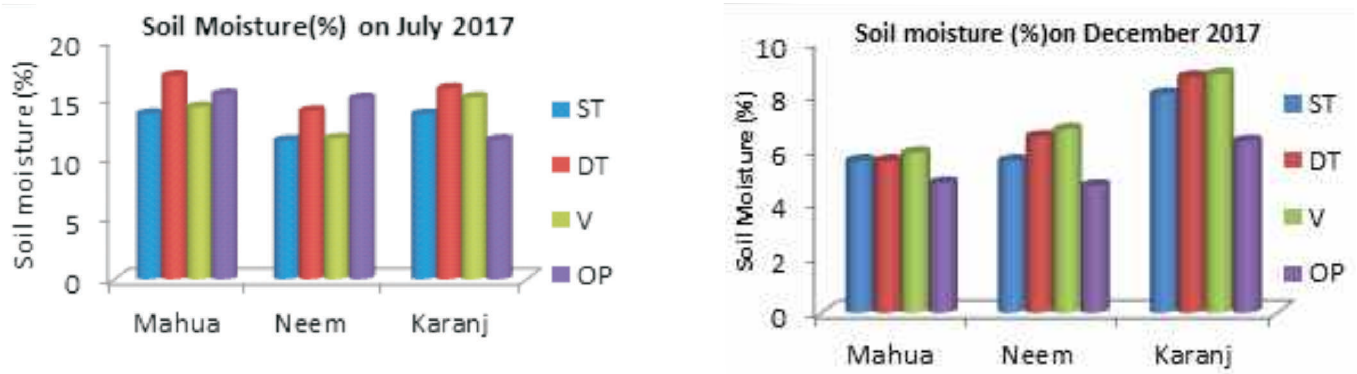


Fig-21: Effect of moisture conservation techniques on *in situ* soil moisture content (%) during 2017

After seven years of experimentation, the soil study revealed that the effect of trees species and soil moisture techniques on soil properties was not found distinctive. However, maximum mean soil organic C and available K (0 – 15 cm depth) was 0.439 per cent and 286 kg ha^{-1} under *A. indica* with control and V-shape basin, respectively. Further, minimum soil pH (7.38) was found under *A. indica* with double trenching and EC (0.074 dSm^{-1}) under *P. pinnata* with single trench.

Evaluation of promising fruit species with different moisture conservation practices in red soils of Bundelkhand region (Rajeev Ranjan, MonalishaPramanik and SP Tiwari-Datia**)**

The experiment was started in 2015-16 with three fruit species *viz*. custard apple, pomegranate and lemon and four moisture conservation treatments *viz*. sun hemp, plastic, stone and no mulch as control replicated thrice in factorial randomized block design to identify the most promising fruit species for sustainable production in semi-arid region of Bundelkhand. After two years of plantation, pomegranate and lemon were survived almost 100 per cent irrespective of mulch treatments, whereas survival of custard apple was mere 71.0 per cent. Growth parameters of fruit plants such as plant height, collar diameter, no. of branches and canopy spread were recorded in different mulch treatment and data revealed that the mean maximum plant height 106 cm, 154 cm and 154 cm were observed in custard apple, pomegranate and lemon under plastic mulch treatment respectively, whereas the mean minimum plant height 72.4 cm, 140 and 137 cm were recorded in custard apple, pomegranate and lemon under control respectively (Table.14).

Table -14: Effect of different mulch treatments on survival (%) and growth parameters of fruit plants during 2017

Species/ Treatment	Custard apple				Pomegranate				Lemon			
	Sun hemp	Plastic	Stone	Control	Sun hemp	Plastic	Stone	Control	Sun hemp	Plastic	Stone	Control
Survival (%)	78	56	74	78	100	100	100	100	100	100	100	100
Plant ht (cm)	91	106	83	72	147	154	149	140	151	154	148	137
Collar dia (mm)	18	21	14	10	25	25	27	26	37	38	36	34
No. of branches	5	4	3	2	10	10	10	9	12	13	12	11
Canopy dia. (cm)	42	50	23	13	97	110	104	91	143	151	126	120

The soil moisture data was recorded on daily basis after irrigation. The soil moisture content was higher in the sunhemp treatment plantation of pomegranate and lemon, whereas the soil moisture was lowest in stone mulch treatment. The study showed that water availability to the plant was higher in case of sunhemp mulch treatment for longer duration. (Fig. 22)

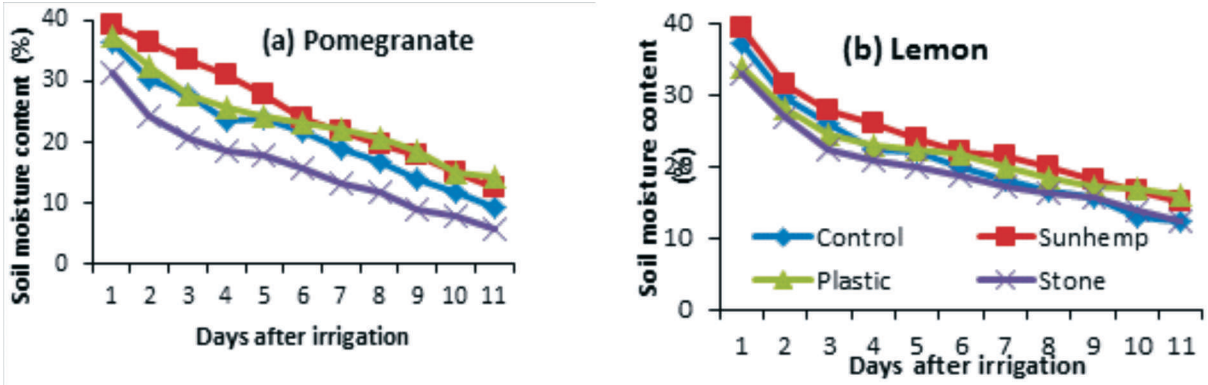


Fig-.22: Soil moisture depletion in (a) Pomegranate and (b) Lemon under different mulch treatments

Evaluation **of cover crops under cashew and mango plantation for improving soil health and productivity in Eastern Ghats High Land Region of Odisha** (M. Madhu , D. C.Sahoo ,P.P. Adhikary and H.Gowda- Koraput)

Cover crops plays vital role in improving soil properties and enhancing the productivity of crops. Soil cover management is one of the important aspects in preventing soil erosion particularly in high rainfall areas. But tree crops may require several years to close their canopy, whereas most annual crops provide adequate cover within six weeks after planting. At initial stage of plantation establishment, soil and nutrient loss is enormous without vegetation cover. Farmers in this region hardly apply

external source of nutrients to plantation crops like cashew and mango leads to poor growth and development and yield at later stage. Due to poor socio-economic conditions application of costly external source of nutrients is very difficult apart from low fertility status of the soil. In view of this, growing of cover crops will be the better options since it improves the soil properties and provides nutrients to plantation crops without much additional cost. With the above background, field experimentation was initiated with the following objectives.

- To study the resource conservation efficiency of cover crops under cashew and mango plantation.
- To study the impact of cover crops on soil properties, carbon sequestration and global warming potential of the system.

Mango and cashew grafts were planted in 8 mX 8 m spacing on sloping field of 8-10%. Eight treatments comprising seven cover crops and one plot without cover crops laid out in RBD design.

T_1 : Mimosa invisa
T_2 : *Calopogonium mucunoides*
T_3 :*Pueraria javanica*
T_4 : *Centrosema pubescens*
T_5 : *Cowpea*
T_6 : *Stylosanthus*
T_7 : *Mucuna bracteata*
T_8 : *Control*

Cover crops seeds were sown during July, 2016 as per the treatment details both in mango and cashew plantation. During this period runoff, soil loss, initial soil properties, canopy cover of cover crops and growth performance of mango and cashew were recorded.Growth parameters of mango and cashew plants were collected 20 months after planting in the field. The average plant height and collar diameter of mango plants varied between 60.4 to 112.6 cm and 1.7 to 2.2 cm, respectively. Similarly average plant height and collar diameter of cashew plants varied between 71.3 to 120.0 cm and 2.2 to 2.4 cm, respectively. Canopy of different cover crops measured at 20 months after planting showed that the maximum canopy cover of 95% in *Mucuna bracteata* followed by *Mimosa invisa* (90%) and *Pueraria javanica* under mango plantation (Fig. 23). Similarly, maximum canopy cover was found in *Mucuna bracteata* (95%) followed by *Mimosa invisa* (90%) and *Pueraria javanica (89%) under cashew plantation.* The lowest canopy cover was found in cow pea and control treatments for both mango and cashew plantations (Fig. 24). *The total rainfall during the year 2017 is 1535.9 mm (89 days). Runoff was measured during the year 2017.* About 640.7 mm of runoff producing rainfall was received in 18 rainfall events. Runoff under mango with different cover crops was varied between 32.2 and 82.4 mm which account about 6.7 to 12.86% of the seasonal rainfall of 894 mm. Runoff under cashew with different cover crops was varied between 29.3 and 76.8 mm which account about 4.58 to 11.99% of the seasonal rainfall of 894 mm (Fig. 25). Soil losses varied between 39.07 kg/ha in Mucuna bracteata and 317.72 kg/ha plot without cover crops in mango and cashew plantation. However, soil loss was the lowest in all the cover crops compared to control plots. Soil conservation efficiency of cover crops varied between 19.1 and 87.2% over control plot (Fig. 26).Maximum volumetric soil moisture content (%) was in control followed by *Mucuna bracteata both in Mango and Cashew plantation.* Above ground dry biomass production of cover crops varied between 2.6 and 11.0 t/ha/yr which contributed total NPK nutrients of 129 to 650 kg/ha to soil. Highest biomasses were obtained in *Mimosa invasia* plot of about 9.6 and 11 t/ha at mango and cashew plantation respectively. Whereas, the lowest biomass were obtained in *Calopogonium mucunoides* of about 2.9 and 2.8 t/ha in mango and cashew plantation, respectively (Fig. 27&28).

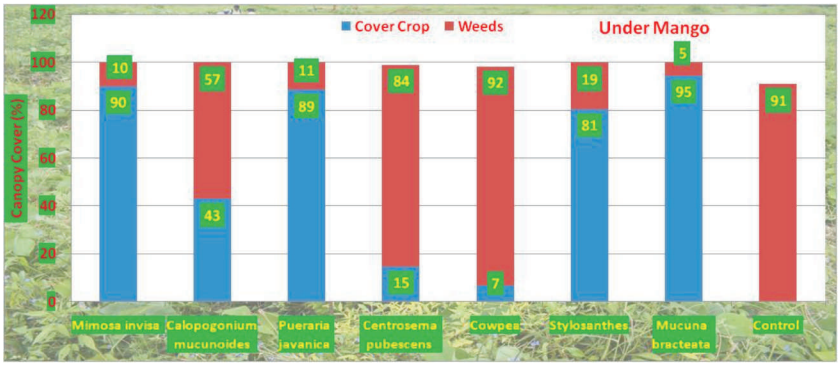


Fig.- 23: Canopy cover of different cover crops under mango plantation

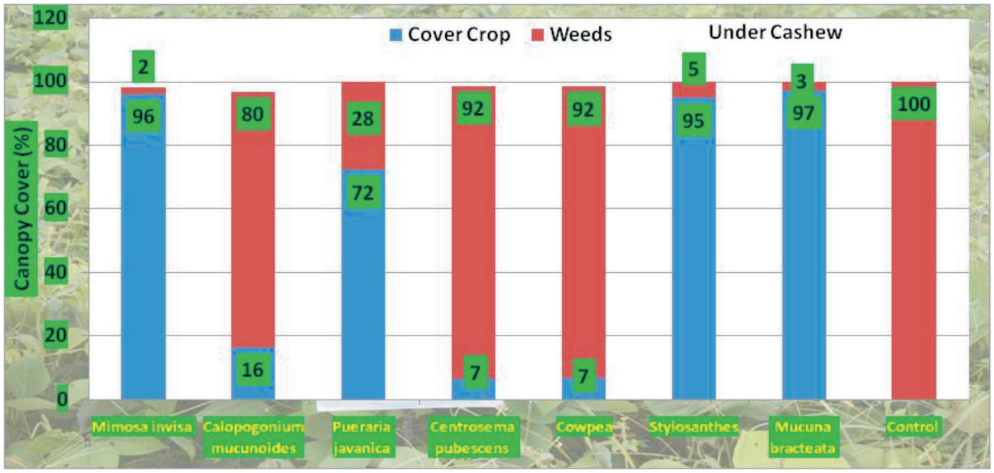


Fig. -24: Canopy cover of different cover crops under mango plantation

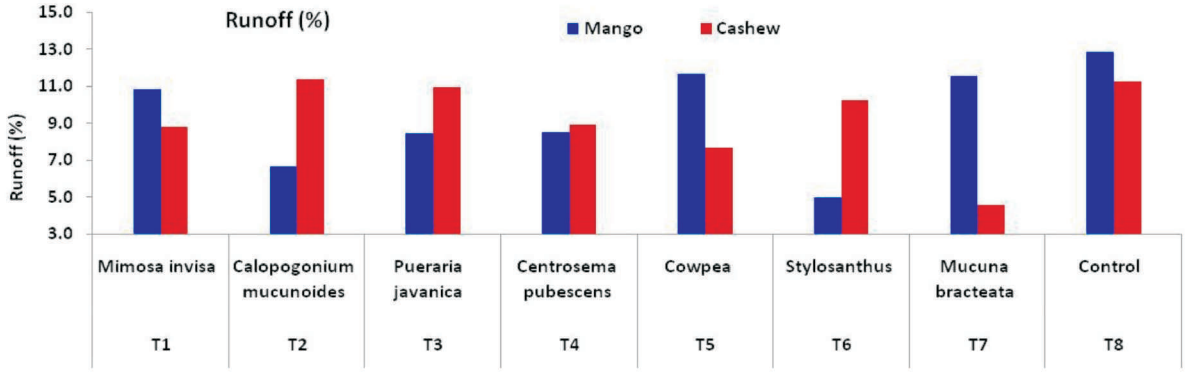


Fig.-25: Runoff under different cover crops in mango and cashew during 2017

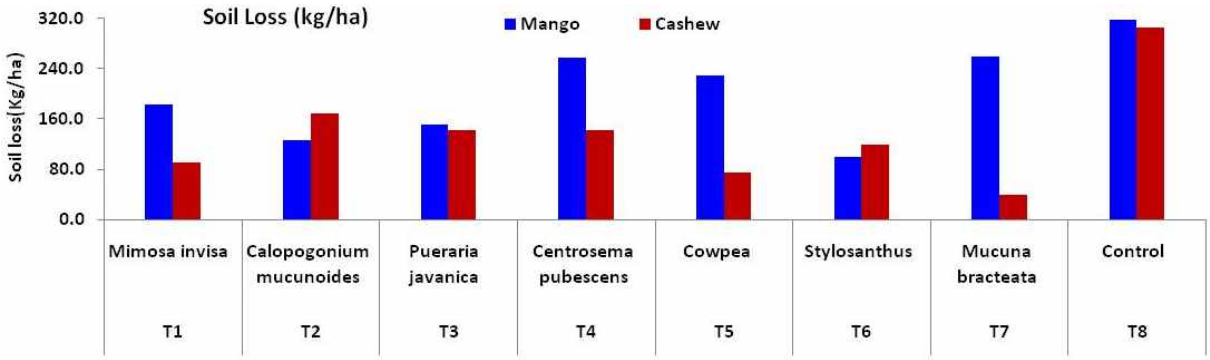


Fig. -26: Runoff under different cover crops in mango and cashew during 2017

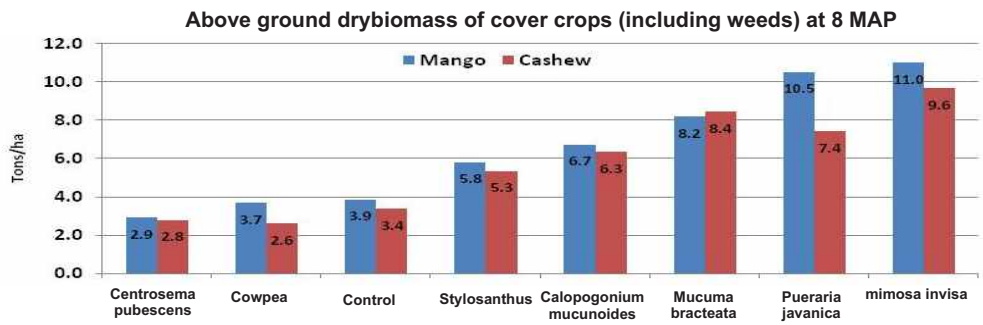


Fig. -27: Above ground dry biomass of different treatments in mango and cashew plantation

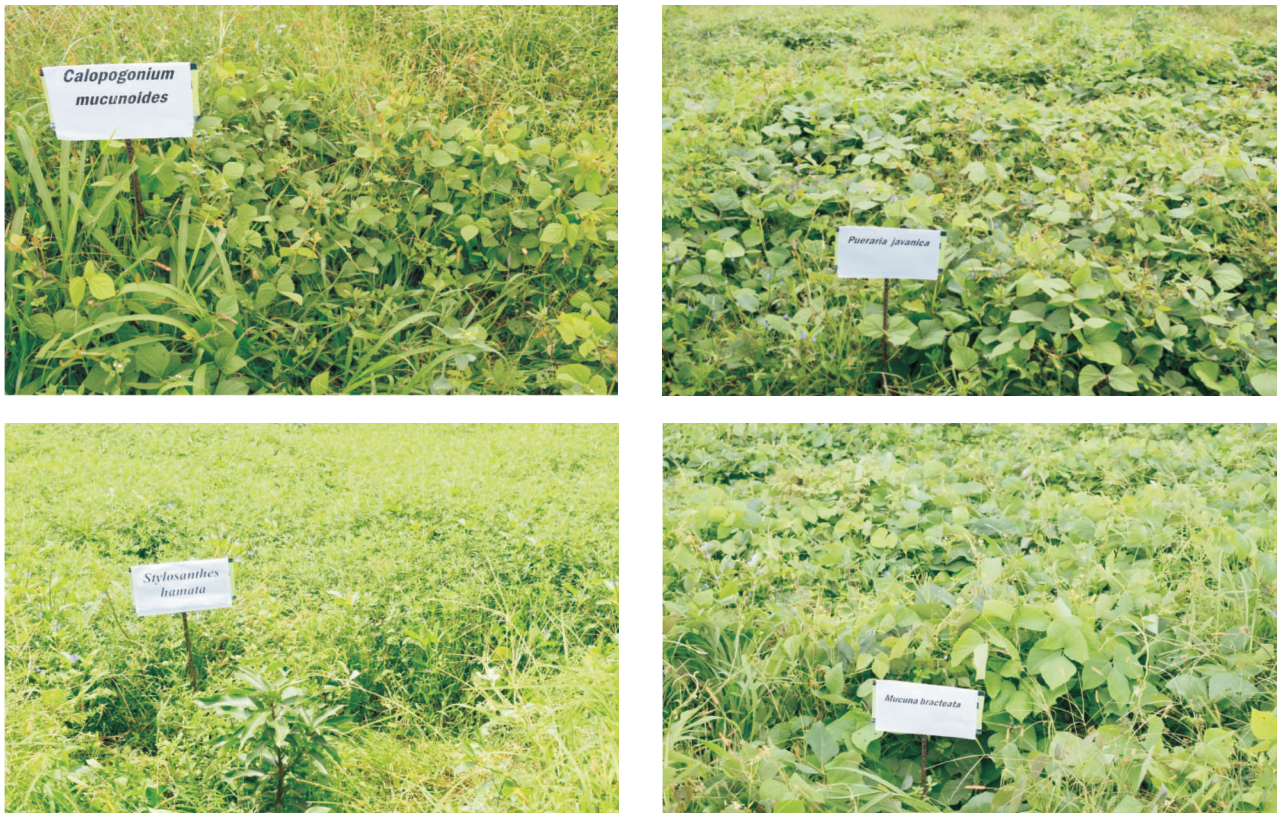


Fig.-28: Growth of different cover crops in mango and cashew field.

Plant growth - MAS

Plant growth - 6 MAS

Early flowering observed in CA-3

Field Progeny Evaluation Trial

Fig.- 29. Establishment of field progeny evaluation trail with 30 genotypes of cassia auriculata

Evaluation, characterization and development of elite genotypes of cassia auriculata for cultivation under arid and semi-regions (S. Kala, H. R. Meena, and I. Rashmi –Kota)

C.auriculata is one among the multipurpose medicinal shrub species has not been utilized effectively. The objective of the project was to identify potential *C.auriculata* genotypes for cultivation and resource conservation in non-arable lands. The main objective of the current year is to evaluate and identify the superior genotypes/ seed source of *Cassia auriculata* under nursery and field condition using plant traits. Basic parameters of average plant height, collar diameter and number of stem /plant, fresh weight of flower yield/plant, pod yield /plant, seed yield /plant were recorded. The assembled genotypes biometric traits viz., plant height (avg. mean range varies from 1.16 m to 2.15 m), collar diameter (avg. mean range varies from 18.15 mm to 28.25 mm), no. of stems /plant (avg. mean range varies from 5 to 12) and seed weight (range varies from 3.14 g to 4.34 g). Plant morphometric and biochemical observations were also recorded for further analysis on phenotypic and genotypic characterization (Fig.29).

Effect of shade trees on productivity and soil health in rejuvenated tea plantations in Nilgiris (R. Ragupathy and K. Rajan-Udhagamandalam)

An experiment on effect of shade trees on the yield of tea and soil health involving *Grevillearobusta*and the *Morusalba* was initiated during 2012 in the research farm. From 2016 onwards observational tea yield under different shade trees were carried out in the farmersfields.Orahalli in Kotagiri Taluk in Nilgiri district was selected for the study in the farmers field. The treatments are Tea + Silveroak, Tea +Morus and Tea only, The collected data at Orahalli near Kotagiri on growth parameters and on soil fertility are presented in table 15&16.

Table -15: Growth rate of tea and shade trees and the yield

Treatment	Month	Tea	Shade tree	Yield of tea (t ha^{-1}one plucking)
		Pruned height (m)	Total height (m)	
Tea only	Feb.	0.74	-	2.20
	Dec.	0.74	-	0.75
Tea+Silver oak	Feb.	0.70	9.70	2.00
	Dec.	1.03	15.00	0.75
Tea+Morus	Feb.	0.83	6.00	2.10
	Dec.	0.86	7.50	2.30

Table.-16: Effect of shade trees and tea on soil health

Treatment	Month	pH	EC (dSm^{-1})	OC (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Tea only	Feb	5.17	0.59	3.01	426	12	92
	Dec	4.30	0.03	3.75	75.6	74	740
Tea+ Silveroak	Feb	4.35	0.66	5.03	430	18	96
	Dec	4.30	0.01	5.9	147	87	870
Tea+Morus	Feb	4.89	0.49	3.19	396	10	87
	Dec	4.18	0.01	1.6	77.7	65.5	655

Resource utilization and productivity of Dragon fruit based horti-silviculture system under rainfed agro eco-systems of Central Gujarat (V. Kakade, P.R. Bhatnagar, Raj Kumar (till 15.7.2017) and D. Dinesh-Vasad)

An experiment was initiated in 2016 to analyse the resource utilization and productivity of Dragon fruit and *Melia dubia*, to evolve the suitable cropping system under rainfed agro ecosystems of central Gujarat. The initial growth parameters were taken after planting of *Melia dubia*. But, in the month of September, 2016 but the plants of *Melia dubia* were damaged by wild animals. Therefore, replanting of *Melia dubia* was done in the month of June, 2017 and then initial growth parameters including plant height and stem diameter was recorded. The planting of Dragon fruit was done in the month of February, 2017 under different treatments. The four plants of Dragon fruit were planted around one cement pole. After planting, plants were covered with branches of thorny plants and old sari to protect the plants from wild life damage. The plant survival percentage of Dragon fruit and *Melia dubia* was recorded during December, 2017 and ranged between 56.95 to 90.3 % in case of Dragon fruit and 66.66 to 100% in case of *Melia dubia* (Table 17). In experiment 2, the planting of Dragon fruit was done at the spacing of 3 x 3m and four plants were planted per pole in the month of January, 2018(Fig.30&31).

Table -17: Plant survival (%) of Dragon fruit and *Melia dubia* under different treatments

Treatment	Treatment details	Dragon fruit	*Melia dubia*
T1	Natural vegetation	-	-
T2	Dragon fruit + *Melia dubia* + *in-situ* moisture conservation measure (Half-moon) (3x3m)	90.3	100
T3	Dragon fruit + *Melia dubia* (3x3m)	90.3	96.4
T4	*Melia dubia* (3x3m)	-	88.89
T5	Dragon fruit (3x3m)	86.12	-
T6	*Melia dubia* + *in-situ* moisture conservation measure (Half-moon) (3x3m)	-	94.5
T7	Dragon fruit + *in-situ* moisture conservation measure (Half-moon) (3x3m)	80.56	-
T8	Dragon fruit + *Melia dubia* (4x4m)	80.56	83.34
T9	Dragon fruit + *Melia dubia* + *in-situ* moisture conservation measure (Half-moon)	56.95	66.66

Fig. 30 : Measurement of growth parameters in *Melia dubia*

Fig. 31: A view of Dragon fruit project

P. 3 : WATERSHED HYDROLOGICAL FOR CONSERVATION PLANNING

3.1: Hydrological behaviour of land uses and management practices

Evaluation of hydrological behavior and production potential of recommended land use system/practices under different agro-ecological regions of India.(K.K. Sharma, S.K. Dubey, A.K. Parandiyal- AGRA)

Data on rainfall, runoff and soil loss were collected using rain gauge and multislot gauging device to generate hydrological information on hydrological behaviour and production potential from four land use systems such as Agri-Horti/Forestry, Horti. and Agri-Agri.. Area received only 440 mm rainfall during monsoon season of 2017. High rainfall event of 70 mm occurred in the month of July which produced maximum runoff and soil loss. Runoff received from different land use systems such as Horti, Agri-Horti/forestry, Agri-Agri were 17.26 mm (4.00 %), 32.39 mm (7.36%), 39.14 mm (8.89%) and 61.56 mm (13.90%) respectively. Similarly soil loss occurred were 3.91 t/ha, 9.4 t/ha, 10.68 t/ha and 13.72 t/ha, respectively from land use systems such as Horti, Agri-Horti/forestry and Agri-Agri. It has been found that the runoff and soil loss was observed to be minimum in Horti. Block followed by Agri-Horti./Forestry and Agri-Agri. Among all four land uses, the runoff and soil loss was found to be minimum because of presence of vegetation along with Anonla trees, which increased infiltration and reduced runoff velocity. There was no tillage practice followed in horti. Block. The survival of planted seedlings of *Tectona grandis* and *Aegle marmelos* (83.92 and 80% respectively) after two seasons of planting was also very good (Table 1).

Table -1: Detail of survival and growth of the planted seedlings (2018)

Name of species	Survival % till Jan. 2018	Av height (cm.)	CAI in height (%)	Av. CD (cm.)	CAI in CD (%)	Av. DBH (cm.)
Tectona grandis	83.92	387.5	111.46	6.74	76.44	3.88
Aegle marmelos	80.00	115.6	66.27	1.81	34.07	-

Growth of plantation of Sagon and Bel

Evaluation of hydrological behaviour and production potential of recommended landuse systems and practices for Shivalik region (V.K. Bhatt, Pankaj Panwar and Ram Prasad-Chandigarh)

Experimental area is located at village Jenouli, Distt Panchkula (Haryana). It comprises outward sloping terraces. Area has been divided in three different land uses. Upper one is selected for Agri-silvi system, middle one for Agri-horti system and lower one for Agricultural use only. Entire area is rainfed and land is degraded consisting of small pebbles and gravels. During the monsoon season of 2012, 55 plants of different multi- purpose forest species (*Eucalyptus hybrid*, *Bauhinia variegata* and *Terminalia arjuna*) were planted during monsoon season. Growth of plants is being monitored once in each year. Being rainfed area, agriculture crop is taken once in a year. During monsoon season hybrid maize was planted in 0.3 ha area and *kulthi* (lrgume) was planted between horticulture and forest plants in 0.4 ha area. Yield of maize was obtained as 18 q / ha and yield of *kulthi,* was 2.90 q/ha. Each identified land use is being gauged separately through Ramser's samplers in three replications each for monitoring runoff and soil loss. There are total nine Ramser's samplers which are designed to collect 2.5% of runoff and soil loss. Runoff and soil loss analysis indicated that agriculture land use gave mean maximum runoff (16 %) and mean soil loss (125 kg/ha) followed by Agri-horti and Agro-silvi system (Table 2).

Table- 2: Runoff and soil loss from different land uses

Landuse	Rainfall, mm	Runoff, mm (%)	Soil loss, kg/ha
Agri	519.1	102 (16.0)	125
Agri+Horti	519.1	37 (5.3)	63
Agri+Forest	519.1	47 (7.3)	42

Evaluation of hydrological behaviour and production potential of recommended land use systems/ practices under different agro-ecological regions of India (Shakir Ali, S. Kala, B.L. Mina and H. R. Meena-Kot**a**)

Semi-arid rainfed region of south-eastern Rajasthan experiences highly erratic rainfall coupled with extremes of temperature, limited availability of surface runoff, soil moisture. Uncertainty in rainfed crop production associated with these constraints restricts input levels and resource constrained farmers are compelled to practice subsistence farming as degrading cropping fields with multi directional slope. In order to develop a sustainable and efficient land system there is need to systematically investigate management induced changes in land quality and its hydrological behavior. Keeping this in view, a project has been initiated during 2011-12 to generate information on hydrological behavior and production potential of agricultural crop (rainfed soybean), agri-horti.(soybean+ Bael) and silvi-pastoral(*Neem + Cenchrus ciliaris)* in the semi-arid region of south-eastern Rajasthan. The experimental setup has been established in Dhoti watershed. During 2012-13, three land use systems namely; T_1-Rainfed soybean (Agriculture), T_2-Soybean+ Bael (*Aegle marmelos*) (Agri-horticulture): and T_3-*Neem(Azadirachta indica) + Cenchrus ciliaris (*Silvi-pasture) *were* imposed over the field size plots(each 0.10 ha) in a topo-sequence. The silvi-pastoral was in upper plot, agri-horti in middle plot and agricultural crop in the lower plot. The slope of the plots ranged from 1.0 to 1.5%. The sowing of soybean in the experimental plot was completed on 03/7/1016, while planting of trees and grass was done during 2012. During the 2017, area received 886.3 mm rainfall through 39 events. A total 8 runoff producing events were recorded with 640.4 mm rainfall. The runoff generating potentials of the land use systems were $T_2(9.9) < T_1(7.6) < T_3$(6.1% of monsoon season's rainfalls) and the corresponding sediment yields was of 6.7, 5.2 and 3.9 t/ha-yr, respectively. The yield of rainfed soybean in T_1 and T_2 treatments were recorded 1.343 and 1.053 t/ha, respectively. However, grass yield under the treatment T_3 was 9.11t ha^{-1}. The height and collar diameter of the bel and neem plantation were 1.35 and 3.6; and 3.27m and 8.8cm, respectively.

Hydrologic systems analysis across multiple spatial scales and its implications on Hydrologic processes in sub-humid catchment of Eastern Ghats High Land Region of Odisha (Ch. J. Dash, P.P. Adhikary, D. C.Sahoo and N.M.Alam-Koraput)

In this project, emphasis is given to identify the pattern and relationship between runoff and soil loss process over a range of spatial scale in Eastern Ghats High Lands Region of Odisha. The study area is Sakirput watershed, Semiliguda block, Koraput district, having an area of 125 ha and slope varies 1 to 62% and the watershed consists of three types of land use such as Agriculture, Forest, and Scrub. The mean runoff coefficient was observed to highest for barren land. Scrub having stony soil produced higher runoff coefficient than agriculture land use, however scrub with small pebbles produced lesser runoff coefficient then forest land use (though good cover, but soil with big rocks) irrespective of plot length. The average runoff coefficient ranged between 4.0 and 25.1% for agricultural land use, 1.26 and 7.42 % for scrub (pebbles), 1.43 and 5.66% for

forest land use, 8.61 and 50.62% for barren land uses. AMC plays an important role in producing runoff, and it was observed that 6.3 mm, 6.8 mm, and 28.1 mm rainfall required producing runoff under barren, agriculture, scrub and forest land use, respectively (Fig.1-2).

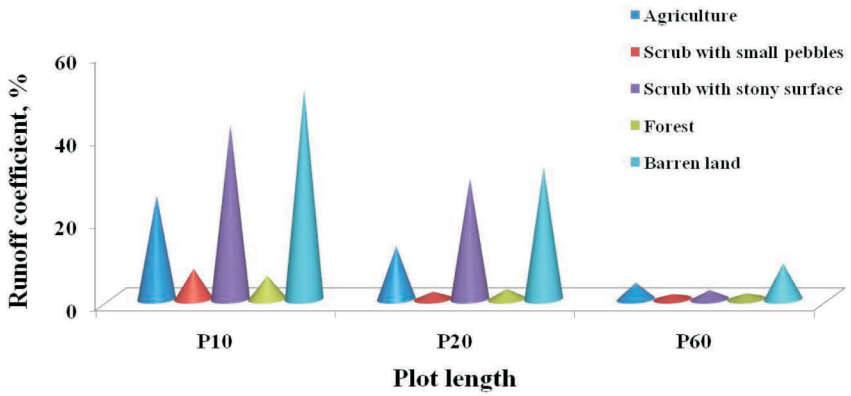


Fig. -1. Relationship between runoff coefficient and plot length under different land uses

Plot length	AMC I	AMC II	AMC III
Agriculture land use			
P10	>26.3 mm	>=6.8 mm	>=6.8 mm
P20	>26.3 mm	>=7.8 mm	>=7.0 mm
P60	> 26.3 mm	>=7.8 mm	>=7.0 mm

Plot length	AMC I	AMC II	AMC III
Scrub with small pebbles			
P10	>35.7 mm	>=28.1 mm	>=21.2 mm
P20	>35.7 mm	>=28.1 mm	>=21.2 mm
P60	> 35.7 mm	>=28.1 mm	>=21.2 mm

Plot length	AMC I	AMC II	AMC III
Scrub with stony soil			
P10	>6.8 mm	>=6.8 mm	>=6.8 mm
P20	>6.8 mm	>=6.8 mm	>=7.0 mm
P60	> 7.0 mm	>=6.8 mm	>=7.0 mm

Plot length	AMC I	AMC II	AMC III
Forest			
P10	>35.7 mm	>=28.1 mm	>=21.2 mm
P20	>35.7 mm	>=28.1 mm	>=21.2 mm
P60	> 42.7 mm	>=28.1 mm	>=21.2 mm

Plot length	AMC I	AMC II	AMC III
Barren land			
P10	>6.8 mm	>=6.3 mm	>=6.3 mm
P20	>6.8 mm	>=6.8 mm	>=6.8 mm
P60	> 6.8 mm	>=6.8 mm	>=6.8 mm

Fig. -2. Threshold rainfall to create runoff under different plot length and land uses

P.3.2. Water Harvesting, Groundwater Recharge and Management

Development and rejuvenation of natural springs through soil and water conservation measures (U.K. Maurya, Ambrish Kumar, Santosh Kumar Rai and S.K. Bartarya-D. Dun)

Experiment was conducted during 2017-18 to study the hydrological behaviour of natural springs in Semalta watershed of Kalsi and Chakrata Block, Dehradun. Data on rainfall from three non-recordable rain gauge stations installed at an altitude of

1250-2250m amsl were measured and collected at each event, whereas, springs water collected in the field at specified sites and their pH and EC were measured in the field. pH of spring indicated neutral to mildly alkaline in reaction whereas EC varies from very slightly to slightly saline. pH and EC of spring water were mildly alkaline, non-saline and is good for irrigation and drinking purposes. Discharge rate of springs indicated a gradual decrease in the post monsoon period; however, there is variation during the monsoon period (Fig.3).

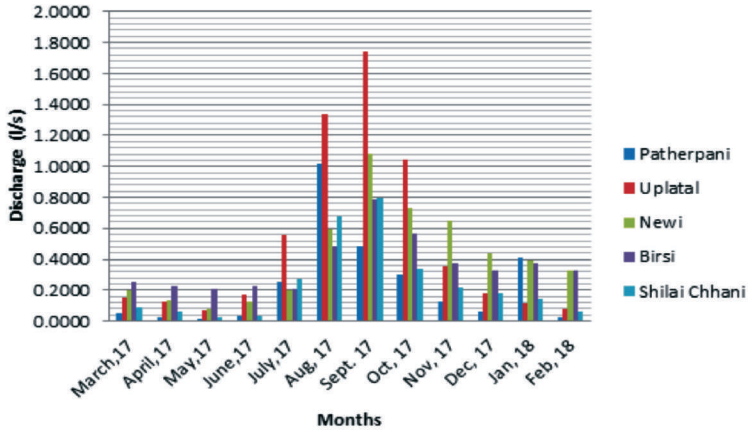


Fig-3. Monthly average discharge variation of springs

The discharge measurement indicated that all the springs responded instantaneously to the precipitation events. It was observed that during lean period the high-altitude springs dry-up, whereas low-altitude springs continue to discharge with low rate indicating low-altitude spring discharges were a mixture of groundwater and precipitation, whereas only precipitation contributed to the high - altitude springs. Geomorphic features indicated that most of these springs were originated with residual hills and spring discharges were mostly derived from seepage water. Study indicated the discharge rate at different gauging sites gradually decreases from post monsoon to pre monsoon indicting springs are having single recharge elevation. Cations and anions of rainwater and spring water were analysed for water quality analysis and results were plotted in Pipers Tri-linear diagram for evaluating hydrochemical facies of these water. It was found that spring water is dominantaly Ca-HCO3, Ca-Cl and Na-Cl type, whereas, rainwater is of Ca-Cl type (Fig. 4 a&b).

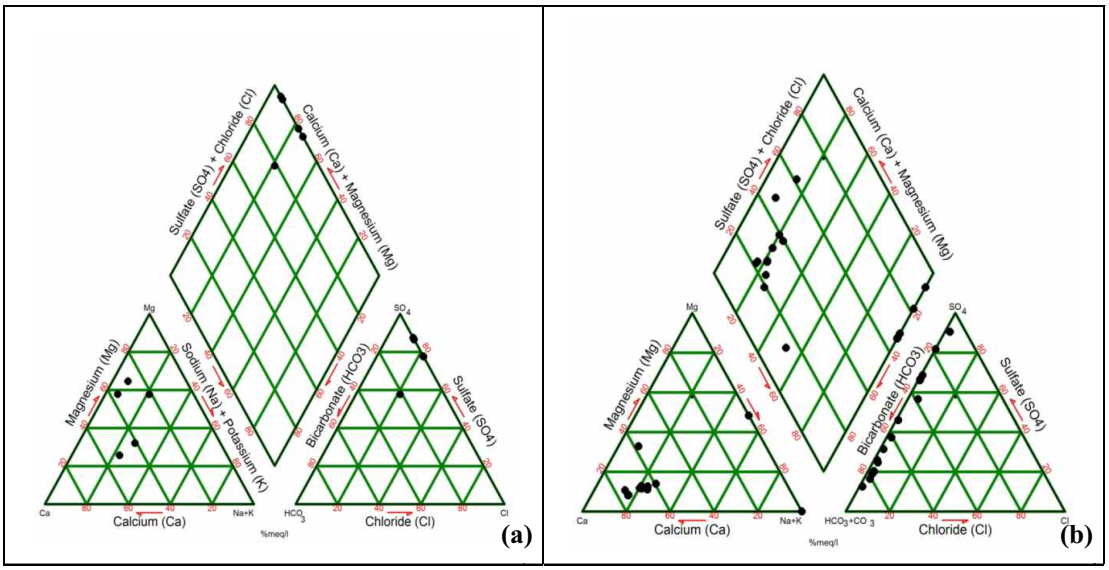


Fig-4. Tri-linear diagram: (a) Rainwater samples➔Ca-Cl type water, (b) Spring water samples➔ Ca-HCO3, Ca-Cl and Na-Cl type water.

Rain water as well as spring water samples were analysed for their stable isotope and established the source, their meteoric affinity and altitude of recharge. Accuracy and reproducibility of stable isotope measurements were done at WIHG laboratory, Dehradun, and it was compared with International water standard of Vienna (VSMOW), and it was found that accuracy level of analysis matches with the International lab standard (Fig.5 a&b).

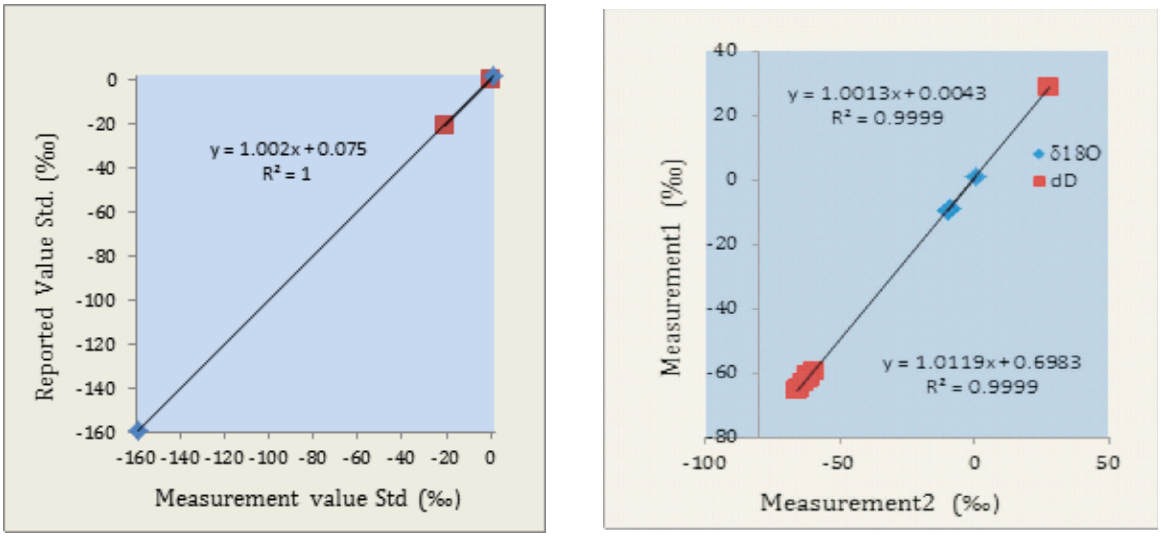


Fig-5. (a) Reported and (b) measured VSMOW standard value in ‰ at WIHG Lab.

Local Meteoric Water Line (LMWL) was established with respect to Global Water Meteoric (GMWL) for Semalta Watershed and a relationship between $\delta^{18}O$ & δD in precipitation and spring water samples were established. It was found that sample points falling close to the Global meteoric water line, indicating that these waters have retained their meteoric affinity and were used as tracers for flow path for all the spring (Fig.6).

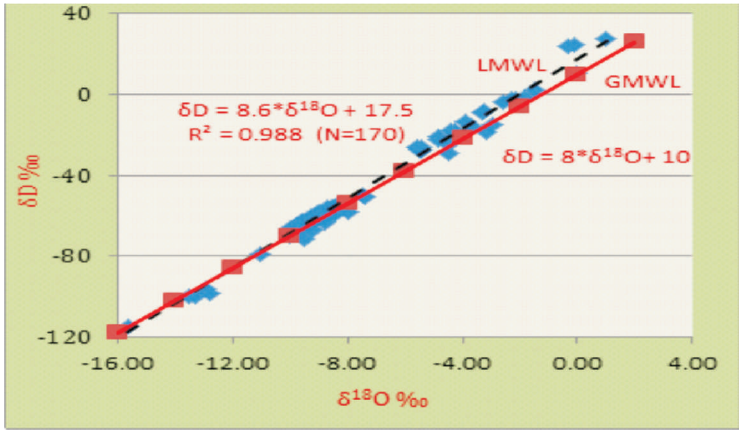


Fig- 6. Relationship between $\delta^{18}O$ & δD in precipitation and spring samples.

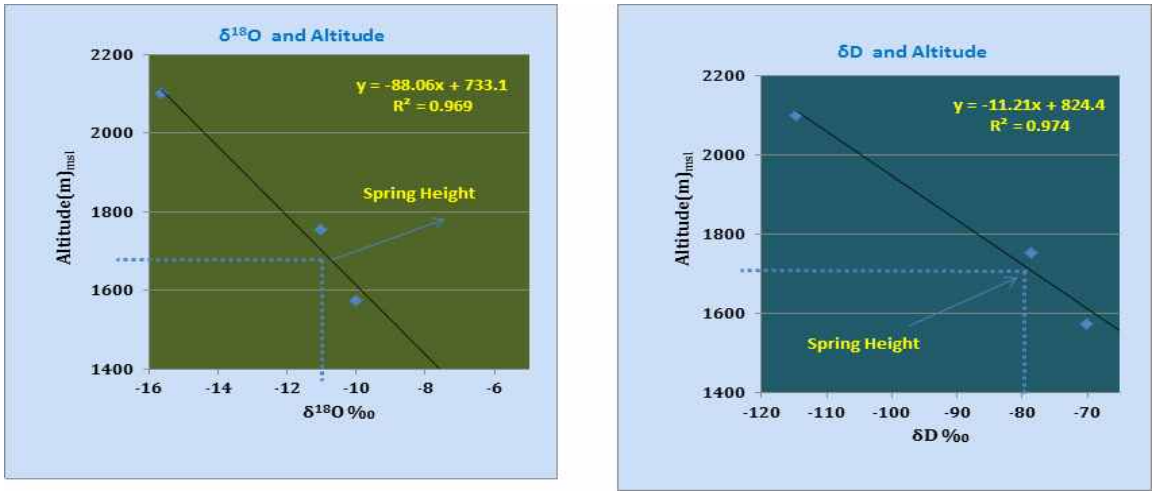


Fig-7 (a) $\delta^{18}O$ vs altitude of rainwater samples, (b) δD vs altitude of rainwater samples from Semalta watershed. Dotted line indicates the recharge altitude of springs.

Altitude effects was calculated as inverse of slope of best-fit line. Isotopic variation shows that sample collected with a total height difference of 500m with variation of ~-1‰ for $\delta^{18}O$ and ~-7 ‰ for δD per 100m rise in altitude suggests that the springs considered in the study may be recharged with waters of more than 1800m, a suitable site for putting structure pertaining water conservation measures (Fig. 7 a & b)and accordingly three sites were selected for making staggered trenching.

CRP on Water (Theme 1): Development and Management of Integrated Water Resources in Different Agro-ecological regions of India (P.R. Ojasvi, Deepak Singh, S.S. Shrimali, K.K. Sharma, R.B. Meena, A.K. Singh, B.S. Naik, H. Biswas, V.K. Bhatt, Sharmishtha Pal, Pankaj Panwar, Monalisha Pramanik, Manish Kumar, Rajeev Ranjan, D.C. Sahoo, Jyoti Dash, . Madhu, G.L. Meena, R.K. Singh, S. Manivanam, V. Kasturi Thilagam, OPS Khola, P.R. Bhatnagar, D. Dinesh)

This project is being implemented by a consortium of seven Institutions covering a country wide study on different aspects of RWH. Assimilation and development of national data base on design rainfall, DEM, LU/LC; hydrologic soil group is being done. 61 statistical distributions have been employed using 57 years of daily rainfall data (1951-2007) for developing design rainfall. So far design rainfall of 1-day maximum, seasonal total at 50%, 65% and 75% probability have been developed (Fig.8). Database of weekly total at 90, 95 and 99% probability, 3-hr rainfall, and 6-hr rainfall will also be developed.

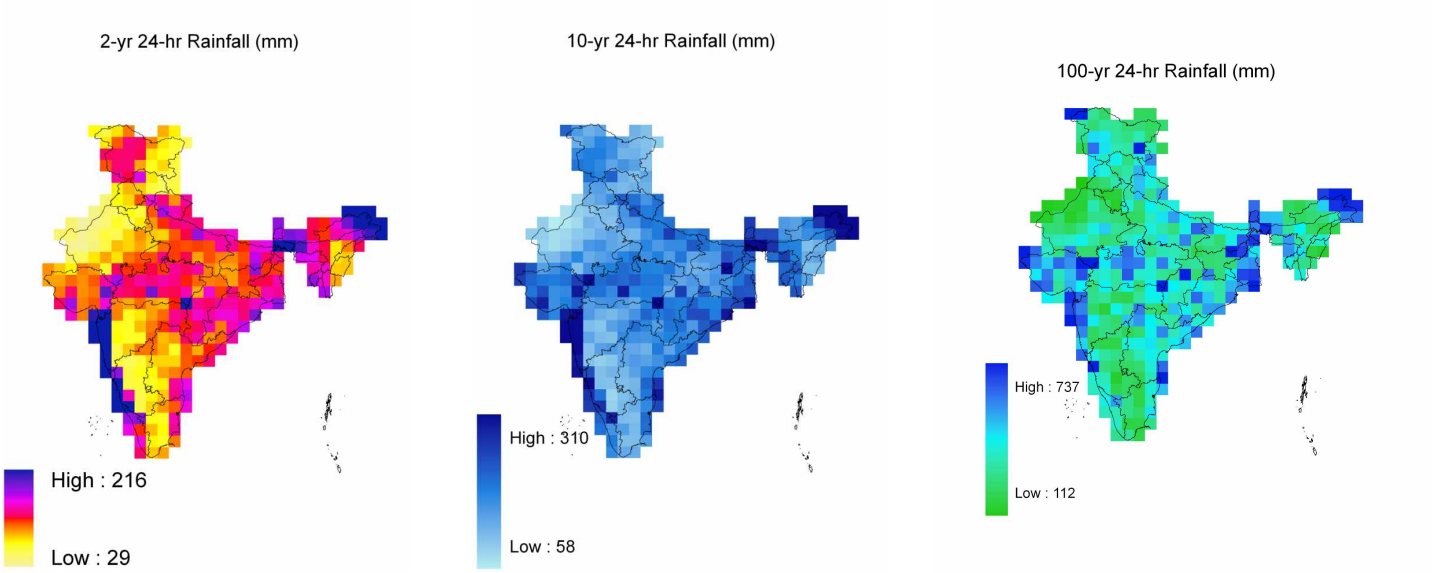


Fig-8-day maximum rainfall for various return periods

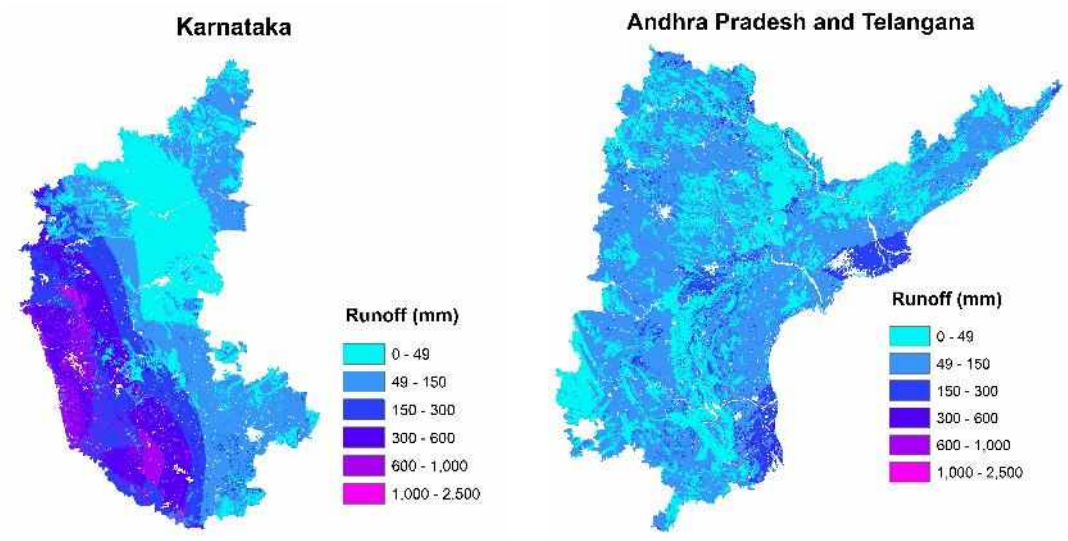


Fig- 9: Rainwater harvesting potential based on the 75% probability rainfall at 30 m resolution

Rainwater harvesting potential at the design rainfall of 75% probability (the criteria used in semi-arid regions for estimating runoff volume) has been worked out for Karnataka, AP and Telangana states (Fig. 9). This data can be used for various decision making related to harvestable runoff volume. For example, on the one ha catchment basis, the total RWH potential of Karnataka state is about 1.74 million ha-m. However, each unit of 900 m^2 would yield average runoff (spatial average) as demonstrated in table-3, in different rainfall zones and taking into account the land cover and soil conditions.

Table- 3: Average harvestable runoff from each unit of 900 m^2 at 75% probability rainfall

Ranfall (mm) (75%)	Runoff (m^3)
464-1010	47
1010-1781	137
1781-2617	269
2617-3485	368
3485-4561	447

Fig-10: A solar powered irrigation system for farm pond at farmers field in Ballari, Karnataka

A system of solar powered micro irrigation system (Fig. 10) is also being standardized for efficient utilization of harvested water in different agro-ecological zone of the country. An energy efficient DC Solar pump system of 3 HP capacity (submergible type having 3000 WP solar PV modules with discharge capacity of 18000 litres per hour) was installed in the field of farmer Sh. Boga Reddy of K.Virapura village under Ballari Taluk with his existing drip irrigation system. Two farm ponds were constructed with total storage capacity 5407 m^3 in farmer's field. The total catchment of these farm ponds is 24 ha area and during rainy season both kharif and Rabi, stream flow/runoff is harvested in the farm pond. This year during Rabi, the farmer had grown chilli and tomato in 3 acres land using solar pump with drip method using farm pond water in place of diesel pump with surface irrigation method (Table4). It has been observed that by using solar pump with drip irrigation method, 545 kWh of energy is saved, Rs 7603/- is saved towards energy (fuel) cost, 357 Kg of CO_2 emission is avoided and net return increased by 55% over his earlier practice.

Table -4: Benefit cost analysis of vegetable cultivation with surface irrigation using diesel pump (pre-scenario) with drip irrigation using solar pump (present scenario).

Crops grown	Surface irrigation using diesel pump (pre-scenario)						Drip irrigation using solar pump (present scenario					
	Area covered (Acre)	Yield (Kg)	Input cost (Rs)	Gross return (Rs)	Net income (Rs)	BC ratio	Area covered (Acre)	Yield (Kg)	Input cost (Rs)	Gross return (Rs)	Net income (Rs)	BC ratio
Chilli (Bydagi variety)	1.75	1750	52500	175000	122500	3.3	1.75	2275	43750	227500	183750	5.2
Tomato (hyb)	1.25	2500	35000	50000	15000	1.4	1.25	3000	30000	60000	30000	2
					137500						213750	
*Chilli @ Rs100/Kg and tomato @ Rs 20/Kg												

Employing system approach on zero energy drip irrigation in bench terrace farming for hill region (Deepak Singh, P. R. Ojasvi, A.C. Rathore- D. Dun)

To study moisture distribution pattern for developing of irrigation scheduling for hilly region under different terraces using low cost drip tap. Drip tape was installed at bench terraces field in such a way that every terrace was receiving irrigation water independently. In 2017-18, the five vegetable crops were planted in the experimental field such as cabbage, brinjal, tomato, capsicum and chilli in the month of December, 2017. The growth parameters of the crops are being taken. The drip system performance at a time of installation was calculated in the form of uniformity coefficient, distribution uniformity and moisture distribution. Variations in uniformity coefficient (UC) and distribution uniformity (DU) are presented in Fig 11 & 13, respectively. Highest UC and DU was observed in the terrace number 4 which was 8 meter below the water source. As pressure head was reduced, UC and DU decreased considerably and the decreasing head trend was observed from terrace 4 to terrace 1. However, performance of drip system under different terraces was more than 90 % that could be rated as good. Results showed that at the beginning of the drip laterals, the uniformity coefficient and distribution uniformity values were more as compared to at the end of the drip laterals within the same lateral line. The maximum discharge was obtained in the terrace number 4 followed by terrace number 3. Whereas, dripper discharge variation was also followed the same decreasing trend from terrace 4 to terrace 1. The two indices UC and DU assume different meanings. The DU shows the condition of the smallest emitter discharge as compared to that of the average discharge, whereas the UC represents the deviation of discharge from its mean value.Fig. 13 show the water distribution below the emitter under different terraces. The maximum soil water content was found in terrace number 4 and the minimum was found in terrace number 1.

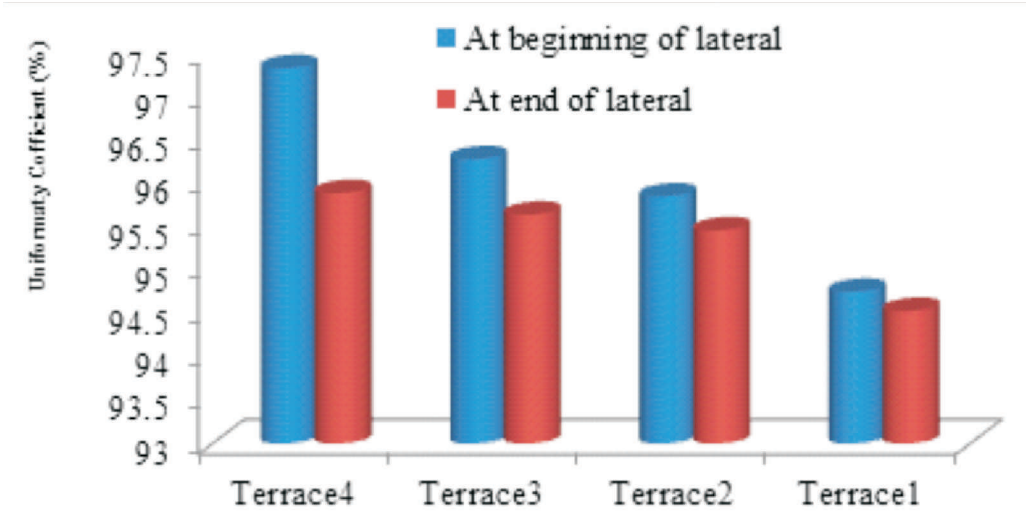


Fig -11. Uniformity coefficient of drip system

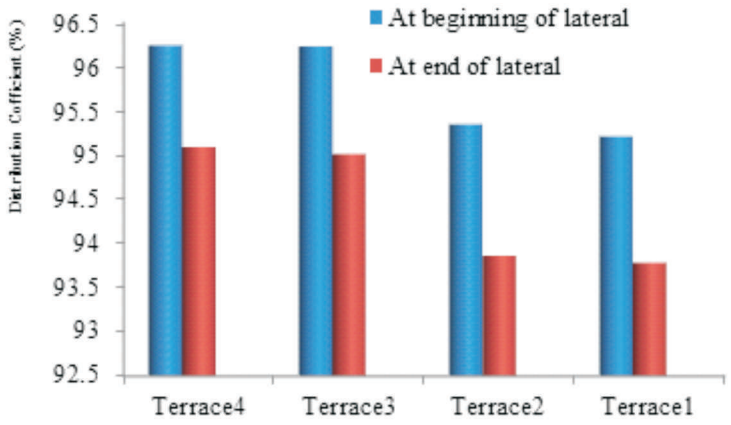


Fig- 12 Distribution uniformity of drip system

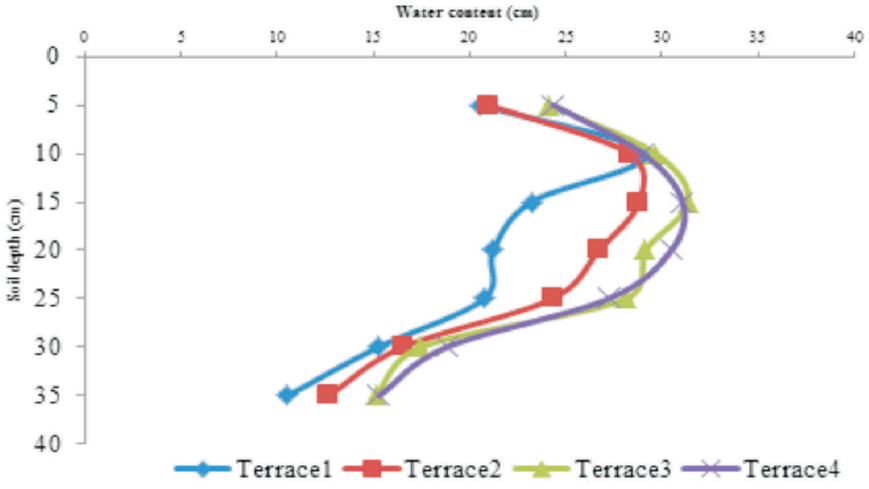


Fig- 13 Soil water distribution under different terraces

Efficient groundwater management for enhancing adaptive capacity to climate change in sugarcane based farming system in Muzaffarnagar district (Ambrish Kumar, U.K. Maurya –D.Dun)

To assess the impact of the water harvesting structures constructed on Harsauli drain, four piezometers were installed at specified locations along the line marked perpendicular to the drain and intersecting near the innovative water harvesting structure (WHS-II) constructed closer to Harsauli village in vicinity of the adopted village – Rasulpur Jaton (plate -1). Pierometers are installed in such a way that they can capture the influence of surface water body on the water table in proximity of the structure to the extent of possibility. Data on water table from all the four piezometers are being collected and compiled for analyse with an objective to observe the impact of water harvesting structure on groundwater. Total 45 water samples were collected from different locations of Hindon (27) and Kali rivers (18). In pre-monsoon season (2017), the lowest pH was observed at Barnawa (6.80) in water samples collected from Hindon river whereas in drains, the lowest pH (6.40) was observed in Titavi sugar mill waste water. Turbidity was found maximum (57.20) at Kinauni site in river water sample whereas maximum turbidity was found in drain carrying emanating from Star paper milll (88.90 NTU) followed by Dhamola nala 85.40 NTU), i.e 8.5 folds higher than the prescribed value of WHO (<10 NTU). Dissolved Oxygen was found nil at many locations due to higher organic load.

In the Kali river water samples, the lowest pH was observed 6.40 at Mansurpur whereas the lowest pH (5.70) was recorded in Mansurpur sugar mill waste water. Likewise, turbidity was found maximum at Mansurpur site i.e. 80.60 in river water samples whereas in drains, maximum turbidity was found in Beghrajpur Industrial drain (184.50.00 NTU) which is 18 folds higher than the prescribed value of WHO (<10 NTU). Dissolved Oxygen was found nil at many locations due to higher organic load. Dissolved Oxygen was found nil at all the drains which is a sign of danger for aquatic life.

Study on pollution status of Yamuna river and its impact on soil and crop health in Western U.P. (Rama Pal, S.K. Dubey, A.K. Singh and R.K. Dubey-AGRA)

The concentrations of eight heavy metals analysed for summer and post-rainy seasons in Agra district at five different sampling sites and some basic statistics are shown in Table 5. The mean concentration of heavy metals in Yamuna water followed the order Zn (1660 μgl^{-1})> Fe (420 μgl^{-1})> Cu (256 μgl^{-1})> Ni (166 μgl^{-1})= Mn (162 μgl^{-1})> Cr (40 μgl^{-1})> Pb (34 μgl^{-1})> Cd (5 μgl^{-1}) in summer and Zn (2480 μgl^{-1})> Fe (608.5 μgl^{-1})> Mn (417 μgl^{-1})> Cu (185.8 μgl^{-1})> Ni (86.6 μgl^{-1})> Cr (71 μgl^{-1})> Pb (12.7 μgl^{-1})> Cd (0.8) in post-rainy season.

Table- 5:- Heavy metal concentrations in river water at different sampling sites and statistical values for mean concentration of various heavy metals.

Heavy metals	Summer							Post-rainy season						
	Concentration (µg/l)					Mean	SD	Concentration (µg/l)					Mean	SD
	A1	A2	A3	A4	A5			A1	A2	A3	A4	A5		
Fe	200	450	540	680	230	420	204.6	252	672	738.4	1059	321.1	608.5	329.2
Pb	20	20	40	60	30	34	16.7	1	2.6	20	30	10	12.7	12.2
Cd	3	4	6	8	4	5	2	0.0	0.0	0.0	4.0	0.0	0.8	1.8
Zn	1200	1500	1800	2000	1660	1632	303.5	1440	1950	2700	4400	1920	2482.0	634.1
Cr	20	20	50	80	30	40	25.5	30	32	85	160	48	71.0	54.4
Cu	150	180	240	570	140	256	179.8	100	120	167	430	112	185.8	138.8
Ni	120	150	180	230	150	166	41.6	20	87	102	156	68	86.6	49.6
Mn	100	130	180	260	140	162	61.8	220	299	450	780	336	417.0	219.2

The concentration of all heavy metals were highest at A4 site because it is positioned downstream of the biggest drain of Agra i.e., Fort Drain which carried waste discharged from most of the chemical and fertilizer industries and residential areas of the city. Except Zn-Cu-Mn in summer and Zn-Cu in post-rainy season, all other heavy metals inside the municipality zone were above maximum permissible limits for drinking water quality given by BIS (2012). The total five sites were fixed inside the Mathura district for Yamuna river water sample collection and analysis for heavy metal content (Fig. 14). The concentrations of eight heavy metals analysed for summer in Mathura district and some basic statistics are shown in Table 6.

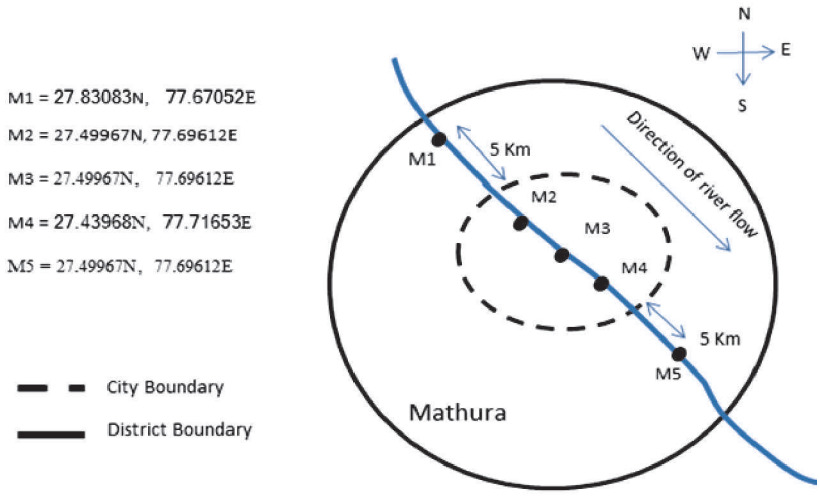


Fig- 14. Schematic representation of five sampling sites along Yamuna river stretch in Mathura

The mean concentration of heavy metals in Yamuna water followed the order Zn (1860 μgl^{-1})> Fe (1222 μgl^{-1})> Pb (656 μgl^{-1})> Cd (254 μgl^{-1})= Mn (158 μgl^{-1})> Cu (116 μgl^{-1})> Ni (96 μgl^{-1})> Cr (70 μgl^{-1}). The concentrations of all heavy metals increased continuously from M1 to M4 sites but decreased considerably at M5 which may be due to the fact that M5 site being located 5 Km downstream of municipality boundary of the city, therefore, the distance provided sufficient time for heavy metals to settle down from dissolved phase to the bed sediments of river due to precipitation and sorption.

Table 6:- Heavy metal concentrations in river water at different sampling sites in Mathura district and statistical values

Heavy metals	Concentration (µg/l)						
	M1	M2	M3	M4	M5	Mean	SD
Fe	460	670	1890	2580	510	1222	959
Pb	320	450	670	1120	720	656	306
Cd	30	50	460	680	50	254	298
Zn	1700	1900	2100	2400	1200	1860	450
Cr	40	50	80	120	60	70	31
Cu	50	75	130	235	90	116	72
Ni	85	95	110	115	75	96	16
Mn	80	160	180	250	120	158	64

The concentration of all heavy metals were highest at M4 site because it is positioned downstream of all the municipal drains of Mathura which carry waste discharged from most of the fertilizer and chemical industries and residential areas of the city. Heavy metals viz., Fe, Pb, Ni and Cr were found within maximum permissible limits for irrigation water quality at all sites. Whereas other heavy metals were above maximum permissible limits for irrigation water quality i.e., Cd at all sites, Zn at M3 and M4, Cu & Mn at M4. The seasonal variations in concentrations of six heavy metals **(**Pd, Cd, Fe, Cr, Cu and Zn**)** estimated at four sampling sites (Fig. 15) along river Yamuna, Etawah is depicted in Table 7

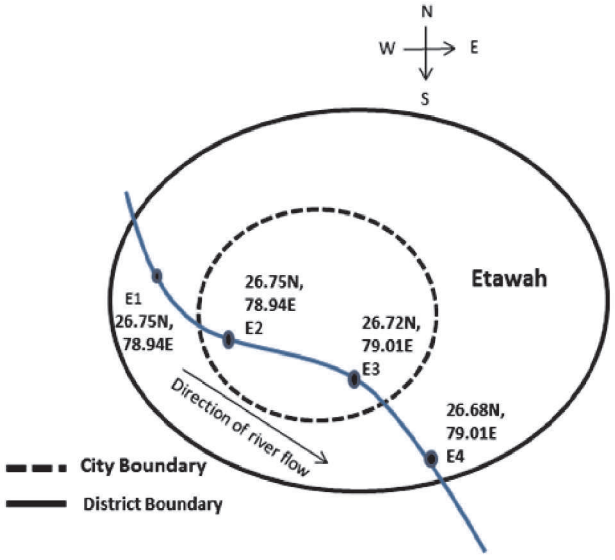


Fig. -15. Schematic representation of five sampling sites along Yamuna river stretch in Etawah

The mean concentration of heavy metals analyzed in the river water samples showed the order of Fe (1237.25 µg/l) > Pb (356 µg/l)> Zn (316.75 µg/l)> Cd (176.25 µg/l)> Cr (139.25 µg/l)> Cu (72.50 µg/l) in summer and Fe (1600 µg/l)> Zn (468.5 µg/l) > Cr (92 µg/l)> Pb (63.75 µg/l)> Cd (46.75 µg/l)> Cu(17.25 µg/l) in post-rainy season. Pb, Fe, Zn and Cu were present within permissible limits as per irrigation water quality standards, whereas, Cd and Cr were above critical limits during both the seasons except at E1 site during post-rainy season. Cd was 6 to 32 times higher than permissible limit in summer and 1.3 to 9 times in post-rainy season. Similarly, Cr was 1.87 to 2.2 times higher than maximum permissible limit in summer and 1.1 to 1.45 times higher in post-rainy season. All the heavy metals had highest concentrations at E2 site in both the seasons as it is present downstream of the sewage entry into river. Whereas, at E3 and E4 sites concentration of heavy metals decreased.

Table -7: Seasonal concentration of heavy metals in Yamuna river water at different sampling sites in Etawah district.

Heavy metals	Summer						Post-rainy season					
	Concentration (µg/l)				Mean	SD*	Concentration (µg/l)				Mean	SD*
	E1	E2	E3	E4			E1	E2	E3	E4		
Pb	128	621	544	131	356	263.42	12	108	90	45	63.75	43.5
Cd	60	321	201	123	176.25	112.42	8	90	76	13	46.75	42.29
Fe	980	1902	1200	867	1237.25	464.23	1234	2323	1609	1234	1600	513.39
Cr	50	220	187	100	139.25	78.12	34	145	111	78	92	47.36
Cu	67	112	81	30	72.5	34	4	30	23	12	17.25	11.528
Zn	230	460	321	256	316.75	11.53	290	460	321	256	468.5	174.98

Evaluation of direct recharge filter for revival of defunct and low yielding bore well vis-à-vis augmentation of ground water table in semi-arid region of Karnataka (B.S. Naik and S.L. Patil-Ballary)

To know the impact of recharge filters, two types of recharge filters were constructed around the existing dry/defunct and low yielding bore wells in farmers' fields. The construction of recharge filters involves excavation of pits sized 5 m × 5 m × 1.5 m (Type 1) and 3 m × 3 m × 3 m (Type 2) around the bore wells centering the casing pipes. In the project, a total of seven (Type 1: 4 nos and Type 2: 3 nos) recharge filters were constructed at selected sites of bore wells in the farmers' fields at Netranahalli and Meramannahalli villages in Molakalmur taluk of Chitradurga district (Fig 16). The transmissivity, specific capacity and yield of bore wells ranged from 9.84 m^2 day^{-1} to 15.6 m^2 day^{-1}, 9.84 lpm m^{-1} to 15.6 lpm m^{-1} and 8.10 to 33.3 lp m^{-1}, respectively. The lithology includes shallow aquifers of alluvium up to 10 m and weathered zones of gneiss and granite occur between the depths of 10 to 25 m below ground level (bgl). Deeper aquifers of jointed and fractured gneiss, granites and schists occur between the depths of 30 to 197 m bgl. Out of 7 bore wells (including two constructed during January 2018), only four bore wells are working and remaining three are abandoned due to non availability of ground water recharge. The drying of bore wells is attributed to the continuous drought with below normal ill distribution rainfall of 456 mm during 2015 and 274 mm during 2016 and over exploitation of ground water. The irrigated area during 2017-18 under bore wells 1 and 3 with recharge filters is 1.0 and 1.5 acres, respectively further the water level increased from 180' (2015) to 220' (January 2018) and 170' during 2012 to 203' during January 2018, respective bore wells. In bore wells 1 and 3, there was increase in water yield from July to November due to more rainfall and thereafter it decreased due no rainfall fell (Fig. 17). The catchment area and runoff expected from these catchments in respect of bore wells (1 to 7) varies from 1.5 to 2.5 acres, and 250 to 417 m^3, respectively. The casing diameter, pump capacity and depth variation of bore wells are 6" each, 5 hp each and 240 to 310 feet from ground level. The water level at the time of construction in all 7 bore wells varied from 60 to 320'. The water level on 12.1.18 in respect of bore wells 1 and 3 are 40' and 33' less as compared to their initial level at the time of construction. Accordingly, in case of bore well 6 and 7, the water level recorded on 14.2.18 are 16' and 35' less as compared to initial level at the time construction. The daily pumping hour in respect of bore well 1, 3, 6 and 7 varies between 4 to 6 hours daily. During 2017 farmers cultivated maize and sorghum under bore well 1 and 3 and produced maize grain yield of 840 kg in 0.5 acre and 1500 kg of sorghum in 0.5 acre under bore 1 and 4320 kg of sorghum in 1.5 acre under bore well 3. Recharge filters for borewells 6 and 7 are constructed during January 2018. In addition other detail characteristics of bore wells with recharge filter i.e. catchment, runoff, diameter of casing pipe, total depth, water level, pumping hours, area irrigated, crops cultivated and yield are depicted in Table 8. The water samples from the bore wells are tested and found suitable for irrigation as the **residual sodium carbonate** (RSC) values are normal (Table 9). Although the bore wells water is marginal with respect to salinity levels, they can be used as protective irrigation during summer and at scarcity during rainy and post rainy seasons under the red soils.

Estimation of water budget components for predominant land uses of south-eastern Rajasthan for conservation planning (G.L. Meena, R.K. Singh and H. R. Meena -Kota)

The project was initiated during April 2010 for estimation of water budget components for predominant land uses of south eastern Rajasthan. Two years were kept for preparation of experimental plot and calibration of plots. During 2012-13 six land use systems were i.e.T_1- Agriculture- Rainfed soybean , T_2- Agri-horticulture: Soybean+ Sapota (*Manilkara achras*), T_3- Horti-Pastoral: *Emblica officinalis +Cenchrus ciliaris,* T_4-Pasture: *Cenchrus ciliaris* ,T_5-Silviculture: *Acacia nilotica* plantation, and T_6- Silvi-pasture: *Acacia nilotica + Cenchrus ciliaris were* implemented in 0.81 ha area. Eighteen numbers of plots of 15x30 m each were taken for six land use systems. During 2017, the area received an annual rainfall of 495.40 mm in 27 events having monsoon rainfall of 463.00 mm in 23 events. During period, total 06 runoff producing events were recorded

Table-8: Characteristics of bore wells selected for recharge through recharge filters in Netranahalli watershed

Parameters	Bore well No. 1 (Sh. Papaiah)	Bore well No. 2 (Sh. Nagraj)	Bore well No. 3 (Sh. Boraiah)	Bore well No. 4 (Smt. Ratnamma)	Bore well No. 5 (Sh. Pallaiah)	Bore well No. 6* (Sh. Yubraj)	Bore well No. 7* (Sh. Oblesh)
Catchment area (acre)	2.5	1.5	2.25	2	2.5	2	2.5
Runoff from catchment (m^3)	417	250	376	334	417	334	417
Casing dia.(inch)	6	6	6	6	6	6	6
Depth (feet)	300	300	320	240	260	150	180
Water level at the time construction (feet)	180 (2015)	165 (2010)	170 (2012)	205 (2013)	220 (2010)	60 (2015)	70 (2015)
Present water level (feet)	220 (12-1-18)	-	203 (12-1-18)	-	-	76 (14-2-18)	105 (14-2-18)
Daily pumping hours (h)	4	-	4	-	-	6	6
Area under irrigation earlier (acres)	2	2	2.5	2.5	1.5	1.5	1.75
Present area under irrigation (acres)	1	-	1.5	-	-	1.5	1.75
Crops cultivated under irrigation with yield	Maize (0.5 acre, 840 kg) and sorghum (0.5 acre, 1500 kg)	Not under operation -	Sorghum (1.5 acre) (4320 kg)	Not under operation	Not under operation	Tomato and chilli	Tomato and chilli

*Recently constructed

Table -9: Water quality of bore wells

Bore well	EC (dS/m)	pH	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	K (meq/l)	Cl (meq/l)	CO_3 (meq/l)	HCO_3 (meq/l)	SO_4 (meq/l)
1	1.6	7.8	5.7	3.2	2.5	0.1	5.9	0.1	3.4	0.7
3	1.9	7.9	6.2	2.9	2.5	0.1	5.1	0.1	3.6	0.8
6	1.6	7.7	6.3	3.1	3.0	0.1	5.7	0.2	4.1	0.9
7	1.4	7.6	5.4	2.8	2.8	0.0	4.5	0.2	3.9	0.8

with 291.00 mm rainfall (Table 10). The runoff generation behavior of the selected land use systems was T_4 (13.30%) < T_3 (22.15%) < T_1 (22.30%) < T_2 (23.40%) < T_5 (24.52%) < T_6 (28.42%) while the sediment yield (Table 2) from the selected land use systems followed the trend as T_4 (0.527 ton/ha) < T_3 (0.613 ton/ha) < T_6 (0.897 ton/ha) < T_5 (1.039 ton/ha) < T_2 (1.720 ton/ha) < T_1 (2.677 ton/ha) which follow same trend over the previous year results. Except agricultural land uses, all the selected systems allowed a very less soil loss from the field (Table 11). The highest sediment yield from the agricultural treatments (T_1 & T_2) could be attributed to the soil disturbance due to the agricultural activities like ploughing, harrowing, sowing, hoeing and weeding etc. It was observed that in case of the runoff and soil loss, the Pasture treatments (T_3 & T_4) behaves in positively correlation way. Although the Silvi-pasture land use (T_6) also have grass as a component but after seven years of plantation the grass is not allowed to flourish by *Acasia nilotica* plants. Thus the Cenchrus ciliaris lost it influence on runoff and soil loss generation behavior of the system. Finally the T_5 and T_6 are behaving in same way after seven years of

Stage 1 : Excavation of pit

Stage 2: Stone filling in pit

Stage 3 : Spreading nylon mesh over stone layer

Stage 4 : Sand filling over nylon mesh

Fig-16. Stages during Recharge filtre consturction in farmers field

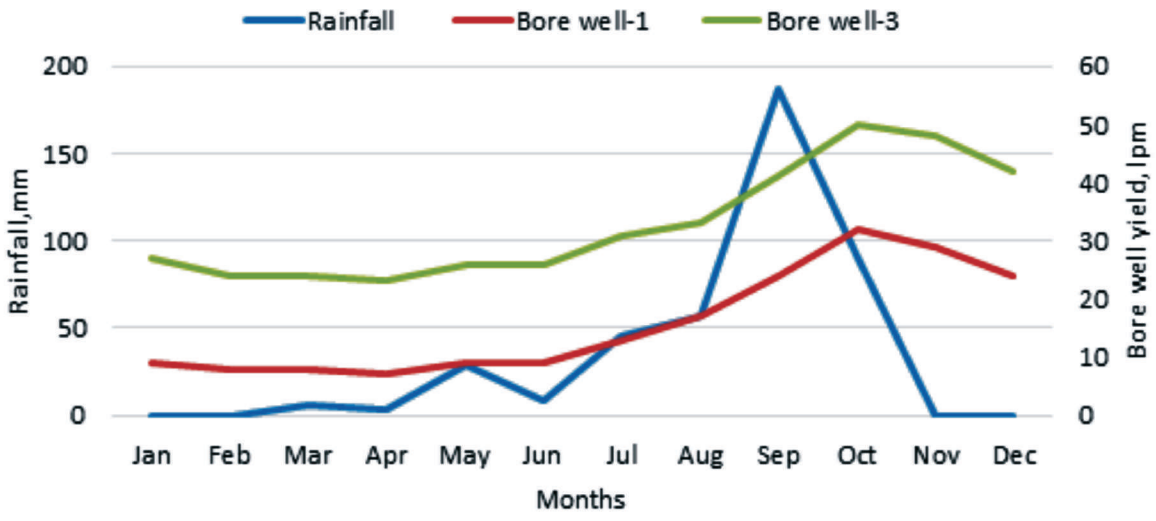


Fig. 17. Trend of rainfall and bore well yield during 2017

completion. The influence of selected land use systems on moisture retention (from saturation to wilting point presser bar) characteristics of the black soils of semi-arid region is presented in Fig 18.

Table- 10: Rainfall-runoff behaviour of different predominant land uses in South-Eastern Rajasthan

Date	Rainfall (mm)	Runoff (per cent) generated from selected land uses					
		T1	T2	T3	T4	T5	T6
28/6/2017	56.20	12.98	10.10	10.82	13.45	23.80	14.43
29/6/2017	16.60	17.09	29.30	21.98	22.05	21.98	41.52
8/8/2017	97.80	28.60	25.28	20.73	21.58	26.94	29.43
9/8/2017	91.80	15.06	23.40	24.29	13.10	23.85	29.15
10/8/2017	14.40	59.12	61.93	67.56	18.34	25.34	59.12
27/8/2017	14.20	31.40	17.13	17.13	6.25	17.13	25.69
Standard Error		7.05	7.35	8.32	2.47	1.39	6.27
Standard Deviation		17.26	18.00	20.38	6.05	3.40	15.36
Mean		27.38	27.86	27.08	15.79	23.17	33.22
Total	291.00	22.30	23.40	22.15	13.30	24.52	28.42
Annual	495.40	13.10	13.75	13.01	16.86	14.40	16.69
Seasonal	463.00	14.02	14.71	13.92	18.04	15.41	17.86

Table- 11: Soil loss behavior of different predominant land uses in South-Eastern Rajasthan.

Date	Rainfall (mm)	Sediment yield (ton ha^{-1} $year^{-1}$)					
		T1	T2	T3	T4	T5	T6
28/6/2017	56.20	0.46	0.39	0.07	0.04	0.12	0.08
29/6/2017	16.60	0.17	0.32	0.12	0.06	0.28	0.18
8/8/2017	97.80	0.42	0.24	0.07	0.16	0.37	0.33
9/8/2017	91.80	0.11	0.19	0.12	0.18	0.17	0.19
10/8/2017	14.40	1.39	0.56	0.22	0.06	0.04	0.11
27/8/2017	14.20	0.11	0.03	0.01	0.02	0.05	0.02
	SE	0.20	0.07	0.03	0.03	0.05	0.04
	SD	0.49	0.18	0.07	0.07	0.13	0.11
	Mean	0.45	0.29	0.10	0.09	0.17	0.15
Total	291.00	2.68	1.72	0.61	0.53	1.04	0.90

Annual events=27, Monsoon event= 23, runoff producing events=06

Strategies for rainwater harvesting and its multiple uses in rainfed agriculture in Central Gujarat (P.R. Bhatnagar, O.P. Meena, V.C. Pande and V. Kakade-Vasad)

Two rainwater harvesting interventions were developed under the project viz. 1) Techniques for collection of direct falling rainwater in small water tanks (Jalkunds) for establishment of horticulture on toplands / uplands, 2) runoff recycling based plastic film lined ponds with provisions of multiple commodity production in spatial as well as time variations. The interventions are to be evaluated with strategic implementation to ensure sustainable water availability for each component as per need and better production and income.The study on Jalkund evaluation was started from 2015-16 with construction of 24

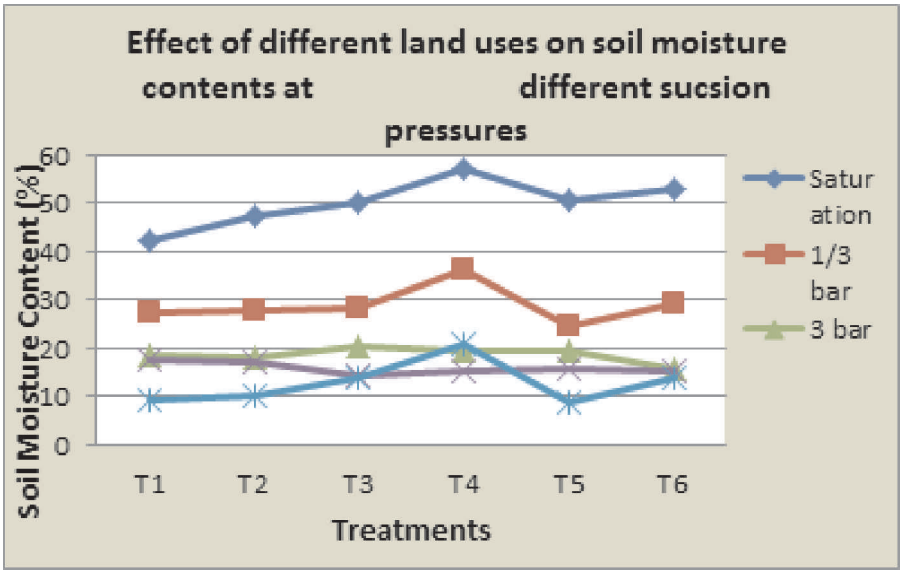


Fig-18. Impact of selected land use systems on soil moisture retention at different pressures

numbers of Jalkunds for eight treatment of water application modes to target crop of custard apple. The LDPE (low density polyethylene) film lined Jalkunds of 3.0 x 1.5 x 1.0 m size were constructed to collect direct falling rainwater as no runoff is available on uplands. The bunds around the Jalkunds were made on the periphery with 25 cm away from top edge so that a collection area of 3.5 x 2.0 m was created that is around 50% more than top area. It will enable to collect 1.00 m depth of rainwater after allowing direct evaporation from a normal rainfall of 850mm. A top cover of grass thatch with bamboo frame was fabricated with underlying LDPE film to protect against evaporation was provided with a provision of a small hole (50x50cm) to fetch water for irrigation and then cover the same. To evaluate the strategies for water utilisation on sustainable basis, experiment was conducted with eight treatments and the predicted temporal water availability in the Jalkund after evaporation and water withdrawal was worked out as given in Table 12. The pan factor (PF the ratio of actual surface evaporation to measured pan evaporation) was expected to be 0.80 for open Jalkund, while it may reduce to 0.50 if covered with grass thatch. With polythene underlying in the cover along with removal of water through a small opening in the cover will certainly further reduce PF to 0.25 or below. With this hypothesis, the experiment was conducted during summer of 2016-17 and 2017-18. The water level decline in the Jalkunds during off monsoon season under different treatments are given in Fig 19. The results indicated the value of PF to be below 0.25 when the Jalkunds were covered with thatch cover (Fig 20). Hence, the strategy for application of water at weekly interval with 0.4 fraction of Cumulative evaporation is enough to provide water to eight plants on sustainable basis. During Monsoon 2017, subnormal rainfall (less than 75%) occurred with low intensity rain occurrence throughout the season. As a result water filling in the Jalkund was quite less and none- of the Jalkund could fill for even 50% of its capacity (i.e. 50 cm) from its initial water level.

Table -12: Details of treatments applied for water application from Jalkund water.

Treatment	Covering of Jalkund	Irrigation water to be applied (fraction of CPE)	Frequency of water application	Mode of water application
PF0.8_IR0.0(T1)	Open	0.0	Weekly	Ring Basin
PF0.25_IR0.0(T2)	Cover	0.0	Weekly	Ring Basin
PF0.8_IR0.4(T3)	Open	0.4	Weekly	Ring Basin
PF0.25_IR0.4(T4)	Cover	0.4	Weekly	Ring Basin
PF0.25_IR0.5(T5)	Cover	0.5	Weekly	Ring Basin
PF0.25_IR0.4 (2Wk)(T6)	Cover	0.4	2- week	Ring Basin
PF0.25_IR0.4 (4wk)(T8)	Cover	0.4	4- week	Ring Basin
PF0.25_IR0.4 (P)(T9)	Cover	0.4	Weekly fill	Pitcher

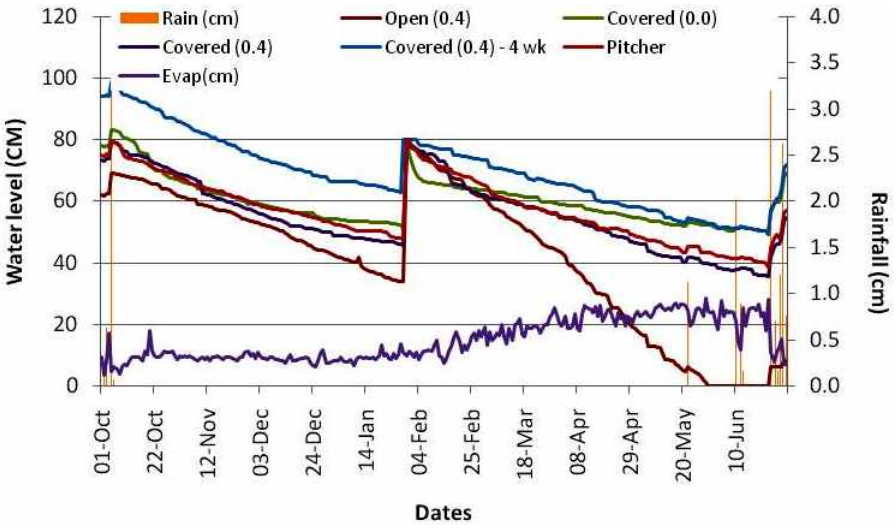


Fig.-19: Water levels decline in Jalkund observed during 2016-17 under different treatments. (For comparison purposes, the water level was equated to 80 cm on 1st Feb 2017).

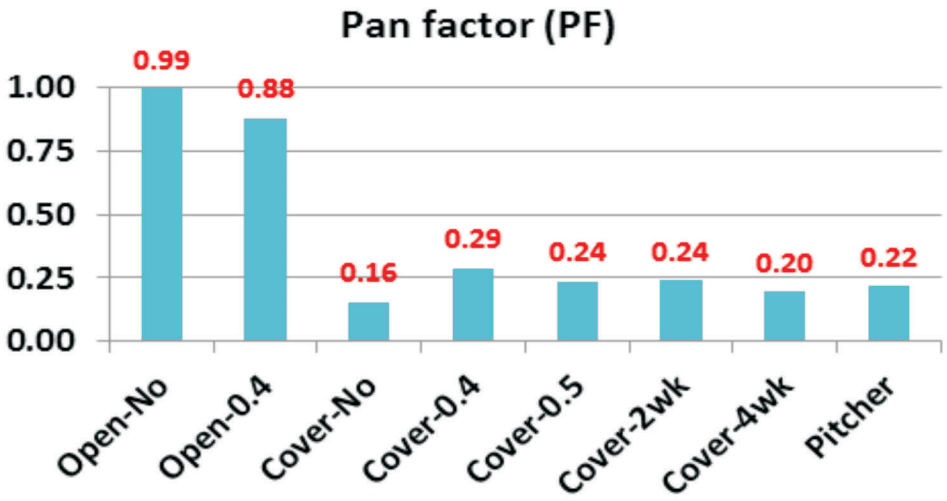


Fig. -20: Pan Factor (PF) observed with different treatments

The second study on runoff recycling with water pond and its multiple uses has been started with construction of a water pond of 200 m^3 capacity by using a site of actively extending gulley head. The gulley head was plugged with an embankment and then pond was dugout with three sides of cut in stair shape and embankment side slopy with 1:1 side slope. It was lined with 250 micron LDPE and covered with soils on three stair side and brick covering on fourth slopy side. A gravity fed micro-irrigation is being installed for irrigation to field at a level 3.5 to 5.5 m below top of the pond. Fish stocking of 150 fingerlings of polycultured fish (silver carp, rohu, mrigal) was stocked. The water utilisation of the pond envisaged are 1) fish culture, 2) horticulture with shrub type plantation on periphery, 3) horticulture or field crops in command with gravity micro irrigation, 4) vegetable and medicinal plantations as per availability of water after using for item 3 above. The predicted water level under different scenario is presented in Fig. 21.

Field evaluation of ground water recharge filters developed by ICAR-IISWC, Vasad (Gaurav Singh, P.R. Bhatnagar, V.C. Pande and O.P. Meena-VASAD)

There are limited studies carried out under field conditions to evaluate artificial ground water recharge filters in terms of recharge rate, sediment filtering efficiency, frequency of maintenance and useful working life. The general observation shows that due deposition of sediments and organic materials in recharge filters after one or two seasons their efficiency gets reduced and the repair cost being high, leading to their discard. A total of 40 recharge filters have been constructed in the farmer's field

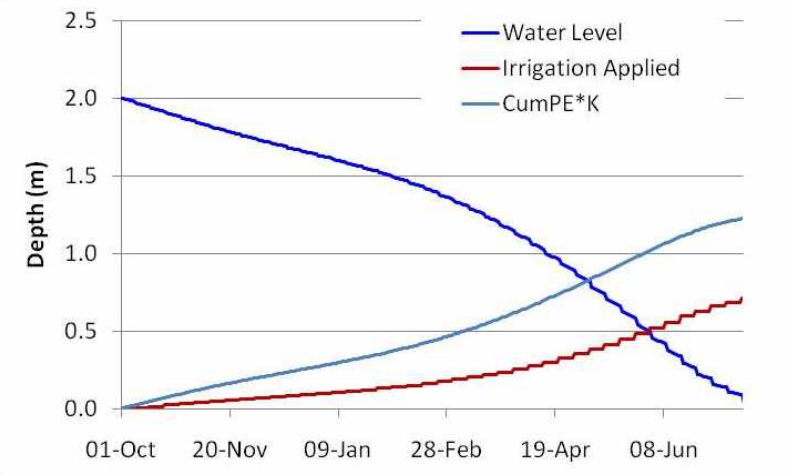


Fig-21. Predicted water level in runoff recycling water pond with irrigation from 1st October to 30th June to 500 plants (newly planted) with irrigation level at 0.4 PE.

from 1999 to 2017 by the Vasad centre under different programmes (Fig. 22). Field visits to recharge filters constructed sites at Villages Nabadh, Navagam at Pavagadh, District - Panchmahal and Villages Vejalpur, District - Kheda were done to assess the existing conditions of constructed recharge filters photographs and samples were collected from different designs of groundwater recharge filters for assessment of sediment deposition during operation since construction.The two anti-gravity concept based groundwater recharge filter designs i.e. one section upward flow and two section upward-downward flow design constructed at research farm of ICAR-IISWC, RC-Vasad were selected for evaluation. Minor repair were done in existing groundwater recharge filters.Construction of gauging structures for runoff and sediment collection was done.Set-up was installed for artificial testing of groundwater recharge filters in field conditions.

Fig.-22: Recharge filters constructed in the farmer's field

P. 4 : REHABILITATION OF AREA AFFECTED BY MASS EROSION

4.1. Development and refinement of technologies for rehabilitation of ravines, landslides, mine spoils, riverbed mining, stream banks, torrents etc.

Ecological Restoration of Stone Mine Spoil areas in South Eastern Rajasthan(B.L. Mina, S. Kala, H.R. Meena, Shakir Ali and Ashok Kumar-Kota)

Rajasthan has the largest geographical area under mining leases (1.16 lac ha) in the country and considered as a museum of minerals both metallic and non metallic including renowned building stones. Open cast mining operation results in extensive soil damage, altering microbial communities and affecting vegetation leading to destruction of vast amounts of land and causes many ecological and environmental problems. On severely disturbed mining sites, establishment of vegetation can be extremely difficult and the natural process of vegetation may resemble primary succession due to exposure of base rock or covering of solid wastes. Mine spoils left to nature may take decades to centuries to develop any vegetation cover by natural process. Establishment of vegetation is a critical step in achieving the goal of ecosystem restoration in mining areas. Re-vegetation of these mine spoils is essential for conservation of environment, biodiversity and to make the land productive. Therefore, carefully planned artificial interventions that mimic natural processes can reduce this time span. So that, project emphasize various approaches in establishment of vegetation for ecological restoration on stone mine spoils *viz*. Planting techniques, selection of suitable tree species and soil fertility improvement through organic manure, mulching and microbial inoculants. A study was initiated in 2015 to develop nursery with 11 tree species *viz*. Acacia nilotica, Acacia senagal, Acacia tortilis, Pongamia pinnata, Butea monosperma, Azadirachta indica, Aegle marmelos, Cassia siamea, Inga dulce, syzygium cuminii and Ficus racemosa. The tree species were raised with different rooting media composition *viz*., T1: Soil, T2: Soil + FYM, T3: Soil + VAM and T4: Soil +VAM+FYM, for stress screening and hardening in order to find out suitable tree species for ecological restoration of mine spoil areas. Four best performing tree species (*Acacia nilotica, Inga dulce, Syzygium cuminii and Pongammia pinnata*) under nursery were selected for field evaluation. Field study initiated in 2016 at stone mine spoil sites located at Laxmipura mines of Ramganjmandi in Kota district of Rajasthan. After of 18 months of planting, more than 90 % of plants, under all treatments, were survived. The growth performance of different plant species was monitored at regular intervals. The observation based on growth performance of tree species in terms of plant height and collar diameter was recorded at the end of 18 months after planting of tree species. Among four tree species, *Desi babool (Acacia nilotica*) and *Karanj (Pongammia pinnata*) were performing better in terms of plant height and collar diameter at stone mine spoil site (Fig. 1-2). Planting techniques which involves pit size and rooting media did not showed any significant difference with respect to growth performance among the tree species. Among the different tree species, plant height of *Desi babool* (161.6 cm), *Jungali jalebi* (109.4 cm) and *Jamun* (46.5 cm) were comparatively better under pit size-1(1.0 m X 1.0 m) as compared to pit size-2 (0.75 m X 0.75 m). However, higher plant height of *Karanj* (112.8 cm) was recorded under pit size-2 than pit size-1. Higher value of plant collar diameter was recorded with *Desi babool* (28.6 mm) and *Jungali jalebi* (17.2 mm) under pit size-1 as compared to pit size-2. While, planting of *Karanj* (21.4 mm) and *Jamun* (7.1mm) showing higher value of collar diameter under pit size-2 than pit size-1 at laxmipura mine spoil site.

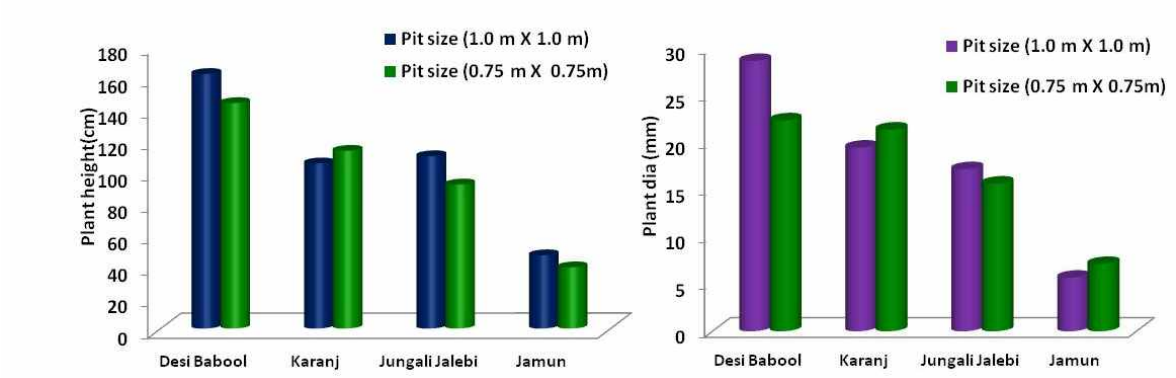


Fig.-1. Plant height and collar diameter of tree species under different pit size at stone mine spoil site

Fig. -2. Performance of *Acacia nilotica* and *Pongamia pinnata* at laxmipura stone mines

Field evaluation of refinement of ravine reclamation technology in a model ravine area development project at Lohli-bagli village in district Bundi Rajasthan [R.K. Singh, H.R. Meena, Shakir Ali, Ashok Kumar, B.L. Mina, Kuldeep Kumar, S. Kala, G.L. Meena and I. Rashmi-Kota]

An externally funded project on Model Ravine Area Development at Lohli-Bagli, in Bundi district, Rajasthan has been initiated by IISWC, RC, Kota. This project was sanctioned as a pilot project under RKVY (Rashtriya Krishi Vikas Yojana), GoI in collaboration with Commissionerate of Watershed Development and Soil Conservation (CWD&SC) Department, Government of Rajasthan with a cost of 6.22 crore which includes monitoring and evaluation component of Rs 149.28 lakhs. This project area is spread over Lohali, Bagli and Rehana villages in 700 ha area along north bank of Mez river. Detailed Project Report has been prepared after conducting PRA physical and socio-economic survey and submitted to Commissioner of Watershed Development and Soil Conservation, Jaipur for executing works. Six sensitization meetings and seminar have been organized with beneficiaries of the project area and all potential stakeholders of ravine reclamation project. The developmental activities could not be initiated in the year 2017 due to non-availability of funds from Govt. of Rajasthan. Bench mark data collection and capacity building activities continued during 2017-18. The total population of Lohali, Bagli and Rihana are 691, 343 and 335 respectively. All the households in these villages and project area belong to other backward caste and no population existed from ST and SC categories. The estimated per capita income of project villages is far below the state per capita income. The poverty ratio in Lohali, Bagli and Rihana has worked out as 0.41, 0.35 and 0.48 against the state average of 0.22. Literacy among different villages varies from 39.5 to 57 %. Analysis of land use data gives an impression that 39.11 % of the total area is cultivable followed by 29.64, 20.71, 8.57 % waste lands, pasture, and forest respectively. The area covered under habitat and other use is about 2%. The total non-arable land area of ravine project is large; which shows the potential for works on non-arable land apart from arable land in the project area. The source of irrigation in Lohali and Rihana are wells and tube wells while Bagli farmers lift water from Mez river to irrigate their field providing irrigation to about 70% of cultivable area. Farmers are using traditional and improved varieties in their field. However, imbalanced or poor nutrients use restricts the maximum potential of crop yields. Urd in Kharif and wheat in Rabi are major crops in the area. Rihana village preferred to grow different vegetables like coriander, chilli, carrot, pumpkin etc for local market in both the cropping season. There are no well planned agroforestry systems observed in the ravine area. However, *Azadirachta indica, Prosopis juliflora* and *Acacia nilotica spp* are the most common naturally occurring agro forestry species on the field bunds, while *Zizyphus*

Table -1: Productivity Gap Analysis (Yield in kg/ha)

Name of crop	India	Rajasthan	Agro climatic zone	District	Project area
Wheat	2872	2961	2802	2132	3610
Mustard	1089	1183	1158	726	1035
Black Gram	451	556	720	790	916
Til	405	340	262	279	178
Maize	2557	1740	2232	2674	1875
Guar	602	593	593	593	937
Gram	875	725	1026	344	823
Coriander	733	797	803	810	600

Source: *http://agriculture.rajasthan.gov.in*

*numularia and Prosopis juliflora*is are more common on pasture and waste lands. The ravine project area does not have any organized orchards and existed scattered few plants of lemon and karonda nearby source of water on some farmers fields. Productivity gap in yield of different crops of project area is done by comparing average yield leveled of country state; district and agro-climatic zone (Table 1) indicate that most of the crops in project area having higher yield in comparisons of district except til, maize and coriander. Mustard and chickpea crops also performing poor against the state and country average respectively. In view of climate change scenario there is a challenges to achieve potential yield and simultaneously stabilize the fluctuation in yields of all the crops for livelihood security. Introduction of improved agronomic practices with climate resilient varieties may fulfill this task.

Field evaluation of design of trenches under different agro-climatic regions
Vasad (P.R. Bhatnagar, V.C. Pande and D. Dinesh)

In order to optimize the design of trenches, a core project was started at seven centres of the institute to cover different agro-climatic regions of the country. The design storm was worked out after analysis of maximum daily rainfall data for 2 years of return period. Four small watersheds were selected and imposed three treatments of staggered trenches with 30, 50 and 80% retention of runoff from design storm, and fourth as control. The four watersheds were gauged for calibration during 2011-14. However, no specific trend was observed between rainfall and runoff for the watersheds as R^2 was found to be insignificant. As a result rainfall-runoff relationship could not be established even with all the events combined from 2011 to 2014. Hence, watershed response before and after implementation of treatments, may be used for evaluation of treatments. Comparison of watersheds indicate no trend between controls (W1) with any other treated watershed (R^2 values were below 0.25 insignificant). But, watershed (W2 with 80%) has good correlation with watersheds (W3 and W4) and have relationships as:

$$Y_{w3} = 0.876\, Y_{w2} - 0.368, R^2 = 0.79$$
$$Y_{w4} = 0.842\, Y_{w2} + 0.688, R^2 = 0.79$$

The treatment of trench densities on runoff, sediment yield and vegetation was started to be monitored from 2015. But, since then subnormal rainfall occurred during the last three years viz. 2015 (only 406.2mm, 48% of normal), 2016 (only 559.8 mm, 65% of normal) and 2017 (only 654.6 mm, 77% of normal with 39 rainy days against only 37 days with more 850 mm of normal rainfall), which resulted in negligible runoff from control and 30% treatment, while no runoff occurred in other treatment in both years. Hence, the treatment effects could not be analyzed.The old Neem plants died due to moisture stress and the mortality ranged between 50 to 76% in the catchments II to IV as against 62% in W1, which is the control plot without any trench. Mortality of the *Azadirachta indica* plants was done during the month of July, 2017. The post monsoon data of neem plant survival followed the trend of trench intensity in W2, W3, and W4 (Fig. 3). Measurements were also taken on dry biomass of vegetation in the four small watersheds treated with trenches during 2017-18 (Fig. 4). W1 showed highest biomass as compared to catchments II, III and IV. This was due to biotic interferences in the three catchments. The biomass in catchments II, III and IV also did not follow any trend. This could be attributed to distribution of moisture retention in trench and its effect on vegetation coming in the catchment. The highest biomass was recorded in W3 (327.6 gm m^{-2}), followed by W4 (265.3 gm m^{-2}) and W2 (144.8 gm m^{-2}). W1 was dominated by green biomass of *Ocimum sanctum* (168.3 gm m^{-2}) followed by

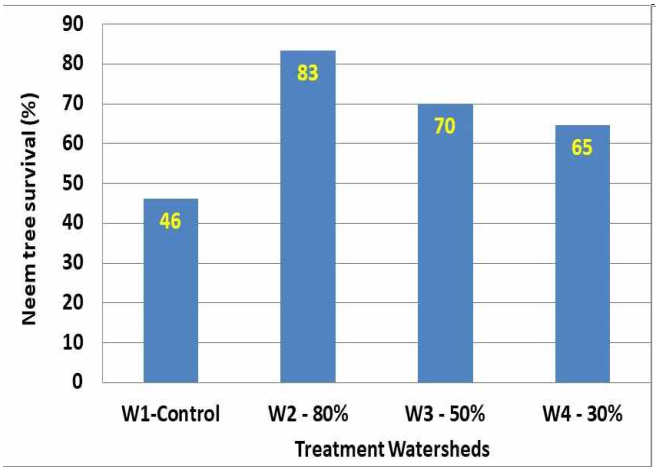


Fig- 3: Survival (%) of neem plants in the catchments

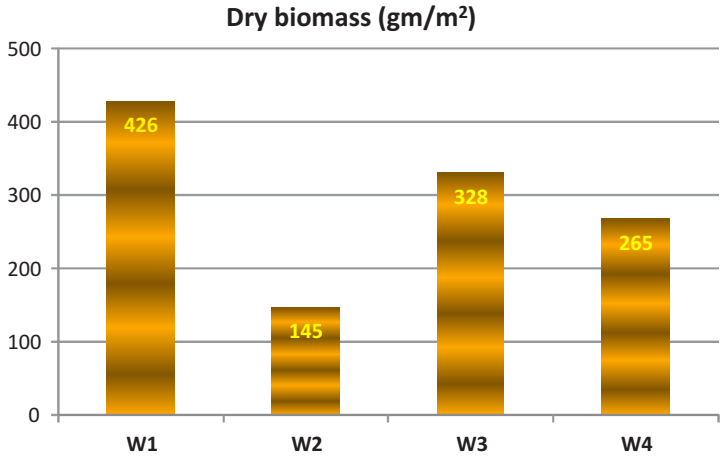


Fig -4: Dry biomass (gm/m^2) distribution of vegetation in the catchments

Desmostachya bipinata (50 gm m^{-2}), *Peristrophe bicalyculata* (37.5 gm m^{-2}), *Desmodium diffusum* (32 gm m^{-2}). In W2, similarly, highest biomass was observed for *Ocimum sanctum* (45 gm m^{-2}) followed by *Apluda mutica* (25 gm m^{-2}), *Peristrophe bicalyculata* (20 gm m^{-2}). W3 had maximum biomass *of* Cassia tora (250 gm m^{-2}), followed by *Peristrophe bicalyculata* (70 gm m^{-2}), *Ocimum sanctum* (64 gm m^{-2}), Desmostachya *bipinata* (50 gm m^{-2}). W4, on the other hand, had maximum biomass of *Aristida funiculata* (50 gm m^{-2}) followed by *Desmostachya bipinata* (47 gm m^{-2}), *Peristrophe bicalyculata* (43 gm m^{-2}), *Apluda mutica* (40 gm m^{-2}).

Agra (A.K. Parandiyal, A.K. Singh and R.B. Meena-)

This project aims at assessing the impact of different trenching densities (trenching for 0 %, 30 %, 60 % and 80 % runoff trapping capacity) on survival and growth of seedlings of *Pongamiapinnata* planted in Yamuna ravines. The study also aims to identify design storm, size and trenching intensity, to quantify resources conserved, to suggest optimum option by devising a DSS and to promote better design of trenches and transfer it to field. Four watersheds having an area of 0.206, 0.290, 0.197 and 0.155 ha have been selected under degraded Yamuna ravines with slope ranging from 8.5 to 15.4 % at research farm of the centre. Daily rainfall data of monsoon year 2017 collected from recording and non-recording type rain gauge was analysed. Total rainfall of 270.2 mm was recorded from June to October 2017. As only one storm of more than 40mm and only two storms of more than 30mm rain were recorded during monsoons, no runoff was generated from any watershed thus no soil loss occurred during this period. The distribution of rainfall during monsoon year 2017 in research farm is presented in table -2. One year old seedlings of *Pongamia pinnata* were planted in three watersheds namely AGA FS-10, AGA FS-11 and AGA FS-12 in July 2015 and watershed (AGA FS-9) was kept been as control. The survival of seedlings was affected adversely due to low rainfall and high biotic pressure of blue bull during first planting season and ranged from 55.1% to 62.82% six months after planting. Replacement of causalities was carried out during July 2016. The survival during 2017 ranged from 76.1 to 86.1 %. The survival and growth parameters of *Pongamiapinnata* are presented in table 3. Status of pre-monsoon and post monsoon soil basic properties were assessed at four watersheds. In the control watershed maximum moisture retention was recorded at ravine bottom followed by ravine slope and least at the ravine top throughout the observation period and at both soil depths. From each treated watersheds, three trenches, located at top slop and bottom were selected. Soil moisture was recorded at three points near each selected trench *viz.* at 1meter on upslope of selected trench, at 1m down of trench and at 2 m from trench on the downward side. Monthly monitoring of soil moisture was carried out during pre and post monsoon as well as during monsoon.

Table -2: Distribution of Rainfall during the monsoon year -2017 of Agra district

Month	Rainfall(mm)	Rainfall storm (mm)				
		> 10.0	> 20	> 30	> 40	> 60
June	78.9	55.5	45.1	45.1	45.1	0
July	82.5	63.4	49.4	0	0	0
Aug.	82.4	61	36	36	0	0
Sept.	26.4	0	0	0	0	0
Oct.	0.0	0	0	0	0	0
Total	270.2	179.9	130.5	81.1	45.1	0

Table- 3:Survival and growth parameters of *Pongamia pinnata* during two seasons after planting in Yamuna ravines

Watershed	(AGA FS-10)	(AGA FS-11)	(AGA FS-12)
Survival (%) till Jan. 2018	86.1	78.7	76.1
Height (m)	0.91	1.7	0.96
CD (cm)	8.38	7.43	9.49

But as the year 2017 was exceptionally dry with a single storm of >40 mm during the year, no impact of trenches was observed as trenches were never found full during the year in any watershed. The EC varied from 0.13 to 0.22 dsm^{-1}, 0.13 to 0.43 $dsm^{-1}$and 0.16 to 0.36 dsm^{-1}at top, middle and bottom respectively. Similarly, pH of experimental site was found normal (8.03 to 8.54) whereas organic carbon ranged from 0.28 to 0.78 percent. Available nitrogen, phosphorus and potassium were recorded low (87.81 to 175.62 kg/ ha), low (3.25 kg / ha) to medium (14.48 kg/ha) and medium (145.60 to 268.80 kg/ ha) respectively.

Chandigarh (A.K. Tiwari, Pankaj Panwar, V.K. Bhatt and Sharmistha Pal**)**

Study is being conducted in four micro hilly watersheds located within the research farm of centre. Land use of these watersheds is sparse mixed deciduous forest. Slope of these micro watersheds varied from 35.8 to 52.5%. These micro-watersheds are equipped with gauging structures and recorder houses. Runoff is being gauged through 0.3 m deep 90^0 sharp crested weirs supported with water stage recorders. Treatments were imposed in all the micro watersheds except control. Areas of micro-watersheds vary from 750 to 1225 sq.m. Three treatments of 30, 50 and 80% retention of runoff from design storm were used in order to determine number of staggered contour trenches in each micro watershed. Runoff was recorded during monsoon season of 2017 from all the four micro watersheds. There were total 16 runoff causing storms (from June to Sept.2017) varying from 10.3 to 132.2 mm. Highest rainfall was 132.2 mm on 21.05.2017. Runoff analysis indicates that runoff varied from 8.1 to 23.7% of rainfall (Table 4) in all the micro watersheds. Soil loss varied from 66 to 293 kg/ha . Bed load i.e. deposited silt in the approach channel and debris basin was also measured which ranged from 4.8 to 24 t/ha. Micro watershed MWS 38 produced minimum runoff.

Table- 4: Runoff (mm) and soil loss (kg/ha) from four micro watersheds during 2017

Month	Rain fall (mm)	Runoff Soil Loss							
		MWS 36		MWS 37		MWS 38		MWS 39	
June	68.7	3.4	3.4	4.1	8.8	3.3	1.8	3.1	0.2
July	191.9	10.4	10	13.6	12.3	3.8	2.6	6.9	2.3
August	366.2	155.7	279.3	88.4	140	54.7	70.7	78.5	63.6
Sept	38.3	0.6	0.2	0.001	0.0	0.2	0.0	0.0	0.0
Total	665.1	170.1	292.9	106.1	161.1	62.0	75.1	88.5	66.1
	%	25.60	--	15.9	--	9.3	--	13.3	--

Soil moisture percentage varied under different micro watersheds. It ranged from 2.03 to 8.55 % in CHD-MWS-36, 2.34 to 9.97 % in CHD-MWS-37, 3.29 to 10.30 % in CHD-MWS-38, 3.32 to 12.3 % in CHD-MWS-39, respectively, over a period from August to December, 2017.

Datia (Monalisha Pramanik and SP Tiwari)

The field evaluation of design of trenches under different agro-climatic regions was continued in sixth year to determine optimum design of trenches in soil-agro-climatic conditions of Bundelkhand region. One day maximum rainfall of two years return period was computed for the design purpose. Experimental site consist of four micro-catchments W1, W2, W3 and W4 of 0.70, 0.23, 0.27 and 0.40 ha area, respectively having variable slope of upto 3.00 per cent. All watershed area was under calibration period of last two years. Event wise rainfall and runoff under different watersheds is shown graphically in Fig5. Average soil loss, total rainfall and runoff for the monsoon period of year 2017 are shown in Table 5. Runoff and soil loss were observed maximum in W1 (22.72 mm and 1.22 t ha^{-1} respectively) while minimum runoff and soil loss in W4 (12.4 mm and 0.05 t ha^{-1} respectively). The land cover and low intensity of rainfall during the monsoon have significant effect on the runoff and soil loss.

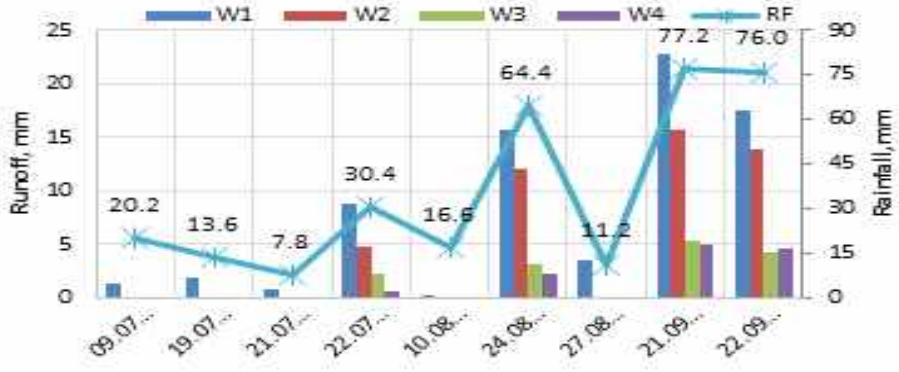


Fig- 5. Event wise rainfall and runoff recorded in different micro-catchments during 2017

Table-5: Runoff and Soil loss in different watersheds during the year 2017

Watershed	Catchment Area (ha)	Runoff (mm)	Runoff (%)	Soil Loss (t ha^{-1})
W-1	0.70	72.1	22.7	1.22
W-2	0.23	46.5	14.7	0.43
W-3	0.27	14.7	4.62	0.07
W-4	0.40	12.4	3.89	0.05

Note: Rainfall during the monsoon: 317.4 mm

The trench design and density in different catchment was estimated using the DSS software. Accordingly, a number of 53,109, 198 trenches have been constructed to retain 30, 50 and 80 % runoff in W2, W3 and W4 micro catchments, respectively keeping W1 as control without trenching treatment in 2015. Karanj (*Pongamiapinnata*) was planted at 6 × 6 m spacing during monsoon 2015.The growth parameters (Plant height, collar diameter) of randomly selected 15 plants of each micro-watershed were recorded during 2017 and found maximum current annual increment in W3 followed by W2 and W4(Table 6). The current annual height incremental varied between 18.2 to 84.5 cm and collar diameter increment varied from 0.40 to 0.90 cm. In spite of bio fencing, the growth of W4 was hampered due to frequent blue bull browsing.

Table- 6: Plant growth parameters of *Pongamiapinnata*

Year	W-2 (30% runoff retention)		W-3 (5 0% runoff retention)		W-4 (80 runoff retention)	
	CD(cm)	Height(cm)	CD(cm)	Height(cm)	CD(cm)	Height(cm)
Jan 2018	3.00	217	2.	168	2.00	148
Current Annual Increment	0.60	47.1	0.	84.5	0.	18.2

***The plant height hampered in W3 and W4 due to blue bull browsing.**

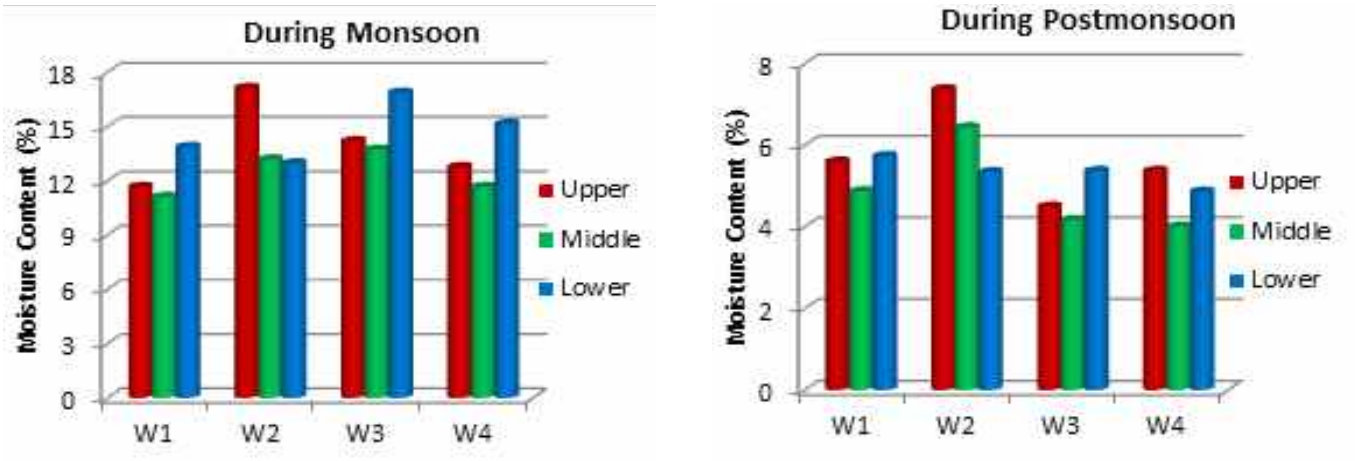


Fig-6. Average soil moisture content (%) in four micro watersheds during monsoon and post monsoon in year 2017

The soil moisture samples were taken from 0-15 and 15-30 cm depth with 1m horizontal interval from one trench to another trench in the upper, middle and lower reach of each micro-watershed. The results revealed that in all micro watersheds the maximum soil moisture content found in the lower reach except W2 which is flatter than W3 and W4 (Fig. 6). Also the similar moisture pattern was observed in 1m interval from trench to trench distance.

Kota (Shakir Ali and S. Kala)

The project was initiated in 2011 with the objectives of identifying design storm, size and trenching intensity; quantifying resources conserved; and suggesting optimum option by devising a decision support system (DSS). The three micro-watersheds namely; W_1 W_2, W_3 and W_4 located in Dhoti watershed was monitored hydrologically for the calibration purpose. The area of the watersheds W_1, W_2, W_3 and W_4 are 0.75, 0.50, 0.45 and 1.00 ha. The relief of the micro-watersheds varies

between 2.21 (W_3 and W_4) and 2.51m (W_1) and 2.24m for the micro-watershed W_2. The slope of the micro-watersheds ranged from 2.51 to 3.58%. The calibration prediction equations for runoff and soil loss were established. The staggered contour trenching treatments were imposed in June 2015 based on runoff trapping potential (Table 7). The trenching density was workout based on the targeted runoff rapping potential as 0(W_C), 30(W_{T1}), 50(W_{T2}) and 80% (W_{T3}) runoff trapping potential, respectively. *Acacia nilotica* seedling at spacing of 4.5 m x 4.5 m and ***Cenchrus ciliaris*** grass at 50 cm x 50 cm spacing in interspaces between *Acacia nilotica* were planted uniformly in all trenching treatments. The calibration prediction equations for runoff and soil loss have already been established utilizing the runoff and soil lossdata for the period 2012-14. During the year under report 2017, the area received 886.3 mm rainfall through 39 events. Runoff producing events were recorded 8 with rainfall amount of 640.4 mm. The runoff generating potential of the W1(control), W2(30% RTP), W3(50% RTP) and W4(80% RTP) were recorded of 15.3, 9.4, 7.6 and 3.5% of monsoon rainfall and sediment yield was of 9.129, 5.244, 4.589 and 1.989 t/ha-yr from the W_1, W_2, W_3 and W4, respectively**.** At end fourth years after planting, the W_{T2} and W_{T3} watersheds had recorded higher growth of *Acacia nilotica* plants over other treatment . The higher growth may be due to higher runoff trapping potential of the W_{T2} and W_{T3} watersheds.

Table -7. Approved trenching treatments and management system

Micro-watershed (W)	Runoff trapping Potential (%)	Management system
W_C	0(Control)	✍ *Acacia nilotica* + *Cenchrus ciliariswere p*lanted in all the watersheds after excavation of trenches. ✍ No. of plants (Acacia nilotica) per hactre: 1111 and *Cenchrus ciliaris* at the spacing of 0.5 m x 0.5 m
W_{T1}	30	
W_{T2}	50	
W_{T3}	80	
Size of trench		3 m x0.6 m x0.45 m

Koraput (D.C. Sahoo, Hombegowda & P.P. Adhikary-)

The design storm has been analyzed for maximum daily rainfall data of IISWC, Research Farm. Maximum daily rainfall for 2 and 5 year return period was worked out to 109 and 152 mm, respectively. An experimental site consisting of four watersheds W1, W2, W3, W4 has been selected having area of 0.17, 0.17, 0.17 and 0.17 ha respectively in the degraded land having an average slope of 8%. Four gauging stations were constructed during 2012 and hydrological data were monitored. All the watersheds were under calibration for a period of two years, *i.e.,* 2012 & 2013. *Acacia Mangium* was planted during the monsoon of 2014 in all the watersheds and three treatments viz., 30, 50 and 80% retention of runoff from the design storm for two years return period were imposed during first week of September and one watershed kept under control for comparison. Staggered Contour Trench with dimension of 2 x 0.5 x 0.45m (Length x Width x Depth) was carried out during mid monsoon, 2014 to harvest and store the excess runoff within the trenches. For 80, 50 and 30 % runoff retention, 187, 132 and 88 number of trenches was taken in watersheds W1, W2, W3, respectively and W4 was kept as a control with only plantation and without trenches. *Acacia Mangium* was planted at 1.5 m plant to plant and 3.0m row to row spacing and observed a survival percent of more than 95%. The gap filling was made during 2015, monsoon.The growth parameters (Plant height and basal diameter) of *Acacia Mangium* could not be observed during 2017 due to entire plant damage by animals grazing. There was no permanent fence at the farm boundary and the temporary fence made to protect the plants was damaged repeatedly purposefully by the locals to allow open grazing inside the farm. Due to repeated damage and grazing, it became impossible to protect the plants.

Runoff and soil loss monitored during the year under different watersheds were analyzed and results are presented below (Table 8). The total runoff producing rainfall was 948.5 mm during the year 2017 from 24 rainfall events. Runoff obtained from W-1 (80%), W-2(50%), W-3(30%) and W-4 (control) watersheds are 9.7 %, 10.4%, 12.2% and 15.8%, respectively. There is reduction in runoff as a result of implementation of trenches by 38.2%, 34.2% and 22.7 % in W-1, W-2 and W-3, respectively over the control watershed. The soil loss in all the watersheds are very less irrespective of any treatments may be due to the undisturbed surfaces over the years covered with good grass/weeds during monsoon. However, the annual soil loss observed as 3.25, 3.32, 4.10 and 4.85 t/ha from W-1 (80%), W-2(50%), W-3(30%) and W-4 (control) watersheds, respectively. There is reduction in soil loss as reduction in runoff due to trenches by 33.0%, 31.5% and 15.5% in W-1, W-2 and W-3, respectively over the control watershed.

Table -8: Runoff and soil loss in different watersheds

Parameter	Runoff retention			
	W-1(80%)	W-2(50%)	W-3(30%)	W-4 (0%)
Runoff (%)	9.7	10.4	12.2	15.8
Runoff (mm)	92.0	98.6	115.7	149.9
Soil loss (t/ha)	3.25	3.32	4.1	4.85

Post monsoon monitoring of soil moisture is continuing. From the average of soil moisture data monitored till now, minimum variation found among the treatments and in the range of 19-20 % in W-1 and W-2 watersheds where as 17-18 % in W-3 and W-4 watersheds at 0-20cm depth. In the soil depth of 20-40 cm, higher soil moisture (%) was found in all watersheds and all the treated watershed resulted in higher soil moisture than the control watershed.

Enhancing productivity of non-arable ravine lands by plantation of *Achras sapota* L. with intercropping system (Raj Kumar (till 15.7.2017), V. Kakade, Gaurav Singh, V.C. Pande and D. Dinesh-Vasad)

An experiment was initiated in 2008 to enhance the productivity of ravine land by plantation of Sapota (*Achras sapota* L.) with intercropping systems. five treatments namely; CCBT (Cowpea + Castor in bench terraces); SCCBT (Sapota + Cowpea + Castor in bench terraces); SBT (Sapota alone in bench terraces); SSTS (Sapota + Staggered trench on slope) and SS (Sapota alone on slope) were executed, each a 72m x 24m size plot (Figure 1 to 5). The spacing between trees was 8x8 m, while cowpea and castor were grown in 2:1 ratio at 15 spacing between each line. The recommended cultivation practices are followed for the crops and the trees. Data on various aspects of plants (crop and tree) growth and yield, and runoff and soil loss parameters were recorded and analysed for the year 2017. The tree height was recorded higher in SBT (3.58m) and it was lowest in SS (3.40m). Whereas, the stem diameter was recorded highest in SCCBT (11.51cm) and it was lowest in SS (9.31cm). In addition, fruit yield was recorded in the order of SCCBT (126.38 Avg. number of fruits/tree)> SBT (110.74 Avg. number of fruits/tree)>SSTS (65.11 Avg. number of fruits/tree)>SS (47.66 Avg. number of fruits/tree) respectively during 2017 (Table 9). Yield of Cowpea in CCBT (32.75 q/ha) was recorded almost equal to the yield in SCCBT (31.25 q/ha). The castor yield could not be recorded as the plot was damaged due to biotic interference. Annual runoff was recorded lowest in SCCBT (61.44 mm) and highest in SS (Sapota alone on slope) (145.9 mm). However, soil loss was recorded highest in CCBT (3.15 ton/ha/year) and lowest in SSTS (0.36 ton/ha/year).

Table- 9 Runoff, Soil loss, Growth and Production parameters of Sapota under different treatment during 2017

Treatment	No. of fruits per tree	Plant height (m)	Stem Diameter (cm)	Crown spread (m)		Runoff (mm)	Soil loss (t/ha/year)
				EW	NS		
Cow pea + Castor (Terraced) [T1]	-	-	-	-	-	65.54	3.15
Sapota + Cow pea + Castor (Terraced) [T2]	126.38	3.42	11.51	3.01	3.04	61.44	2.53
Sapota (Terraced)[T3]	110.75	3.58	11.49	3.09	3.18	68.56	1.43
Sapota + Staggered trench (Un-terraced) [T4]	65.11	3.53	11.20	3.09	3.18	87.2	0.36
Sapota (Un-terraced) [T5]	47.66	3.40	9.31	2.55	2.18	145.9	1.18

02 RESEARCH ACHIEVEMENTS

P. 5 : INTEGRATED WATERSHED MANAGEMENT FOR SOCIO-ECONOMIC GROWTH AND POLICY ADVOCACY

5.1 : Participatory Watershed Management and Integrated Farming System (IFS)

Socio-Economic analysis of farming/livelihood systems of farmers across different land categories in Yamuna ravine area (D.C. Meena and A.K. Parandiyal-Agra)

Survey schedule has been developed and finalized for data collection and 40 respondents selected randomly from each selected villages of Bah and Fatehabd block of Agra district. Required primary data have been collected (Table 1) from the respondents have been selected by personal interview and group discussion method using pre-tested schedule prepared for the purpose. As per survey data bajra-wheat is major cropping system in study area and it is followed by fallow-mustard cropping system. Some farmers in study area are also growing vegetables. The average family size of sample farmers is 8.61 (male - 4.61 and female-4.00). The main occupation of 75 % of sample farmers is agriculture + dairy, followed by agriculture labour and other labour (20%) and business and services (5%). The average literacy rate of sample farmers is 62% About 73% of total agriculture land is irrigated and 27% is rainfed. As per survey data, private job/labour is the major component of the family income. The livestock is playing important role in the existing crop-livestock farming system. Tube well and hand pumps are the major source for drinking water and tube well for irrigation in the study area. Some farmers are also lifting irrigation water from Yamuna River.

Refining methodologies for data validation, planning, monitoring and evaluation of watersheds (S.L.Patil, H. Biswas, B.S. Naik, A.S. Morade, M. Prabhavathi , P. Ojasvi, Pradeep Dogra, and S.S. Shrimali-Ballary)

The ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Ballari has been partnering with Watershed Development Department, Government of Karnataka for monitoring and evaluation of watershed programmes planned and implemented under Sujala-III Project since April, 2016, with the following set objectives:

- Develop methodologies to assess that interventions planned are actually needed for watershed development.
- To devise a suitable data collection strategy during project implementation phase that is synchronous with impact assessment needs.
- Fine tune existing project and impact indicators for assessment of watershed projects.

As a part of M&E programme of Sujala-III Project by ICAR-IISWC, Ballari, the following activities were carried out during 2017-18 (Table 2):

1. **LRI data generation and validation:** A total of 90 surface soil samples were collected from three micro-watersheds (Babulgaon 2, Karanjikhurd and Raipalli 2) of Raipalli sub-watershed, Bidar and analysed for their physico-chemical properties. Data were compared with those generated by the LRI partner (UAHS, Bagalkote). The Raipalli sub-watershed methodology followed by the LRI partner, is in line with the standard procedure (checklist for validation furnished in Table 2). Validation of data (on 500 * 500 m grid) on important soil parameters was completed and the accuracy levels across soil properties and micro-watersheds range from 81 to 100%, which is reasonably accurate given the sampling time lag, sampling and estimation errors and application/non-application of fertilizers/manures, cultivation of different crops by the farmers etc. Another 180 samples were collected from three micro-watersheds of Lingapura halla sub-watershed, Tumkur, Koppal and Bedwatti micro watershed.

2. **Generation of thematic maps:** Forty-two thematic maps in respect of Raipalli sub-watershed were prepared and based on the information obtained site-suitability of crops as provided by the LRI partner (in the atlases) was verified and found to be accurate to the extent of more than 85%.

Table-1: Basic Information of selected villages

Villages/Particulars	Mai	Budhera	Baripura	Aie
Geographical area (Ha)	524.21	309.85	380.43	570.66
Forest Area	229 (43.68)	159 (51.32)	96.29 (25.31)	86.40 (15.14)
Agricultural land	108 (20.60)	89 (28.72)	193.38 (50.83)	372.11 (65.21)
Irrigated	82 (75.93)	23 (25.84)	125.70 (65.00)	308.85 (83.00)
Rainfed	26 (24.07)	66 (74.16)	67.68 (17.79)	63.26 (17.00)
Ravine/uncultivated area	187.21 (35.71)	61.85 (19.36)	90.33 (23.74)	112.15 (19.65)
Families (No.)	399	65	113	436
Population (No.)	2210	411	796	2,968
Male	1153 (52.17)	293 (71.29)	429 (53.89)	1,664 (56.06)
Female (No.)	1057 (47.83)	118 (28.71)	367 (46.11)	1,304 (43.94)
Child (0-6)	358 (16.20)	46 (11.19)	152 (19.10)	674 (22.70)
Schedule Caste	365 (16.52)	0 (0.00)	00	269 (9.06)
Literacy rate (%)	63.61	59.24	66.15	53.14
Total Workers	530 (23.98)	135 (32.84)	239 (30.03)	697 (23.48)
Main Worker*	496 (93.58)	86 (63.70)	232 (97.07)	661 (94.84)
Marginal Worker**	34 (6.42)	49 (36.30)	07 (2.93)	36 (5.16)
Cultivators	335 (63.21)	61 (45.19)	104 (43.51)	518 (74.32)
Agril. Labourer	24 (4.53)	34 (25.19)	118 (49.37)	130 (18.65)
Govt. Tube well	2	00	00	00
Personal tube well	15	06	11	21
BPL Card Holder	42	20	10	132
Indira Awas Yojana	34	00	06	63

*Employment or earning more than 6 Months, ** Marginal activity providing livelihood for less than 6 months

3. **Data Collection from watershed farmers' and analysis**: Data in structured schedules were collected from 225 farmers of three micro-watersheds of the Raipalli sub-watershed. Validation of different parameters covered in the baseline report prepared by the LRI partner was completed.

4. **Validation of Decision support systems:** Inputs were given for DSS preparation for (a) estimation of runoff, (b) size and location of farm ponds, (c) crop water requirement, (d) water balance and budgeting, and (e) on conservation measures (SWC Engineering measures) to identify the type of structures, their design and estimate, for both arable and non-arable land.

5. **Monitoring of soil and water conservation measures:** Corrected and revised proposed DLT map for Chikkadabeta-1 and Yelishirur-2 micro watersheds. Comments and suggestions were provided on hydrological data products (Thematic maps / graphical representations / tables to be derived / generated in quantifying the components of intensive hydrologic investigation in each micro-watershed) for LRI Atlas prepared for Raipalli-2 micro-watershed. Different soil conservation structures such as Trench-cum-bund, boulder waste weir and check dams were verified for their site suitability and structural adequacy in Raipalli sub-watershed.

6. **Scrutiny of DPR submitted by Bidar:** DPR of Raipalli sub-watershed was scrutinized. Comments on the contents of DPR and response of the PIA have been prepared.

7. **Verification of horticultural/forestry plantations:** Different plantation sites containing block plantation of mango, roadside plantation, block plantation of forestry species, bund plantation with cucurbits, etc. were verified in Raipalli sub-watershed. Survival was found to be 80-90% in respect of different planted species.

8. **Crop/fodder demonstrations:** Visits were made to farmers' fields to inspect the crop demonstrations with improved technology in respect of pigeonpea and different fodder species for promoting animal husbandry.

9. **Capacity building:** The content of training programmes and feedback of participants in respect of nine training programmes conducted between July and August, 2017 at DATC, Vijayapura and Mysuru for ADAs, AOs, AAOs, watershed committee members, WDT members, watershed assistants and watershed committee representatives were evaluated and suggestions for improvement were provided.

Table- 2: Indicators for validation of LRI data/atlases by ICAR-IISWC, RC, Ballari.

Indicators	Remarks	Source
Availability of satellite imageries overlaid on cadastral maps	√	KSRSAC, Bangalore
Adequacy of soil and profile sampling, and selection of sampling sites	√	NBSSLUP, Bangalore and UHS, Bagalkote
Adequacy of grid size	√	
Timeliness in analysing samples and availability of data	Analysis completed on time, data supplied to M&E agency readily on request	
Adequacy in number of maps generated to decide on treatment	√	
Ease in understanding the LRI data, maps and atlas	Atlases have been prepared in a user - friendly manner with abbreviations and symbols explained. However, training of field level workers necessary	
Training provided on generation of LRI atlas and their use	√	NBSSLUP, RS, Bangalore
Extent of similarity in soil fertility parameters and site suitability for crops between maps generated by ICAR-IISWC, Ballari and LRI partner	84-100%	NBSSLUP, Bangalore and UHS, Bagalkote

02 RESEARCH ACHIEVEMENTS

P. 6 : Human Resource Development and Technology Transfer

P-6.1: Capacity Development Approaches and Information and Communication Technology (ICT)

Role of Soil and Water Conservation Technologies for Climate Resilient Agriculture in Himalayan Ecosystem – An Action Research (D.V. Singh, Charan Singh, Ramanjeet Singh, D.M. Kadam and Deepak Singh-D. Dun).

Participatory water resources development through inter watershed water transfer, seepage control through silpaulin lining of storage structures, development of organized agri-horticulture, etc. were taken up in Hattal and Sainj villages under TSP. These villages are remotely situated in Jounsar tribal area of Uttarakhand and represent lesser Himalayan Ecosystem. During the period of report, impact of developed water resources on area, production and productivity of major crops was assessed. Developed water resources are being properly managed by village level institution *i.e.* Farmers' Associations created in these villages with effective local leadership. Every day, harvested water is being shared among the members of the association by way of opening their water connections (21 in Hattal and 9 in Sainj) for a fixed time from the control mechanism built near the storage tanks. Impact of project interventions in terms of change in area, production and productivity of major crops is presented in Table 1. It could be seen from this table that productivity of different high value crops (off-season vegetables) had witnessed an increase of 47.7 and 14.1 % in case of cauliflower and tomato, respectively and in the range of 12.7 to 16.5 % in case of other vegetables like sweet peas, beans, capsicum, etc. This enhancement has been arrived by comparison of the average of four years (2014-2017) with that level which existed before completion of the technological interventions on water resource development during 2013. It also shows that the reduction in rainfed cultivation of maize and wheat (31.4 to 32.1 %) is replaced with the increase in gross cultivated area and production of highly remunerative vegetables crops by three and a little more than four folds, respectively. The major driving factors to this change are the creation of water resource for irrigation in such a difficult hilly terrain by introducing a cost effective technological intervention of spring water harvesting and developing a self sustainable mechanism of participatory water resource management in Hattal and Sainj villages in Jounsar tribal region of Uttarakhand.

Table -1: Impact of project interventions on area, production and productivity of major crops in selected villages

Major crops	Before project (2013)			After project –Mean (2014-17)			% Increase or decrease		
	Area (ha)	Prod. (t)	Yield(q/ha)	Area (ha)	Prod. (t)	Yield(q/ha)	Area	Prod.	Yield
A. Maize (kharif)	43.3	108.1	25.0	29.7	70.7	23.8	-31.4	-34.6	-4.8
B. Wheat (rabi)	38.4	72.0	18.8	26.1	46.6	17.9	-32.1	-35.3	-4.5
C. Summer - Off-season-I (March-April to July-August) irrigated									
Tomato	7.9	123.0	156.3	25.6	456.5	178.2	225.2	271.0	14.1
Other vegetables	2.6	13.1	50.0	4.8	27.1	56.4	81.4	106.2	12.7
D. Autumn - Off-season-II (July-August to Oct.-Nov.) irrigated									
Cauliflower	8.4	105.0	125.0	27.9	518.8	184.6	231.9	394.1	47.7
Other vegetables	2.1	7.9	37.5	4.5	19.6	43.7	114.1	148.8	16.5
Total (C+D)	21.0	249.0		62.8	1022.0				

Data on area and production of different crops grown during different seasons and inputs used by the tribal families in selected villages was subjected to the economic analysis by taking prevailing market prices of inputs and crop produce during respective years of the project period (2013-2017). Average annual family income from agriculture realized by the tribal farm families during different years in Hattal and Sainj villages is presented in Fig. 1. During 2013, average farm income was observed to be Rs 33640/- in Hattal which has been enhanced in the range of Rs 86981/- to 213031/- during last four years

Tomato crop in Sainj

Cauliflower crop in Hattal

(2014-2017). Since water resource development was taken up in Sainj village one year later *i.e.* during 2015, enhancement of average annual family income was realized from 2015 onwards from very poor level of Rs 11230/- (average of two years 2013 and 2014) to as high as Rs 259121/- during 2017. The wide variation in annual farm income can be mainly attributed to the highly fluctuating prices of vegetables realized by the farmers during different years. When data of both the villages was pooled and mean of post project period (Rs 123828/-) was compared with pre-project level of income (Rs 28902/-), the enhancement in farm income of the tribal families was worked out to be 4.28 times. This enhancement in income can be credited mainly to the introduction of water resource development interventions which enabled the cultivation of high value crops (off-season vegetable) in sizable areas by the farmers of these villages.

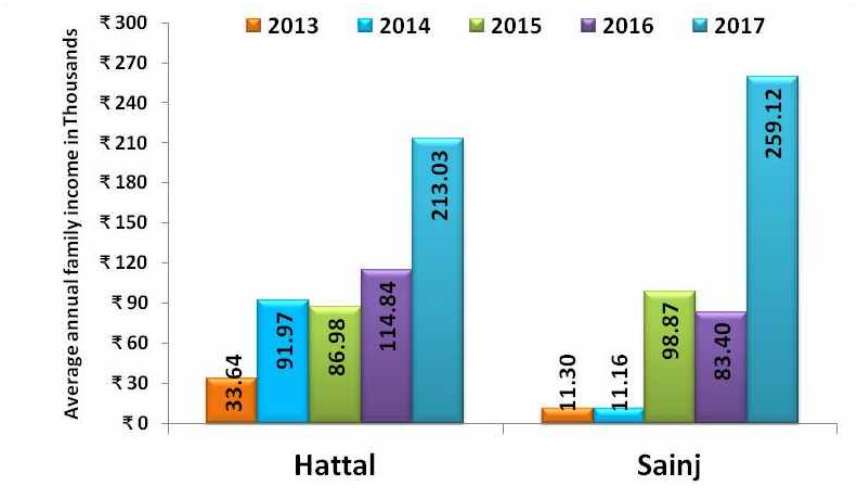


Fig. -1. Average annual family income of farmers from agriculture in Hattal and Sainj

P-6.2: Participatory Technology Dissemination and Adoption

Ensuring sustainable agricultural development and livelihood security in lower Shiwalik range of Uttarakhand (Raman Jeet Singh and D. M. Kadam- D.Dun)

Five Demonstrations (one acre each and total of 2.0 ha) of improved variety of groundnut (Girnar-2; developed by ICAR-DGR, Junagarh) were conducted in Kabulpuri Raighati village of block Lakshar of Haridwar district. Results revealed that farmers' local groundnut variety (1455 kg/ha pods) and Girnar-2 variety (1485 kg/ha pods) were at par with each other in terms of productivity. Farmers kept seeds of Girnar-2 for sowing in next season due to its attractive seed colour and long pods. New generation post emergence weedicide (Bispyribac-sodium or Nominee Gold) was provided to farmers at right time with technical guidance regarding its use. Farmers' practice was only pre-emergence spray of Butachlor. They hadn't any information on post-emergence weedicide in paddy. Results of using post-emergence weedicide, no weed population was

present at 90 days of paddy transplanting. Similarly, training on real time N management using leaf colour chart (LCC) was given to farmers at the time of top dressing of urea in paddy (15 days after transplanting onwards) and in wheat (60 DAS). Hundreds LCC strips were provided to farmers of the project site. Out of 100 farmers, only 47 tested LCC and saved 100 kg/ha of urea in both paddy and wheat crops resulting in saving of Rs. 1500 + 300 (1800) per ha and saved non-renewable energy of 8400 MJ/ha which reduced carbon emission of 410 kg Ce per ha.

Performance of groundnut (Girnar-2) crop in the farmer's field

Performance of post-emergence spray of weedicide in paddy crop

Assessing farmer's knowledge, vulnerability and adapting capacity of soil and water conservation technologies under changing climatic scenario (Core project)

D. Dun (Bankey Bihari, Rajesh Bishnoi, Indu Rawat)

Achievements/Progress:

a. Pilot Survey for feasibility testing of the survey instrument was conducted in study of area.

b. Information collection from the selected villages at all the research centres is in progress. Total 945 farmers and 90 officials are to be covered.

c. At Dehra Dun centre from VikasNagar Block 105 farmers were interviewed.

d. Initial trends shows that almost all the farmers were aware about climate change. They knew about the type of change, reasons and their impacts. According to their opinion when compared to past 20 years the total quantity of rainfall and no of rainy days have reduced drastically.

e. 78.9% respondents reported that the Frequency of occurrence of drought has increased. With regard to temperature no of hot days have increased.
f. As per the perception of farmers the reasons for climate change are 82.0% use of vehicles , use of chemicals in crop cultivation and deforestation etc.
g. 69.7% farmers expressed that due to climate change and increase in temperature there is reduction in crop and milk yield. and swelling of udder in milch animals thereby reducing crop and milk yield.
h. 45.6% farmers reported that due to drought not only crop failure, but also they have to sell out their cattle due to lack of fodder. According to their opinion crop diversification can help to some extent to cope with the climate change scenario.
i. 91.2% farmers reported that due to complicated rules and regulstion, government policies are not of much help.

Agra (D.C. Meena, R.K. Dubey and Rama Pal)

Social vulnerability of a community has emerged as the least known element in the changing climatic scenario. Social vulnerability is partially the product of social inequalities and those social factors that influence or shape the susceptibility of various groups to harm and they also govern their ability to respond. Therefore, there is a need to determine, who or what are the elements of social vulnerability; how we can identify vulnerable social groups in changing climatic scenario. Social vulnerability also helps to determine actions by informing policymakers and practitioners; alert the public and raise awareness; stimulate discussion; gain funding etc. Among all the sectors, Agriculture sector is more vulnerable to climate change and since we are also working in the rainfed areas which are more exposed to climate *i.e.* more vulnerable. In addition, vulnerability is not only an objective situation. Its impact on the behaviour of individuals or households depends. In general measure, on the perception they have of the risks to which they are subjected and on their capability to confront said risks. The project was initiated during 2016. Details review of literature related to study has been collected and studied. Agra district selected for the study since it is high vulnerable to climate change (ATLAS on vulnerability of Indian agriculture to climate change, NICRA, CRIDA). Three villages *namely:* Jalapur, Surera and Beelpura from Agra district have been selected purposively having predominantly rainfed. Thirty five respondents from each village were selected for the study randomly. Ten officials from different government departments working on soil and water conservation from Agra district will also be interviewed. Data has been collected from selected farmers by using standard schedule/PRA and group discussion techniques.

Ballary (S.L.Patil, Suresh Kumar (up to Aug., 2017), B. S. Naik and A.S. Morade)

The core project was initiated during 2016-17 in order to assess the farmer knowledge, vulnerability and adapting capacity of soil and water conservation technologies under changing climatic scenario. The project aimed at assessing the perception of farmers towards climate change and variability and further moderation of the impact of climate change with adoption of soil and water conservation technologies, and thereby farmer income. Based on the vulnerability status as reported by CRIDA, Chitradurga district in Karnataka state was selected for data collection. During 2017-18, as per the project planning minimum of 35 samples/farmers data totaling to 115 samples/farmers were collected from three villages i.e. Devasamudra, Ramasagara and Venkatapur in Molakalmuru taluk of Chitradurga district on the vulnerability status. In addition, 10 field functionaries (PDO's, AAO's and AHO) working in Molakalmuru taluk of Chitradurga district were interviewed for institutional measures taken in response to climatic variability and data was also collected as per schudle from them with project related review of literature. Land holding particulars of farmers from all the three villages indicated that the rainfed area (5.35 acres) was higher compared to protective irrigated area of 0.94 acres (Table 2). Agriculture (69.5%) was the main occupation of the farmers and nearly 20.9% works in the field as labour . More than 3/4th of farmers do not have irrigation facilities in study area and nearly 21.7% of farmers possess as a source of irrigation (Table 3). All the interviewd farmers in three villages were aware of the climate change and its effects on crop yields and their livelihood. Further they were in the opinion that rainfall is ill distributed even though sometimes it occurs and that is reducing the crop yields and employment. The reasons for climate change from farmers were attributed to felling of trees and increase in temperature and also intelligent farmers foresee similar situations in future.

Table- 2: Land Holding Particulars

Land Holding	Area(acre)	Average(Acre)
Irrigated	108.60	0.94
Rainfed	567.58	5.35
Total	676.18	--

Table -3: Irrigation Facilities

Irrigation facilities	Frequency	Percentage
Open well	2	1.7
Tube well	25	21.7
Canal	0	0.0
Pond	0	0.0
Diesel pump set	0	0.0
Electric pump set	0	0.0
Low lift hand pump or paddle pump	0	0.0
No irrigation	88	76.6
Total	115	100.0

Chandigarh (Swarn Lata Arya, Sharmistha Pal, and K. Sathiya)

The present research, as part of a more recent strand of adaptation research, seeks to investigate actual adaptations at the farm level, as well as the factors that appear to be driving them in Shiwalik foothill villages in Panchkula district in Haryana State. Data was collected through reconnaissance survey and by using different RRA tools such as focal group discussion, key informants interview, transect walk, crop calendar and field observation. The data was also collected from the discussion with agriculture development workers, GOs, NGOs and INGOs workers and government officials. Furthermore, the household survey conducted by using structured questionnaires was used to gather detailed information on farmers' perception on climate change and adaptation measures practiced (Table 4).

Village Jabrot (Study Area 1) is situated in Raitan area of Pinjor block abour 9 kms away from Pinjor on link road of Pinjor - Mallah state road towards northern side. Sub-surface structure was constructed by Soil Cons Department of Haryana in 2001-02 by tapping the water of perennial and ephemeral streams emanating from the higher reaches by constructing vertical infiltration galleries (Subsurface Dam) across the channel or stream or river from the surface of the earth down to the level of the impervious layer. The Kajiana village (Study Area II) is situated in Raitan area of Pinjor block about 7 km away from Pinjor on link road connecting Bhorian and Janoli villages . Sukhomajri (Study Area III)is a small hamlet located in the Shiwalikfoothills 30 kms north-east of Chandigarh on Pinjore-Nalagarh road at 30° 53' latittude and 76° 53' longitude, in Panchkula district of Haryana State. A 12 meter high earthen embankment was constructed in 1978 to store runoff water from 9.12 ha. hilly catchment. The stored water was conveyed to agricultural fields through underground pipeline. Now more than 70 percent of capacity has lost.

Table- 4: Demographic Characteristics of selected villages

Items	Jabrot	Sukhomajri	Kajiana
Total No. of families	57	136	72
Total population	339	771	429
Av size for family	5.94	5.66	5.95
Total work force	174	394	188
Land holding			
<1 0 ha.	45	98	59
1-2 ha.	6	13	11
2-3 ha.	1	5	2
>3.0 ha	5	0	0
Av size of land holding (ha./family)	1.19	0.35	0.44
Cultivated area	67.98	16	05
Irrigated	12.25	32	27
Partially irrigated	14.89		
Unirrigated	40.84		
Animal holding /family	5.28	12.11	3.83

Datia (MK Meena, Rajeev Ranjan, RS Yadav)

Project was initiated in the year 2016-17 to examine the perception, awareness and extent of knowledge of farmers on climate change and their perceived adverse impact on crop production, determine the attitude of farmers and officials and determining the factors influencing knowledge and attitude of farmers towards soil and water conservation technologies under the changing climatic scenario and determine the vulnerability and adaptive capacity of farmers towards various soil and water conservation technologies to changing climatic scenario in Bundelkhand region. To address the identified objectives review of literature, interview schedule development and pre testing of schedule was completed to develop the concepts and methodologies. Selection of Blocks and villages, survey of selected villages (blocks and village selected on the basis requirement of data, frame sampling unit), Selection of respondents (stratified multistage sampling) completed. Three villages (30 respondents from each village) from *Datia* district were identified for collection of information's. During the reporting period, data from one village *viz*. Jigna (30 respondents) were collected through interview method and information regarding other general issues collected through Focused Group Discussion (FGD's). Collected information were compiled in the prepared format for analysing. Models/index/scales for analysing adoption intensity of soil and water conservation practices were identified.

Kota (Ashok Kumar, H.R. Meena and I. Rashmi)

Study was initiated during 2016-17 in Baran District of South eastern Rajasthan to examine the perception, awareness and extent of knowledge of farmers on climate change and their perceived adverse impact on crop production besides determining the vulnerability and adaptive capacity of farmers towards various soil and water conservation technologies to changing climatic scenario. A sample of 50 farmers selected randomly as respondent for collection of data from Kadaiya Nohar village in Chabra Block. A pretested questionnaire was used to collect data from selected respondents. The questionnaire consisting mainly questions about the demographics of household; the agricultural practices; awareness, perception and attitude about climate change and the perceived changes in climate and impacts they have experienced overtime and adaptation strategies they have employed to cope with the effects of climate changes. Land holding pattern revealed that majority of the farmers (60%) were marginal farmers followed by Small (22%) and semi medium (16%) categories. The income generated from different sources by the sample households showed that Share of agriculture income is highest (69.5%) followed by Dairying (13%) and service (9.55%). As part of the study, respondents were presented with number of statements to know their perception and attitude about climate change and respondents were asked how strongly they agreed or disagreed with each of these or unable to give response i.e. undecided. majority of the farmers (92 %) perceived that Climate change is really a problem and 52 % of the respondents disagreed with the contention that this problem is not in their region. 60 Percent of the farmers perceived that frequency of drought have increased in last 10-20 years while 70 % of the farmer respondent was either not agreed or undecided with question whether this frequency will reduce in future. 78% of the respondents also foresee that availability of water will reduce in future since 88% have the opinion that monsoon when compared to past receded earlier due to changing climate scenario in the region. The results about attitude revealed only 10 % of the respondent strongly agreed that maintaining ecological balance is the duty of the government contrarily 32 percent strongly agreed respondents thought that community have a larger role than government in taking initiatives for checking ecological degradation in area. About 76 % with 28 % strongly agreed that scientists will find solutions to the problems of climate change while 68 percent respondents thought that humans are capable of finding ways to make adaptations to vagaries of climate change However, 94 %(52% strongly agreed) with the statement "I do worry about the loss of flora and fauna of my area" which is a positive sign for them that they are aware about the possible loss as a result of climate change. In contrast, Over half (56% of the respondents disagreed with the statement that it is hard to change their habits for more environmental friendly and effects of climate change are too far in the future to really worry them(68%).

Udhagamandalam (P. Sundarambal, K.Kannan, P. Raja and O.P.S. Khola)

Coimbatore district of Tamil Nadu, one of the vulnerable districts to climate change has been selected for the study. In Tamil Nadu the major climatic event is drought and Coimbatore is one of the most drought affected districts of Tamil Nadu.Sultanpet block from Coimbatore district has been selected purposively which is having predominantly rainfed cultivation. Three villages (Varapatti, Vadavalli and Vadambachery) were selected at random from sultanpet block .Data were collected from 105 farmers (35 from each village). Most of the farmers were aware about climate change. They knew about the type of change, reasons and their impacts. According to their opinion, compared to past 20 years the total quantity of rainfall and number of rainy days have reduced drastically and in some years they have observed total monsoon failure and received rain only during cyclones and depressions. Frequency of occurrence of drought has increased. With regard to temperature, number of hot days has increased. Number of days of occurrence of dews reduced. They foresee the similar trends in future too. As per the perception of farmers the reasons for climate change are air pollution due to industrialisation, more use of vehicles

and chemicals in crop cultivation and mushrooming of wind mills.They expressed that due to climate change there is an increase in pest and disease incidence like aphids, thrips and powdery mildew in crops like Bhendi, Maize, Tomato, fungal attack in maize and millets and severe whitefly attack in coconut and swelling of udder in milch animals thereby reducing crop and milk yield. Coming to heat in animals is also affected. They also reported that due to drought,apart from crop failure, fodder production is also affected due to which they have to either invest heavily on concentrate or they have to sell out their cattle.

As perceived by the farmers, changing the time of sowing to match with the rainfall receipt time, and crop diversification can help to some extent to mitigate the climate change affects. They reported that crop insurance could be of great help but in practice, they face so many difficulties in getting the benefits due to complicated rules and norms. They have an attitude that it is the duty of the government to maintain the ecological balance and the community is not having much role. As far as adaptive capacity is concerned, in some of the households at least one family member has migrated to the nearby areas to work in industries like power looms, textiles, steel, dyeing etc., Each farmer has dug more than two bore wells to a depth of 1000 to 1200 feet to rescue their grown up coconut plantations and to raise irrigated vegetable crops at least to a smaller extent. There is a complete change in cropping pattern from Tobacco-Cotton –Vegetables to Maize-pulses/vegetables. Selling of livestock due to fodder scarcity and distress selling of assets was also observed. The major SWC technologies adopted by the farmers on their own were bunding, summer ploughing, drip, mulching which could help them to some extent. Very few farmers have adopted farm ponds for water harvesting and trenching in coconut

Establishment of wind mills-Areason for less rainfall (farmers pereption)

Frequent drought resulting in crop failure

Adaptation Strategy-Agroforestry

Adoption of stone bunding


Adoption of drip in plantation and vegetable crop


Adoption of trenching and mulching in coconut

Photographs related to various aspects of climate change

Vasad (V.C. Pande and O.P. Meena)

Agriculture sector is quite vulnerable to climate change in general and the rainfed areas, in particular, affected due to stressed and degraded resource conditions. Vulnerability to climate change is subjective as the impact on individuals and the households depend largely on their perception about the risks to which they are subjected and their capability to confront said risks. Further, capability to withstand the risk of climate change not only depends on the resource endowment but also the knowledge base of the community and this encompasses both the knowledge about climate change and coping mechanisms including the technological backup available. With this perspective, the present study was initiated in Vadodara district of Gujarat because of its high vulnerability to climate change. The district has high net sown area (70-80% of the geographical area) and 15-20% probability of drought proneness (ICAR-CRIDA, 2013). Taluka and village selections were based on the groundwater availability and the net sown area, the factors responsible for high climate vulnerability in this district. Survey was conducted in Gothada village of Savli taluka, Dumad and Itola villages of Vadodara taluka. In addition, one village Nana-rampura was selected in the managed watershed for the comparison and survey was completed.

Assessment of sustainability factors for Soil and Water Conservation Projects (Rajesh Bishnoi, Indu Rawat, Bankey Bihari and N.M.Alam-D. Dun)

The project was initiated with the following objectives.

- To identify the different factors responsible for participatory and sustainable management of resource conservation projects

- To quantify the contribution of each factor at different sites of resource conservation projects
- To develop a suitable withdraw strategies considering factorial contributions regarding post project management of resource conservation projects

Achievements/Progress:

Four resource conservation projects of ICAR-IISWC, DehraDun *viz*; Kalimati, Sainji, Almas and Langha were selected for the study. Data were collected from 26 respondents from Kalimati project.

42.30 per cent of the respondents were having high level of cooperation followed by 26.9 per cent under medium category. This indicates that majority of people cooperate and get united for the development and management of resource conservation project on collective basis to achieve their common goal of ensuring water availability to sustain their lives.

38.46 per cent of the respondents had high level of accommodation followed by 30.76 per cent under medium category of accommodation. This indicates that the people of all cast, creed and section forgotten the differences temporarily and get united for common cause of water harvesting and natural resources management through resource conservation projects.

46.15 per cent of the respondents were having high level of assimilation followed by 23.07 per cent under medium category of assimilation. The results indicate that people of area get tuned and became similar by forgetting their differences permanently.

73.0 per cent of the farmers come under the category of very low to low extent of competition. This indicates that people were not competing for limited resources, instead cooperated in all activities of development. The low extent of completion revealed that the people were in the dire need of resources to support their lives and instead of achieving their goal individually they recognized the importance of collective working on resource conservation related issues.

Most of the farmers (65.38 per cent) perceived that the extent of conflict was low to very low. This shows the farmers commitment in solving the common problem of water scarcity through watershed management. On the other hand, a very meagre 11.53 per cent of respondents believed that the conflict was of high extent which might be due to their divergent view regarding the watershed development or due to their own interest basis.

Farmer Participatory Technology Application for Sustainable Resource Management and Livelihood Security in North-Western Himalaya (Bankey Bihari, S.S. Srimali, Lekhchand, U.K. Mourya, Rajesh Bishnoi, D.M. Kadam and Trisha Roy-D.Dun**)**

The project aims at identifying suitable location specific technologies, developing technological modules and application through close interaction, farmer-scientist interface and technical feedback based intervention. Innovation, stakeholder participation at different platforms and livelihood interventions in light of multiple realities including household resources, multi disciplinary approach and climate resilient interventions are the main focus of the proposed project with following objectives:

To enhance farmer–scientist interface, facilitate knowledge enrichment and providing continued technical feedback.

To identify, integrate and assess economically viable and socially acceptable technological options for varied agro-ecological situations.

To develop suitable technical modules for farm families to increase productivity and profitability of the farmers for their livelihood security.

To study the farmers perception about the performance of the technological interventions in varied field situations.

To build network of linkages among different stakeholders/organizations/agencies around the farm household for harnessing their access to information, technology, resources and market.

To analyse the impact of the interventions under the project and suggest suitable strategies for further up-scaling and out-scaling.

Achievements/Progress:

1. Under crop based module, wheat cultivars (VL- 892, VL-907 and HS 507) covering 50 ha area involving 295 farmers were demonstrated at farmers field. VL-892 and 907 was found superior to local cultivar RR-21.
2. Under Horticulture based module, keeping in view the problem of degraded lands and wild animal menace, about 7000 plantations of Jack fruit, Bael, Drumstick and Kagzi Lime were done.
3. Under NRM based module, demonstrations on bunding, checkdam, hydrogel, sipaulin tanks and compost pits have been executed. Total about 89 farmers have been covered.

4. In livestock based module, dual purpose (meat and egg) poultry bird (broiler) was introduced to address the problem of migration and unemployment in the project area. Also, distribution of veterinary medicines was done during animal health camps to control Endo and Ecto parasites in about 2000 no. of animals along with mineral mixtures, UMMB, vitamins and food supplements. Three animal health camps were organized at different villages. Sixty four poultry units were established in which 2000 DOC and starter feed was provided with technical know-how.
5. Nine farmers' goshthies were organized where major problems and issues related to agriculture and allied sectors were discussed for enhancing their income and ensuring their livelihood security. Nineteen scientists-farmers interface meetings/trainings were conducted where all the interventions were discussed and "do how "steps were explained.
6. MoU was signed between ICAR - Indian Institute of Soil & Water Conservation (IISWC), Dehradun and TATA Consultancy Services (TCS) Limited, Mumbai on 26th February, 2018 to collaborate the effortstowards Extension services to the farmers of the nine states (Uttarakhand, Chandigarh, Uttar Pradesh, Rajasthan, Madhya Pradesh, Odisha, Karnataka, Gujarat and Tamil Nadu) across the country. Collaboration is done in regard to ICT based extension activities under the name "IISWC & TCSL Collaboration – PAWS (personalized advisory on water and soil)" which will be based on TCS patented platform mKRISHI®.

Signing of MoU with TCS for ICT Projects

Documentation and validation of ITKs in Soil and Water Conservation practiced by tribal farmers in Tamil Nadu (P. Sundarambal, P. Raja, R. Ragupathy , K. Kannan and V.Selvi- Udhagamandalam**)**

Tribal communities possess sufficient level of traditional wisdom and knowledge which they use in their day to day activities. Since they live in far-flung and remote areas, people outside the tribal habitations are generally unaware of this valuable traditional knowledge. Their wisdom and practices in the genre of soil and water conservation need to be documented and their efficacy validated. Hence the study was taken up. During the period under report, documentation of ITKs on SWC practiced by Kurumbas, Irulas and Malayali tribes of Vellore district were done through interview schedules, group discussion and field visits (Table 5).Validation of three ITKs documented during previous years have been initiated.

Table- 5: Details of SWC ITKs practiced by the tribes of in Vellore district

Name of the ITK	**Advantages**
Construction of stone and earthen bunds	Erosion control, moisture conservation, reduces nutrient loss
Criss- cross ploughing	Improves soil moisture
Planting of Banana and coconut on newly formed bunds	Stabilizes the loose soil immediately after bund formation and economic use of bund portion.
FYM (Cattle, cow &sheep manure) application	Improves soil fertility.
Application of green leaves (Neem, Calotropis, *Veppalai, Ooanakodi, Navamaram, pungam* and Vitex)in paddy	Improve soil fertility.

Mixed-cropping (Samai+Redgram+Avarai/Castor) (Chillies/Brinjal+Cowpea+Castor)	Risk minimization, Effective use of resources and harvesting crop produce in different time intervals
Levelling/*Sathuramadithal* in slopy lands with Indigenous tools *Kudinjal&Parambu*	Moisture conservation and avoid nutrient loss through rain water.
Pond for water harvesting	For irrigation, Fish farming and cattle drinking.
Farm forestry on bunds (Guava, Mango, Jack fruit, Citrus, Coconut, Pungam &Teak with agriculture crops)	To use the bund portion for economic production and control wind action.
Raising indigenous Banana Variety: Malaivazalai/ Udhirampaham).	Grows well with limited irrigation and even under rainfed condition. Can be ratooned up to 5-8 years.
Penning the field with Cattle and Sheep & Goat in movable fence	Improves soil fertility and boost crop productivity.
Raising rainfed crops like samai for one season and leaving the sloppy land fallow for 3-4 years	To give rest to land and to recoup soil fertility To improve soil fertility & to give rest to land
Maintenance of loose boulders as barriers in small gullies	Prevents soil erosion.
Irrigation from streams/ gullies through gravity	Conserves energy and reduces expenditure.
Crop rotation Rainfed: Ragi/Samai/Cumbu/Cholam-Beans-Horse gram/ Gingelly Cotton-Groundnut Irrigated: Paddy-Beans/Other vegetables, Ragi -Beans/Vegetable crops	Help to sustain soil fertility
Use of country plough for summer ploughing	Conserves moisture and reduces expenditure
Use of Lantana, Jatropha, Agave and Poolankuchi plants for live fencing.	Erosion control, protects the field from animals & acts as field boundary.
Crop residue recycling (Stubbles of ragi, samai, paddy and pulses)	Improves soil fertility and moisture conservation.
Multitier cropping (Samai, Avarai, Teak, Mango, Guava, Jack, Coconut &Castor)	Sustained income and soil conservation.
Basin formation around trees	Moisture conservation.
Burning crop residues and weeds & incorporation in soil	Addition of ash to soil and improve soil fertility.
Growing less water demanding crops like Thinai, Samai , Maize in rainfed condition	To reduce water demand and expenditure.
Use of Palanku , an indigenous implement in Groundnut and Ragi cultivation	Used for loosening the soil, thinning and moisture conservation
Agroforestry (Mango/Tamarind/Coconut with horse gram/Cholam/paddy) in rainfed areas	Effective use of resources, sustained income and fertility improvement
Tank silt application	Improves soil fertility
Intercropping(Trees+Flowers/vegetables(Coconut/Banana+Crossandra/vegetables)	Effective resource use, additional yield and income

Pond for water harvesting

Crop residue recycling

Penning with sheep & goat in movable fence

Penning the field with cattle

Green leaves (Neem, Veppalal, Pungam, Nochi) manuring for paddy field

Multitier cropping (samal, Avaral, Teak, Mango, Guava, Jack,Coconut & Castor

Parambu and Kodinjal for Sathuram adithal / leaveling and bunding in slopy lands

Palanku for thinning loosening soil in ragi and groundnut

Planting Banana and coconut on new bund for stabilisation

Stone Bunding

Stone paving in gully banks for erosion control

Live fencing with Lantana, Agave and *Poolankuchi*

Images of ITKs in Practice

Field validation of ITKs

Validation of 3 important ITKs *viz .,* incorporating Eupatorium with FYM, burial of pruned tea leaves and branches in trenches in tea estates and planting of Erythrina in the tea estates are being carried out . Under the Erithrina+pepper +tea system, soil moisture and SOC (2.4%), N (309 kg/ha) and K(294 kg/ha)were higher compare to Silver oak + pepper +tea(Fig-2). In the ITK on burial of tea pruning in trenches in tea estates soil moisture content was more in all the three depths when compared to trenches without tea pruning(Fig -3).

Incorporation of Eupatorium leaves with FYM for reducing acidity and improving soil fertility

Burial of tea prunings in the trenches for moisture conservation

Good growth of potato under Eupatorium incorporated with FYM

Silver Oak+Pepper+Tea

Erythrina+Pepper+Tea

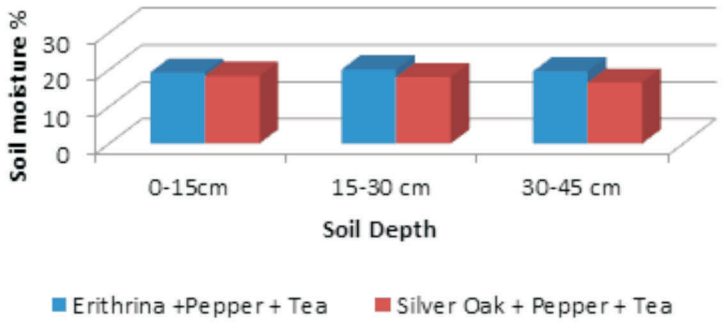


Fig. -2: Soil moisture under Erithrina and Silver oak

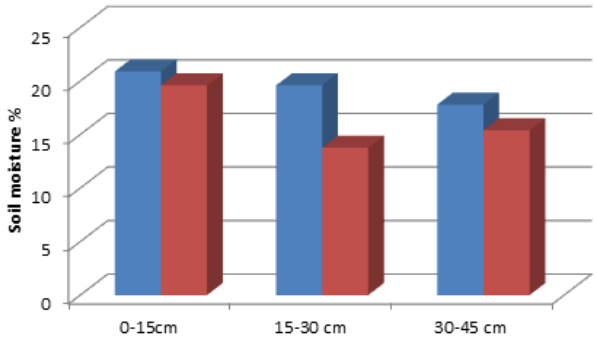


Fig. −3: Effect of burial of tea pruning on soil moisture

Tribal Sub Plan (Scheduled Tribe Components)

Development activities and technology demonstrations on Natural Resource conservation and capacity building in selected tribal village/hamlets in different parts of the country for upliftment of tribal communities were initiated under tribal sub plan (TSP) now known as scheduled tribe components (STC).

Objectives

Ensuring that the share of resources spent for the benefit of the SCs and STs is at least in proportion to their share in proportion of the country.

Substantial reduction in poverty and unemployment among the SCs and STs.

Creation of productive assets in favour of the Scheduled Castes and Scheduled Tribes.

Human resource development of the Scheduled Castes and Scheduled Tribes through specifically providing adequate educational and health services, and

Provision of physical and financial security against all types of exploitation and oppression.

Headquarters/Centres	Districts	State
Districts having tribal village/hamlets selected for implementing Scheduled Tribe Components (Tribal Sub Plan) Headquarters, DehraDun	DehraDun	Uttarakhand
Research Centre, Bellary	Chitradurga	Karnataka
Research Centre, Kota	Dungarpur & Bundi	Rajasthan
Research Center, Koraput	Koraput	Odisha
Research Center, Udhagamandalam	The Nilgiris	Tamil Nadu

Financial Achievements:

The earmarked budget of Rs. 33.00 lakh was allocated to cooperating centers for the year of 2017-18 out of which more than 91 per cent was utilized for implementation of approved activities in selected tribal areas of different districts of the different states adopted by our cooperating centers.

Centre	Sanctioned			Expenditure		
	Operational	Assets	Total	Operational	Assets	Total
Kota	1.50	0	1.50	1.50	0	1.50
Bellary	3.00	0.50	3.50	3.35	0.71	4.06
Ootacamund	5.00	3.00	8.00	6.50	2.63	9.13
Koraput	4.00	4.00	8.00	3.42	3.44	6.86
Dehradun	9.50	2.50	12.00	7.37	1.25	8.62
Total	23.00	10.00	33.00	22.13	8.02	30.15
Expenditure in percentage	--	--	--	96.21	80.21	91.36

Soil and water conservation & water harvesting at Ootacamund

Tapping of spring water by well with stone pitching in Melkuppu and Pudur villages respectively in the Nilgiri district serves five farmers covering 3 ha land in Melkuppu village and provide drinking water for 40 families besides irrigation facility in Pudur villages. This intervention reduced the drudgery of bringing drinking water from far off places for women and children in the tribal areas. Desilting of existing check dams in Melkuppu villages increased the water availability which is benefiting 15 farmers covering 6 hectares of plantation crops in this village.

Physical achievements

Activities	Area / Quantity	No. of beneficiaries
ICAR-IISWC, RC, Udhagamandalam		
Soil and Water Conservation & Water harvesting	2.4 ha	27
Production activities		
a. Goat rearing	12 Goats	6
b. Introduction of coffee pulping machines for value addition and drudgery reduction	4 machines	104
c. Improved implements and agricultural equipments		
d. Horticultural development	3150 plant	50
Capacity Building / Training Programmes	5 trainings	5 trainings
ICAR-IISWC, RC, Koraput		
Mango based agroforestry system	10.0 ha	12
Eucalyptus based agroforestry system	19 ha	28
Distribution and Rearing of Vanaraj chicks	04 SHG	32
Rearing of Japanese Quail for doubling family income	2 villages	52
Demonstration on vegetables	10 ha	103
Creation of irrigation facility (Diesel pump set)	4 villages	47
Distribution of small millets	130 kg	116
Training on mushroom production	01	20
ICAR-IISWC, Dehradun		
Plantation of fifty thousand Lemon grass rooted slips in eroded community land		80
Pit digging (0.45 m x 0.45 m x 0.45) for plantation of forestry sp. In community land		55
Procurement of forestry planting material i.e. MPTs (Banj, Bhimal, Kharik, Reetha)		68
Repairing of existing water tank for rearing fish fingerlings for demonstration purpose		4
Procurement of Lemon plants and distributed among the farmers.		80
Procurement of Onion seedling and distributed among the farmers of sahiya/udpalta.		32
Laying of GI Pipe pipeline for drinking water supply in Udpalta on participatory mode.		80
Drip irrigation system has been installed in the farmers field		1
Three days training programme		20

Traditional medicinal herbal unit and marketing hub for tribal products at Ootacamund

A women self help group (SHG) named Queen of Hills Herbal Product comprising 17 members as executives and farmers from 64 villages is upgraded for large scale production and commercialization of herbal medicinal products through providing pulverizing machines, boiling unit, drying facilities and packaging machines and materials for livelihood support

.

Eucalyptus based agroforestry system at Koraput

Two paired row of Eucalyptus clones are planted at a 6 meter wide. In between the 2 paired Eucalyptus rows,

agriculture crops were cultivated with standard practice. The wide spacing between the paired row will allow the sufficient light for the agricultural crops. The agro forest model will augment the gross return in comparison to mono cropping. The system will also reduce the vulnerability of crop failure. 19 ha area was covered. 28 farmers were benefitted by this system.

Demonstration & Distribution of Vegetable seeds at Koraput

Improved vegetable seeds were distributed to the stakeholders in TSP adopted villages. Seeds of different vegetables *Viz*. Cabbage, Cauliflower, Chili, Cowpea, beans, Radish, Brinjal, Onion Okhra, This initiative covers 103 farmers during this financial year**.**

Promoting Agri-Horticulture

For doubling the farmers' income, the Agri-Horticulture Production System is promoted among the stakeholders of SCSP & TSP program in Hadauti Region/Kota Region of South-Eastern Rajasthan. For extending the benefits of this novel cause/program; total five villages i.e. Kanihera, Jakhana, Pipliya, Maditiya and Delunda in Keshoraipatan Tehsil of Bundi district were selected. Fruit plant saplings of Citrus, Pomegranate, Karonda, Orange, Ber, Lasoda, Sapota and Guava were distributed to the stakeholders to promote Agri-Horticulture Production System in Hadauti Region**.**

Construction of Recharge filters at Ballari

Two recharge filters have been constructed in farmers' field for rejuvenation of low yielding bore wells in Netranahalli and Meramannahalli villages of Molakalmur taluk of Chitradurga district. The construction of recharge filters involves excavation of pits sized 5 m 5 m × 1.5 m (Type 1) and 3 m 3 m × 3 m (Type 2) around the bore wells centering the casing pipes. From the bottom up to 1.2 m, small holes (4-6 mm) were made into the casing pipes which are then wrapped with nylon-mesh to prevent the passage of mud and dust through the holes.

Demonstrations of Bt. Cotton, groundnut (K-9) and redgram (BRG-2with Agromin mixture of micro-nutrient

In 42 farmer fields who have cultivated Bt. Cotton, application of micro-nutrient with improved Bt. Cotton hybrid Superb produced 38% greater yield over farmers cultivated cotton. Similarily, In groundnut (K-9) and redgram (BRG-2), application of micro-nutrient (Agromin), the yields were greater by 50 and 98% over farmers practice.

Mera Gaon Mera Gaurav Programme:

The Mera Gaon Mera Gaurav programme was successfully executed by the institute and its eight research centres located in different agro-climatic regions of the country. Under this programme twenty five (24) numbers of teams of scientists were formed at institute Head Quarters and its research centres. In all one hundred nineteen (120) villages were selected from thirty three blocks identified from twenty One (21) districts of the country. Bench mark survey was conducted in all the villages selected. Various activities under taken are as under.

Soil sampling and distribution of soil health cards to farmers.

General awareness for *Sawchh Bharat* programmes and different schemes of centre and state Government.

Training programmes on natural resource management.

Soil health management and site-specific use of fertilizers.

Packages of practices for annual crops, vegetables and horticultural crops.

Established linkage of farmers with KVKs and KMF.

Demonstration of conservation measures.

Rearing of Japanese quail.

Mushroom production.

Rainwater harvesting pumping.

Lemon grass cultivation.

Capacity building on rainwater harvesting and recycling.

Capacity building on mechanization for millet production.

Interaction meeting with the farmers regarding their needs for sustainable agriculture.

Awareness on adaptation of soil and water conservation measures, agricultural mechanization, rainwater harvesting and recycling, adaptation of high yielding pulses, vermin composting and integrated nutrient management.

Demonstration on use of tractor, power sprayer and vermin- composting.

Compartmental bunding and bench terraces in farmers' field.

Mini tractor, power sprayer, silpaulin sheets for drying pulses, silpaulin vermin beds and distribution of high yielding to the farmers.

In addition of these activities, other technical services were also provided to farmers as their requirements. A total number of 2465 events (visits, interface meets, trainings, demonstrations etc) were organised during the year and a good numbers of farmers took part in the proceedings and got benefitted. Along with this the activities like **Linkages development and** Facilitation for new varieties; seeds, technology etc were also pursued actively.

Swachch Bharat Abhiyan (Clean India Movement):

Swachh Bharat Abhiyan is a campaign initiated by the Government of India. The programme is the largest ever cleanliness drive with the participation of Government employees, and school and college students from all parts of India, in the campaign. The Institute at its level contributed towards the drive by organising various programmes i.e. Swachchta Pakhwada, Swachchta divas etc at institute Head Quarters at DehraDun as well as at its Research Centers.


"मेरा गाँव मेरा गौरव" कार्यक्र
के अन्तर्गत


स्वच्छ भारत अभियान - 2018


स्वच्छता ही सेवा है।


स्वच्छ भारत अभियान


29 08 2017

03 TRAINING AND EDUCATION

Regular Training Programme for Officers:

During the year 2017-18; two batches (116th & 117th) of regular four months Certificate Courses on Soil and Water Conservation and Watershed Management were organised at Institute Headquarters, DehraDun during the period under report. In all 51 officers, that include eleven women participants, attended the course. Up to 31 March 2018, a total of 2913 officers have been trained at institute Head Quarters DehraDun and its regional research centers (Bellary, Kota and Udhagamandalam).

Short course training programmes:

To cater the need of capacity building of different type of stakeholders engaged in soil and water conservation activities in different states across the country a series of training courses, eight in number, were organised. in which 197 participants were trained in soil and water conservation and watershed management. Five sponsoring agencies were enrolled for organisation of training programmes. The major focus was given on practical exposure, skill development and participatory approaches.

Details of Short courses training programmes organised during 2017-18

Name of Training Course	Sponsoring Agency	Date	Total
Training-on drainage line treatment and soil and water conservation for Van Panchayat members	DFO, Alaknanda Soil Conservation Forest Division, Gopeshwar, UK	18-20 May, 2017	18
Administrative Procedures for Administrative Officers and Staff of IISWC	ICAR-IISWC, DehraDun	07th Sept.,2017	25
Ravine Reclamation	Bhoomi Sudhar Nigam, U.P.	11-16 Dec.,17	09
Administrative Staff	ICAR-IISWC, DehraDun	18-22 Dec.,17	45
Horticulture Based alternate Land Use System	Farmer FIRST project –IISWC, DehraDun	02-03 Feb.,2018	25
Exposure on soil and water conservation techniques	Directorate of Agriculture, DehraDun Uttarakhand,	16-17 Feb., 2018	30
Skilled Development for Skilled Supporting Staff	ICAR-IISWC, DehraDun	22-23 March,2018	30
International Training Programme on Soil Water Conservation	IAFS-III	06-20 March.1018	15

Other events organised by Institute and its Research Centres during 2017-18

Event	D Dun	Agra	Bellary	Chandigarh	Datia	Koraput	Kota	Ooty	Vasad	Total
Kisan Diwas	2	2	1	-	-	-	-	-	-	5
Exposure visit	18	3	-	1	26	-	-	2	2	52
Kisan Goshti	5	5	2	-	6	-	-	-	-	18
Exhibitions	6	-	-	-	2	2	1	1	-	12
Swachchta Abhiyan	7	4	1	1	6	2	1	6	1	29
International Yoga Day	1	1	1	1	1	1	1	1	1	9
Worlds Environment Day	-	1	-	-	-	1	1	-	-	3
Agril. Techno.week	-	-	-	-	-	-	1	-	-	1
Sankalp se Siddhi- New India movement	1	1	1	1	1	1	1	1	1	9
Parthenium Awareness Week	1	-	-	-	-	-	1	-	-	2
Sadbhawna Diwas	-	-	1	-	-	-	-	1	-	2
Hindi Saptah/Chetna Mass	1	1	1	1	1	1	1	1	1	9
Himalayan Day	1	-	-	-	-	-	-	-	-	1
Vigilance Awareness Week	1	1	1	1	1	1	1	1	1	9
Animal Health Camp	3	-	-	-	-	-	-	-	-	3
World Soil Day	1	1	1	1	1	1	1	1	1	9
Agriculture Education Day	1	1	1	1	1	1	1	1	1	9
World Water Day	-	-	-	-	-	-	-	1	-	1
Short Course Training Prog.	7	-	-	-	-	1	-	7	1	16
Farmers training	7	-	-	-	10	11	-	4	4	36
International Trg. Prog.	1	-	-	-	-	-	-	-	-	1
Four months regular training programme	2	-	-	-	-	-	-	-	-	2
Winter School	-	-	-	-	-	-	-	1	-	1
World Telecommunication. & Inf. Science Day	-	-	-	-	-	1	-	-	-	1
Van Mahotsav	-	-	-	1	-	-	-	-	-	1
Librarian Day	1	-	-	-	-	-	-	-	-	1
Total	67	21	11	9	56	24	11	29	14	242

04 AWARDS AND RECOGNITION

Dehra Dun:

Dr. Ambrish Kumar chaired a technical session on Water, Environment and Health in the International Conference on Sustainable Technologies for Intelligent Water Management" organized jointly by the Department of WRD&M, IIT Roorkee, and IWRS at IIT Roorkee during Feb. 16-19, 2018.

Dr. Ambrish Kumar delivered a lecture on participatory gravity flow water conveyance system for irrigation in Himalayan foothills in the training programme organized by National Centre for Good Governance (LBSNAA), Mussorie (Uttrakhand) for the senior level officers and engineers of Rajasathan on 23/2/2018.

Dr. Ambrish Kumar invited as a Guest of Honour on the World Water Day -2018 organized by IWRS and Institution of Engineers (India) at IIT Roorkee on March 27, 2018.

Dr. Indu Rawat got 1st prize in 'Nibandh Pratiyogita' organized on the occasion of 'Swachhta hi sewa programme' during 15-9-2017 to 02-10-2017.

Dr. Indu Rawat got 1st prize in an essay competition on 'Rashtrahit me Swachhta ka mahatva' in a programme on Swachhta Pakhwara during Sep 14-20, 2017.

Dr. Indu Rawat got 'Young Scientist award' in the National Seminar on 'Transforming Agriculture to doubling farmers' income' which was organized by Samagra Vikas Welfare Society (SVWS) in association with Babasaheb Bhimrao Ambedkar University, Lucknow during Feb 10-11, 2018.

Dr. Trisha Roy received the Best poster award during the conference FFCSWR, 2018 at AAU, Gujarat for presenting poster on "Use of Pusa Hydrogel to improve the productivity of rice in the foothills of Himalayas"

Dr. M. Sankar, Scientist was conferred with the award of "International Young Scientist Award" for outstanding contribution in Agriuclture in Farmer workshop by Hind Agri-Horticultural Society held at Umarpur, Musaffarnagar (U.P.) on 9th September, 2017.

Dr. Raman Jeet Singh, Scientist received Young Soil Conservationist award of Indian Association of Soil and Water Conservationist for the year 2017.

Dr. M. Sankar, Scientist awarded Visiting Scientist Fellowship by Chinese Academy of Science, to Visit State Key Laboratory of Environmental and Geochemistry, China. Visited from 08.05.2017 to 15.05.2017.

Dr. U.K. Maurya nominated as External Examiner by Sam Higginbottom University of Agriculture Technology and Sciences (SHAUTS), Allahabad to conduct M.Sc. (Ag.) Soil Science and Agricultural Chemistry Examination of Naini Institute of Agricultural (NIA) Sciences, for the period of July-Dec., 2017.

Dr. M. Sankar, Scientist awarded Internal Grant of University of Reading, UK and NERC, Soil Security Programme, UK for participate GCRF collaborative project workshop at University of Reading, UK. Visited from 13.03.2018 to 14.03.2018.

Dr. U.K. Maurya nominated as External Examiner by Banaras Hindu University Varanasi to conduct practical exam of B.Sc. (Hons) at Dept. of Geology, Centre of Advanced Study, Institute of Sciences, during 5-6, Dec. 2017.

Dr. Gopal Kumar, Sr. Scientist awarded best poster award for the poster on "Design and development of up-flow filter and two component filter for direct well recharge" by Gopal Kumar et al., in FFCSWR-2018 held at AAU Anand, Gujarat, 1 to 3rd Feb 2018.

Dr. Gopal Kumar, Sr. Scientist awarded best paper award in oral category for the paper ""Development of a low cost automatic runoff sampling setup for small hilly catchments" by Gopal Kumar et al., in the national seminar on smart farming for enhancing input use efficiency, income and environmental security (SFEIES) at Umiam Meghalaya, from 19th to 21st Sept 2018.

Dr. Gopal Kumar, Sr. Scientist awarded best paper award award in oral category for the paper "Potential litchi growing areas in India and consideration of climate change" by Gopal Kumar et al., in the national conference on "Perspective of Challenges and Options in Litchi Production and Utilization." At ICAR-NRCL,, from 6-8 June 2017.

Dr. Gopal Kumar, Sr. Scientist awarded best paper award in oral category for the paper "Identifying potential litchi growing areas and adaptations under projected climate change" by Gopal Kumar et al., in the national conference on

"Technological challenges and innovations in agriculture for enhancing farmers income" at JAU, Junagarh, Gujarat from 28th to 31st May 2017.

Dr. Gopal Kumar, Sr. Scientist awarded best paper award for the paper "Advances in Understanding Beneficial Plant Microbe Interaction and Their Applications in Litchi" by Vinod Kumar and Gopal Kumar in the national conference on "Perspective of Challenges and Options in Litchi Production and Utilization." At ICAR-NRCL,, from 6-8 June 2017.

Dr. Gopal Kumar, Sr. Scientist won gold medal in Discus throw during North Zone ICAR sports meet-2017 held at ICAR-IISR, Lucknow, 29th Oct -2nd Nov 2017.

Dr. Gopal Kumar, Sr. Scientist won gold medal in Discus throw during ICAR-Inter-Zonal sports meet held at ICAR-NAARM, Hyderabad, 21st to 25th Feb 2018.

Agra:

Dr. S.K.Dubey received award for his contribution in Hindi from NARAKAS Agra.

Ballary:

Dr. S.L. Patil, Head of the Centre, was nominated by DDG (NRM), ICAR, Krishi Bhawan, New Delhi, as a Member of Zonal Monitoring Committee (ZMC) for KVK Gadag and KVK Kalaburgi, Karnataka.

Dr. Ravi Dupdal, Scientist (Ag. Economics), was awarded Ph.D degree by the University of Agricultural Sciences (UAS), Dharwad, Karnataka during 2017.

Sh. Amrut Morade, Scientist (Fruit Science), was awarded Merit certificate in "Conservation Forestry" and "Study Tour" in four months "Certificate Course on Soil and Water Conservation and watershed Management" organized at ICAR-IISWC, DehraDun.

Dr. B.S. Naik, Scientist (Engg) obtained 2nd place in Hindi written competition organized on the occasion of National Hindi Divas on 14-09-2017 at ICAR-IISWC, RC, Ballari (Karnataka).

Datia:

Dr. R.S. Yadav conferred 'Fellow – 2017' Indian Society of Agroforestry by Indian Society of Agroforestry, ICAR – CAFRI, Jhansi

Kota

Dr. Shakir Ali, principal scientist (Engg.), awarded K.F. Antia Memorial Prize by The Institution of Engineers (India) during 32nd Indian Engineering Congress at Chennai on December 21, 2017 for the best paper "Estimation of time variant water availability and irrigation potential of small ponds in a semi-arid region of Rajasthan, India published in *J. Inst. Eng. India Ser. A,* 97(1):43–51.

Dr. G.L. Meena, Scientist (Soils) awarded Young Scientist Award in the International Conference on Conservation and Management of Agricultural & Natural Resources: Strategies for Food Security in Developing Countries organised by Career Point University, Kota, during 8-9th November, 2017.

Dr. H.R. Meena, Sr. Scientist (Horticulture) awarded Life Time Achievement Award in the International Conference on Conservation and Management of Agricultural & Natural Resources: Strategies for Food Security in Developing Countries organised by Career Point University, Kota, during 8-9th November, 2017.

Koraput

Dr. Ch. Jyotiprava Dash awarded Merit Certificate at ICAR- IISWC- Dehradun in Oct, 2017 under 4 month training programme.

Dr. Praveen Jakhar awarded IASWC-Young Scientist Award for the year -2017 by the Indian Association of Soil and Water Conservationist, Dehradun.

Dr. Karma Beer received Shrestha Rajbhasa Karmi Award Nagar Rajbhasa Karyanayan Samiti, Koraput. Sunabeda in 29, Jan, 2018.

Dr. P.P. Adhikary, et al. received best paper award by SADHNA, Dr YS Parmar University of Horti. & Forestry, Solan, HP. in 2018.

Dr. P.P. Adhikary, et al. received best poster award during the conference on FFCSWR-2018, IASWC & AAU, held at Anand,Gujarat in 1-3rd Feb, 2018.

Dr. M. Madhu, et al. received best poster award during the conference on FFCSWR-2018, AAU, held at Anand, Gujarat, 1-3rd Feb, 2018.

Udhagamandalam:

ICAR- IISWC, Research Centre Udhagamandalam has been awarded with second prize for "Best Joint Programme Organizing in Hindi" by Town Official Language Implementation Committee

Dr. O.P.S. Khola, Principal Scientist & Head was the Chief Guest for the Closing Function of Hindi Pakhwara Celebration and Prize Distribution at ICAR - CICR Regional Station, Coimbatore on 27 Oct. 2017.

Dr.V.Selvi received the Best Research Paper Award – 2017 of IASWC, Dehradun during the Inaugural Function of Conference on Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018) held at Anand Agricultural University, Anand during Feb 1-3, 2018.

Dr. K. Rajan, Principal Scientist evaluated one M.Sc. and one Ph.D. Thesis and Dr. P. Raja, Sr. Scientist evaluated one M.Sc. Thesis.

Dr S Manivannan, Principal Scientist (SWCE) attended DPC meeting for promotion of Scientists at ICAR – National Institute of Abiotic Stress Management, Baramati on 15th May 2017 as subject expert member nominated by DG, ICAR.

Dr. S. Manivannan, Principal Scientist was Guest of Honour for the 2nd Annual Greenathon organised under the theme of "Save our shoals and springs" organised at St Joseph's College, Coonoor, Nilgiris on 07.10.2017.

Dr. S. Manivannan, Principal Scientist participated as guest of honour and delivered a special address in special outreach programme on agriculture welfare schemes on 13.12.2017 at Anaimalai, Coimbatore District organized by Department of Field Publicity, Government of India.

Dr. S. Manivannan, Principal Scientist attended Scientific Expert Committee Meeting at Tamil Nadu Pollution Control Board, Chennai on 21.11.2017.

Dr. S. Manivannan, Principal Scientist delivered inaugural address as Chief Guest in the inaugural function of VelaanThiruvizha 2018 (Agriculture Mela 2018) organised by Sakthi Institute of Engineering and Technology on

Dr. P. Raja, Sr. Scientist Chaired the Technical Session on "Paleoclimate and Monsoonal Changes" on 17th August 2017 on 17th August, 2017 in XXVI Indian Colloquium on Micropaleontology and Stratigraphy (ICMS - 2017) organized by Department of Geology, University of Madras, Guindy Campus, Chennai during 17-19 August, 2017.

Dr. P. Raja Sr. Scientist participated as expert member in the panel discussion on "Climate Change Implications on Monsoonal Changes" on 17th August, 2017 in XXVI Indian Colloquium on Micropaleontology and Stratigraphy (ICMS - 2017) organized by Department of Geology, University of Madras, Guindy Campus Chennai during 17-19 August, 2017.

Vasad:

Dr. Gaurav Singh, Scientist (LWME) awarded with third prize in essay writing competition in Vigilance Awareness Week organised at Dehradun during 30.10.2017 to 04.11.2017

Dr. Gaurav Singh, Scientist (LWME) awarded with four merit certificates in 117th batch of four months certificate course on "Soil & Water Conservation and Watershed Management" during 09.10.2017 to 08.02.2018 at ICAR-IISWC, DehraDun.

Dr. V.C. Pande, Principal Scientist et al. awarded best paper during the conference FFCSWR, 2018 at AAU, Gujarat *(*February 1-3, 2018) for the paper entitled "Watershed Management for Resource Conservation and livelihood Security in Central Gujarat".

05 LINKAGES AND COLLABORATION

The Institute and its Research Centres maintains close linkages and work in close association with a number of likeminded institutions engaged in similar type of activities like the Ministry of Rural Development, Ministry of Science and Technology, Ministry of Planning, State Agricultural Universities and other ICAR institutes and conduct collaborative research projects .

Dehra Dun:

Development of efficient and innovative blue and green water harvesting techniques for enhancing the land and water productivity of semi-arid districts of Gujarat, in collaboration with the Department of Science Technology(DST)

National Mission on Sustaining Himalayan Eco-system (NMSHE) - Task force on Himalayan agriculture for lower and middle Himalayan region in collaboration with the Department of Science Technology(DST)

Effect of climate change on hydrology of small watersheds vis-à-vis soil and water conservation measures, in collaboration with the NICRA (National Innovations in Climate Resilient Agriculture)

Environmental tracer based study on erosion induced loss of soil organic carbon and its impact on agronomic productivity and environmental quality, in collaboration with the National Fellow Project (ICAR)

Consortia Research Platform-Water Theme 1 Water Resources Augmentation/ Conservation, in collaboration with the Water Platform Project

Efficient groundwater management for enhancing adaptive capacity to climate change in sugarcane based farming systems in Muzaffarnagar district, (U.P.), in collaboration with the NMSA-MoA Project

Ensuing sustainable agricultural development and livelihood security in lower Shiwalik range of Uttarakhand. In collaboration with the Department of Science Technology(DST)

Establishment of model nursery for fast multiplication of new cultivars of guava, litchi, aonla, pomegranate and mango, in collaboration with the State Horticulture Mission for North East Hills, Uttarakhand

Farmer participatory technology application for sustainable resource management and livelihood security in North-West Himalayas, in collaboration with the Krishi Vigyan Kendra of ICAR

Agra:

Department of Agriculture and Corporation, Ministry of Agriculture, Govt. of India, New Delhi for Resource conservation and management in Jalalpur watershed, Distt. Agra (U.P.)

Ministry of Agriculture, Government of India, New Delhi, under National Bamboo Mission for study on Hydrological and economic evaluation of bamboo plantation in gullied lands under major ravines of India

Central Water Commission, Ministry of Water Resources, Government of India, New Delhi sponsoring Farmers' Participatory Action Research programme in ten villages of Agra district in Uttar Pradesh.

Professional linkage was developed with Forest Department of Uttar Pradesh in research work being executed at Manikpura village of Bah tehsil in collaboration with District Forest Officer, Agra.

Professional linkages were developed with line departments, BSA Ram Ganga Command and ICAR institutes DRMR, Bharatpur, CIRG Makhdoom, CISH, Rehmankhera, Kakori Lucknow, IIPR Kanpur, IGFRI, Jhansi, IISS, Bhopal, IARI, New Delhi and CSSRI, KARNAL.

Plant protection Variety Authority, New Delhi

Forest Department Bhartpur Division

Ballary:

Collaboration with Karnataka Watershed Development Department (Sujala-3), on Technical guidance in DPR preparation, Technical Monitoring and Evaluation of Watersheds.

Collaboration with Agricultural Research Station, Hagari, Siruguppa and Gangavathi, Krishi Vidyana Kendra Hagari, under University of Agricultural Sciences (UAS), Raichur.

Collaboration with University of Agricultural Sciences (UAS), Dharwad.

Collaboration with Krishi Vidyana Kendra Hiriyur, Chitradurga, and Zonal Agricultural Research Station under University of Agricultural and Horticultural Sciences (UAHS), Shimoga.

Collaboration with NBSS&LUP, Benagaluru to prepare soil erosion maps of Karnataka and Andhra Pradesh and maps of watersheds under Sujala III Project.

Collaboration with NABARD, Benagaluru, on Impact Monitoring and Evaluation of Watersheds.

Collaboration with National Seed Corporation, on production of foundation seeds of different crops.

Collaboration with Karnataka Seed Corporation, on production of foundation seeds of different crops

Collaboration with Joint Director of Agriculture, Ballari, on Agriculture Research, Training and Extension.

Collaboration with Deputy Director of Horticulture, Ballari , on Horticulture Research, Training and Extension.

Collaboration with Deputy Director of Fisheries, Ballari, on Fisheries Research, Training and Extension.

Linkage with SAUs of Karnataka, Andhra Pradesh and Maharashtra, on training of B.Tech students in Soil and Water Conservation Engineering.

Joint Director of Mines & Geology Department, (Groundwater), Ballari, **on** Transfer of Technology.

Collaboration with various scientific consortia, on watershed management.

Chandigarh:

Collaboration with Central Ground Water Board, Chandigarh, on ground water recharge through surface ponds.

Collaboration with Punjab Agricultural University, Ludhiana and YSPUHF, Nauni, Solan (HP) through meetings and workshops.

Collaboration with National Institute of Technical Teachers Training and Research (NITTTR), Chandigarh, in regard to Guest Faculty.

Collaboration with DRDA, Himachal Pradesh.

Collaboration with Central Institute of Temparate Horticulture, Kashmir.

Collaboration with IVRI, Research Station, Mukteshwar.

Collaboration with Central Agroforestry Research Institute, Jhansi.

Collaboration with Department of Animal Sciences, Govt. of Himachal Pradesh.

Collaboration with Department of Agriculture, Govt. of Himachal Pradesh.

Collaboration with State Level Nodal Agency (SLNA), Govt. of Haryana.

Collaboration with National Mission on Sustainable Agriculture (NMSA), Govt. of Haryana.

Collaboration with Krishi Vigyan Kendra, Ropar, Punjab.

Datia:

During the year 2017-18 Research Centre, Datia (MP) has maintained linkages with KVK, Datia, district agriculture office, Datia , ICAR – CAFRI, Jhansi and ICAR – IGFRI, Jhansi.

Koraput:

Collaboration with Odisha Watershed Development Mission, Bhubaneswar, Govt. of Odisha for capacitating functionaries on Land & Water Management under IWMP and preparation of District Irrigation Plan of southern six district of Odisha.

Collaboration with Odisha Forestry Sector Development Project, Ministry of Forest, Govt. of Odisha for conducting training programme on "Soil and Moisture Conservation Measures in Forest Areas" and to evaluate the Impact of SMC measures in Forest areas" and consultancy programme on "Evaluation of SMC measures at three forest ranges under Odisha Forestry Sector Development Project"

Professional linkages with SCTI, Koraput; DRDA, Koraput; IGKV, Raipur; OUAT, Bhubaneswar; KVK, DWM, NBSS&LUP, NGOs , MSSRF, Jeypore; RSRS, Koraput;

Collaboration with ICAR RCER, Patna on conducting Integrated Farming System as per recommendation of Regional Workshop on Research Priorities and Reconciliation in Eastern Region" held on 28th May, 2014 at ICAR Research Complex for Eastern Region, Patna.

Linkages with Education Department, Govt. of Odisha for imparting training to school teachers on emerging issues of NRM and climate change.

Linkages developed with District Administration of Southern Odisha (6 nos) for preparation of "District Irrigation Plan" under Prime Minister Krishi Sinchai Yojna (PMKSY).

Udhagamandalam:

Schools / Colleges in the Nilgiris District.
Horticultural Research Station (HRS).
Central Potato Research Station (CPRS), Udhagamandalam, TIFR, Udhagamandalam.
IARI, Regional station, Wellington, UPASI Tea Research Foundation, Coonoor.
SADP, Nilgiris, Department of Agricultural Engineering, Horticulture, Forestry, Animal husbandry.
Forest department, Udhagamandalam.
Agriculture department of Nilgiris and other districts.,
All India Radio,
NAWA (NGO) MYRADA (NGO) and DWDAs of various districts of Tamil Nadu.
National Remote Sensing Agency, ISRO.
ICAR institutes and SAUs from different states.

Vasad:

ICAR- National Bureau of soil survey and land Use planning, Regional Centre, Udaipur.
ICAR- DMAPR, Anand.
Anand Agricultural University, Anand

06 List of Publication

Publication in referred Journal

International

Ch. J. Dash, PP Adhikary, M Madhu, S. Mukhopadhyay, S.K. Singh, P.K. Mishra (2018) Assessment of spatial changes in forest cover and deforestation rate in Eastern Ghats Highlands of Odisha. Journal of Environmental Biology 39(2), 196-203.

D Dinesh**,** L Chithra, M. Sankar, K. Rajan, K. Senthilraja, S. Ramachandran and P. R. Bhatnagar. 2017. Response of treated distillery effluent on soil microbial growth and enzyme activities in maize (*Zea mays* l.) Grown under Vertisols. *Thebioscan.*, 12(4): 1907-1914(NAAS Raiting 5.26)

D Dinesh, L. Chithra, M. Baskar, K. Rajan, K. Senthilraja, M. Sankar, Raj Kumar and K. Sivakumar. 2017. Variation of Soil Microbial Growth and Enzyme Activities by Application of Treated Distillery Effluent in Maize Crop Grown Under Sandy Loam Soils. *Int. J. Curr. Microbiol. App. Sci* (2017) *6*(12): 1334-1348.(...5.38).

D. Dinesh, A. Baskar, K. Rajan. 2017. Effect of cultivation methods and nitrogen management strategies on growth and yield of rice (Oryza sativa L.) grown in coastal alluvial soils of southern India. *International Journal of Current Microbiology and Applied Sciences*, (...5.38)

Debarup Das,Amaresh Kumar Nayak, V. K. Thilagam,DibyenduChatterjee, M. Shahid, Rahul Tripathi, S. Mohanty,Anjani Kumar, B. Lal,Priyanka Gautam, B. B. Panda, S. S. Biswas.2018. Measuring potassium fractions is not sufficient to assess the long-term impact of fertilization and manuring on soil's potassium supplying capacity. Journal of Soils and Sediments.https://doi.org/10.1007/s11368-018-1922-6.

Hameed, A. Raja, P. Ali, M., Upreti, N., Kumar, N., Tripathi, J.K., Srivastava, P. 2018. Micromorphology and Clay mineralogy of Palygorskite bearing calcic-soils from Western Thar Desert: Implications for late Quaternary monsoonal fluctuations. Published online, CATENA, Elsevier, ISSN: 0341-8162.

Kaushak, R., Jayaprakash, J., Mandal, D, Kumar, A., Alam, N.M., Tomar, J.M.S., Mehta, H. And Chaturvedi, O.P. 2017. Canopy management practices in mulberry impact on fine and coarse roots. Agroforest Syst. (... 7.17).

Kaushal, R., Jayaparkash J., Mandal D., Kumar Ambrish, Alam N. M., Tomar J. M. S, Mehta H., Chaturvedi O. P., 20172017. Canopy management practices in mulberry: impact on fine and coarse roots. Agroforestry Systems, Doi.org/10.1007/s10457-017-0148 -8 (...7.17)

Maina Kumari, O.P. Singh and Dinesh Chand Meena "Regional Variation in Agricultural Water Demand and Water Availability in Uttar Pradesh, India" in International Journal of Agriculture, Environment and Biotechnology Citation: IJAEB: 10(2): 253-262, April 2017 DOI: 10.5958/2230-732X.2017.00030.4 (... 4.69)

Maina Kumari, O.P. Singh and Dinesh Chand Meena Crop Water Requirement, Water Productivity and Comparative Advantage of Crop Production in Different Regions of Uttar Pradesh, India" in *Int.J.Curr.Microbiol.App.Sci (2017) 6(7): 2043-2052* (... 5.38)

Pande, V.C., Kurothe, R.S., Kumar, Gopal, Singh, H. B. & Tiwari, S. P. (2018). Economic assessment of agri-horticulture production systems on reclaimed ravine lands in Western India. *Agroforestry Systems*, 92(1): 195-211(...7.17)

PP Adhikary . H. C. Hombegowda . D. Barman . P. Jakhar . M. Madhu, 2017 Soil erosion control and carbon sequestration in shifting cultivated degraded highlands of eastern India: performance of two contour hedgerow systems. Agroforest. Syst., 91: 757–771(...7.17).

PP Adhikary, Ch. J. Dash (2017) Comparison of deterministic and stochastic methods to predict spatial variation of groundwater depth. Applied Water Science 7 (1), 339-348.

R. K. Dubey R. C. Dhaker S. L. Mundra R. C. Tiwari S. K. Dubey and Reena Dubey "Response of Indian mustard to Nutrients and Plant Growth Regulators: The Influence on Yield, Available Soil P Balance and P Recycling through Residues" in *International Journal of Current Microbiology and Applied Sciences ISSN: 2319-7706* Volume 6 Number 8 (2017) (...5.38)

Raja, P., Nilendu Singh, Srinivas, C.V., Mohit Singhal, Pankaj Chauhan, Maharaj Singh and Sinha, N.K. 2017. Analysing energy–water exchange dynamics in the Thardesert. Climate Dynamics. Springer International Publishing, ISSN 0936-577X; DOI 10.1007/s00382-017-3804-9; C085:

Rama Pal, R.K. Dubey, S.K. Dubey and A.K. Singh "Seasonal Variations in Physico-Chemical Properties of Yamuna Water and its Suitability for Irrigation"in International Journal of Current Microbiology and Applied Sciences ISSN: 2319-7706 Volume 6 Number 12 (2017) pp. 1638-1647 (...5.38)

Rama Pal, R.K. Dubey2, S.K. Dubey3 and A.K. Singh3 "Assessment of Heavy Metal Pollution through Index Analysis for Yamuna Water in Agra Region, India" in *Int.J.Curr.Microbiol.*App.Sci(2017)ISSN:2319-7706:6(12):pp:1491-1498(...5.38)

Rama Pal, RK Dubey, SK Dubey, AK Singh and AK Nitant "Assessment of heavy metal pollution of Yamuna water in Mathura region through index analysis approach" in International Journal of Chemical Studies ISSN: 2349–8528 2018; 6(1): 399-402 (... 5.31)

Rama Pal, RK Dubey, SK Dubey, AK Singh and TC Sharma "Assessment of heavy metal pollution of Yamuna water in Mathura region through index analysis approach" in *International Journal of Chemical Studies 2017; 5(6): 1286-1289 ISSN: 2349–8528* (... 5.31)

Rathore, A.C., A.Kumar., J. M. S. Tomar, Jayaprakash, J., H. Mehta, R. Kaushal, N. M. Alam, A. K. Gupta, A. Raizada and O. P. Chaturvedi (2018). Predctive models for biomass and carbon stock estimation in Psidium guajava on bouldery riverbed lands in North-Western Himalayas, India. Agroforestry Systems, 92(1):171-182 (...7.17)

S.Kala, H.R.Meena , I.Rashmi, M.Prabhavati, A.K.Singh and R.K.Singh (2017) "Status of Medicinal plant diversity and distribution at rehabilitated Yamuna and Chambal ravine land ecosystem in India" published in *International Journal current microbiology and Applied sciences* ISSN:2319-7706(6)3:618-630 (... 5.38)

Sharma, N.K., Singh, Raman Jeet, Mandal, D., Kumar, A., Alam, N.M., and Keesstra, S. 2017. Increasing farmer's income and reducing soil erosion using intercropping in rainfed maize-wheat rotation of Himalaya, India. Agriculture, Ecosystems & Environment 247: 43-53. (NAAS rating 10.04)

Singh, Raman Jeet, Ghosh, B.N., Sharma, N.K., Patra, S., Dadhwal, K.S., Meena, V.S., Deshwal, J.S., and Mishra, P.K. 2017. Effect of seven years of nutrient supplementation through organic and inorganic sources on productivity, soil and water conservation, and soil fertility changes of maize-wheat rotation in north-western Indian Himalayas. Agriculture, Ecosystems & Environment 249: 177-186. (... 10.04)

SoumitaMitra, SwayambhuGhosh, Kamala KantaSatpathy, Bhaskar Deb Bhattacharyaa, Santosh Kumar Sarkara,, Pravakar Mishra, P. Raja. 2017. Water quality assessment of the ecologically stressed Hooghly River Estuary, India: A multivariate approach. Marine Pollution Bulletin, Elsevier Ltddoi.org/10.1016/j.marpolbul.2017.09.053

Surendran, U. Kumar, V., Ramasubramoniam, S. and Raja, P. 2017. Development of Drought Indices for Semi-Arid Region Using Drought Indices Calculator (DrinC) – A Case Study from Madurai District, a Semi-Arid Region in India. Water Resources Management (May 2017), An International Journal – Published for the European Water Resources Association (EWRA), Springer International Publishing, DOI 10.1007/s11269-017-1687-5; ISSN 0920-4741.

National

A.K.Singh, S. Kala, S.K.Dubey, K.K.Sharma, A.K.Parandiyal, B.K.Rao and B.Prasad (2017) "Resource conservation and Economic utilization of Yamuna Ravine land through bamboo (Dendrocalmus Strictus) plantation" published in Indian Forester, 143(4):328-333

Akram Ahmed., J.M.S. Tomar, H. Mehta, R. Kaushal, D. Deb, O.P. Chaturvedi and P. K. Mishra. 2018. Throughfall, stemflow and interception loss in Grewia optiva and Morus alba in north west Himalayas. Tropical Ecology **(... 6.00)**.

Bankey Bihari, Lakhan Singh, Rajesh Bishnoi and Suresh Kumar (2017) Prioritization of training needs and constraints faced by watershed field functionaries and farmers. *Indian Journal of Agricultural Sciences*. 87(5): 30-36. [... 6.00]

Biswas, H.; Raizada, A.; Kumar, S.; Prabhavathi, M. and Mohan Kumar, P. (2017). Impact of deficit rainfall coupled with high groundwater exploitation on water quality in semi-arid region of Karnataka. *Indian Journal of Soil Conservation,* 45: 60-65.(...5.20)

Biswas, Hrittick; Raizada, A.; Kumar, Suresh; Prabhavathi, M. and Mohan Kumar, P. (2017). Impact of deficit rainfall coupled with high groundwater exploitation on water quality in semi-arid region of Karnataka. *Ind. J. Soil Cons.,* 45(1): 60-65. (...5.20)

Ch. J. Dash, PP Adhikary, M Madhu, DC Sahoo, BK Dash, GB Naik, GW Barla (2017). Traditional soil and water conservation practices by the tribal farmers in Koraput district of Odisha. Indian Journal of Soil Conservation 45 (2), 227-234.

Chandra Shekhar Sanwal, Raj Kumar, Sneha Dhobhal, Sushma Kerkatta and S.D. Bhardwaj, "Production and conservation of medicinal plants in understory of degraded Chir pine forests using suitable techniques" Current Science, Vol. 112, No.12, 25 June 2017(...6.84)

Chaudhary, V.P., Parmanik, Monalisha and Patel, A. (2017). Effect of Conservation Tillage and Crop Residue Management on Soil Physical Properties and Crop Productivity of Wheat. *Agricultural Mechanization in Asia, Africa and Latin America,* 48 (4): 62-70. (...6.12)

DC Sahoo, M Madhu, PP Adhikary, Ch. J. Dash, SS Sahu, S Devi (2017) Adoption behaviour of different soil and water conservation measures among tribal farmers of Gajapati, Odisha. Indian Journal of Soil Conservation 45 (1), 112-116.

Dev, I; Ram, A.; Ahlawat, S.P.; Palsania, D.R.; Newaj Ram; Tewari, R.K.; Singh, R.; Sridhar, K.B.; Dwivedi, R.P.; Srivastava, M.; Chaturvedi, O.P.; Kumar, R.V. and Yadav, R.S. (2017). Bamboo (*Dendrocalamus strictus*) + sesame (*Sesamum indicum*) based Agroforestry model: A sustainable livelihood option for farmers' of semi-arid region. *Indian J. Agricultural Sciences*, 87 (11): 1528-34.(...6.22)

Devra, Singh, N., Kaushik, R.A. and Meena, H.R. (2017). Standardization and Storage Study of Aonla (*Emblica officinalis* Gaertn) based Blended Ready-To-Serve Beverages. *International Journal of Current microbiology and applied sciences*, 6(5): 1275-1284.(…5.38)

Dinesh, D., Chithra, L., Baskar, M., Rajan, K., Senthilraja, K., Sankar, M., Raj Kumar and Sivakumar, K. (2017). Variation of Soil Microbial Growth and Enzyme Activities by Application of Treated Distillery Effluent in Maize Crop Grown Under Sandy Loam Soils. Int.J.Curr.Microbiol.App.Sci (2017) 6(12): 1334-1348

Dinesh, D., Chithra, L., Sankar, M., Rajan, K., Senthilraja, K., Ramachandran, S. and Bhatnagar P. R. (2017). Response of treated distillery effluent on soil microbial growth and enzyme activities in maize (Zea mays l.) Grown under Vertisols. Thebioscan., 12(4): 1907-1914.

Dupdal, Ravi and Patil, B.L. (2017). Economic analysis of farmer's awareness and perception about weather based crop insurance as tool of mitigation against climate variability in north Karnataka. *International Journal of Commerce and Business Management,* 10(2):77-82.(....4.14)

Gupta, G., Yadav, R.S. and Maurya D. (2017). Decomposition of Different Litter Fractions in Agroforestry System of Central India. *Int. J. Curr. Microbiol. App. Sci.* 6 (9): 1089-1097. (...5.38)

Kala, S, Reeja, S. and Kumaran, K. (2017). First Report on Success of Stem Cuttings on *Simarouba glauca,* Dc – An Easy Method for Mass Multiplication of Superior Mother Trees. *Int.J.Curr.Microbiol.App.Sci.,* 6(4): Pp.2646-2653.(…5.38)

Kala, S., Kumaran, K., Srimathi, P., Reeja, S. and Singh, R.K. (2017). Studies on Variability, Correlation and Path Analysis Using Important Seed Traits in *Bixa orellana* (L). *Journal of Tree Sciences*, Vol.36, No.1, Pp.94-102.(…3.51)

Kala, S., Meena, H. R., Rashmi,I., Prabavathi, M., Singh, A. K., and Singh, R. K. Singh (2017). Status of Medicinal Plants Diversity and Distribution at Rehabilitated Yamuna and Chambal Ravine land Ecosystems in India. *International Journal of Current microbiology and applied sciences*, 6(3): 618-630. (…5.38)

Kumar, A., Dhyani, B.L., Bihari, B, Mandal, D., Singh. C., Desai, S, Shrama, S.K. and Garg, S. 2017. Design and development of gravity flow water conveyance system for irrigation in Himalayan foot hills Indian Journal of Soil Conservation 45(1): 40-44., (... 5.20)

Lekh Chand and R. Puniya (2017). Bio-efficacy of alone and mixture of herbicides against complex weed flora in wheat (Triticum aestivum) under sub-tropical conditions. Indian Journal of Agricultural Sciences 87 (9), 1149-1154 [... 6.00]

Madhu, M., Ragupathy, R., Hombegowda, H.C., Muralidharan, P. and Khola, O.P.S. 2017..Initial growth performance of Shola species under enrichment plantation in the Nilgiris, Tamil Nadu. Journal of Environmental Biology, 38 91) 91-95.

Maina Kumari, O.P. Singh and Dinesh Chand Meena "Crop Diversification: Contribution to Agricultural Growth in Eastern and Bundelkhand Regions of Uttar Pradesh" in Trends in Biosciences 10(24):ISSN0974-8431, 5009-5014, 2017 (... 3.91)

Mandal, U., Panda, R.K., Mishra, P.K., Alam, N. M., Kar, G. (2017) Conceptualization of community-based integrated farming system model design with multi-objective optimization management, Current Science, 112(11), 2234-2242. (... 6.97)

Manivannan.S, V. Kasthuri Thilagam and O.P.S. Khola, 2017. Soil and water conservation in India: Strategies and Research Challenges. Journal of Soil and Water Conservation 16 (4): 312-319.

Meena, G.L., Singh, R.S., Singh, R.K., Meena, H.R., Meena, S. and Mina, B.L. (2017). Assessment of soil productivity potential of some soils of Aravali hills based on parametric approach. *Indian Journal of Soil Conservation*, 45(1): 28-39.(…5.20)

Meena, L.R.; Yadav, R.S. and Kumar, S. (2017). Enhancing productivity, profitability and soil health through integrated nutrient management in ber-based hortipasture system in Rajasthan. *Range Mgmt. & Agroforestry,* 38 (1):100-107.(...6.32)

Mehta, Harsh., Raj Kumar, Ayub Darr, G.P. Juyal, Sridhar Patra, Sneha Dobhal, A.C. Rathore, Rajesh Kaushal, P.K. Mishra.2018. "Effect of geojute technique on density, diversity and carbon stock of plant species in landslide site of North West Himalaya, Journal of Mountain Science 11629. Naas J334-7.02 dated May,07 2018.

Mishra, C.D., Tiwari, Y.K., Nema, R.K., Nema, A.K., Singh Gaurav and Kumar Rajesh (2018). Effect of irrigation sources on yield of wheat crop in selected canal command area of Rani Avanti Bai Sagar irrigation project. Journal of Agrometeorology, 20 (Special issue I), 58-62(…6.40)

Narayan, D., Kumar, P., Kumar, M. and Yadav, R.S. (2017). Rainwater harvesting practices and resource conservation in agroforestry system in red soils of Bundelkhand. *Indian J. Agroforestry*, 19 (2): 34-37.(...4.53)

Narayan, D.; Tiwari, S.P. and Biswas, H. (2017). Augmentation of productivity and profitability through resource conserving technologies at cultivator's field in Central India. *Indian Journal of Soil Conservation,* 45: 214-222.(...5.20)

Narayan, D.; Tiwari, S.P. and Biswas, H. (2017). Augmentation of productivity and profitability through resource conserving technologies at cultivator's field in Central India. *Indian J. Soil Cons.,* 45 (2): 214-222.(...5.20)

Nath, V., Kumar, G., Pandey S.D. and Gupta A. (2017) Status of litchi in India, Acta Horticulture, accepted dated-13-9-2017.

Pande, V. C., Rao, B. K., Bhatnagar, P. R. (2017). Can Watershed based interventions be panacea to agrarian distress in Vidarbha Region of Maharashtra, India: A Case Study. *Journal of Rural Development*, 36(4): 607-628(...4.58)

Patil S.L. and M.N. Ramesha (2018). Impact of improved production technologies on chickpea yields, economics and energy use in rainfed Vertisols. *Legume Research*. 41(1): 79-86(...6.12)

Patil. B.L.; Radhika V. S.; Avinash C. S. and Dupdal, Ravi (2017). Economics of Low and Unstable Yield in Rainfed Area and Policy Panacea for the Farming in Northern Karnataka. *Int. J. Pure App. Biosci.,* 5(6):54-58.(...4.74)

R.B.Meena, A.K.Singh and D.C.Meena "Post adoption behavior of farmers towards soil and water conservation technologies in watershed management programme"in Journal of Soil & WaterConservation16(3):285-292,July-September2017ISSN:022-45x;2455- 7145;DOI:10.598/2455.2017,00042.X (... 5.08)

R.C.Dhakar, R.K.Dubey, R.C.tiwari and S.K.dubey " Water use ,yield and economics of fenugreek (Trigonella foenum-graecum L.) under verying IW-Cpe ratios and fertilizer levels in South West Rajasthan" published in Legume research 40(4):726-730

Ram C., Singh H.B, Patel, R.B. and Kumar, G. (2018) Effect of application of manures and bio-fertilizers on yield, soil fertility and economics of Groundnut (*Arachis hypogaea* L.) under middle Gujarat conditions, International Journal of Chemical Studies 6(2): 751-753.

Rama Rao, C.A.; Raju, B.M.K.; Samuel, Josily; Dupdal, Ravi; Sudhakar Reddy, P.; Yella Reddy, D.; Ravindranath, E.; Rajeshwar, M. and Srinivasa Rao, Ch. (2017). Economic Analysis of Farming Systems: Capturing the Systemic Aspects. *Agricultural Economics Research Review.* 30(1):37-45.(...5.90)

Rashmi, I., A.K. Biswas, K.C. Shinogi and Kala, S. (2017). Phosphorus Movement and Vertical Distribution in Four Soil Orders of India: Column Leaching Experiment. *Int.J.Curr.Microbiol.App.Sci.* 6(4): 1919-1930.(…5.38)

Sangita Aba Khatal, Ali, S., Hasan, M., Singh, D.K. Mishra, A.K. Iquebal, M.A. (2018). Assessment of Groundwater Recharge in a Small Ravine Watershed in Semi-arid Region of *India. Int.J.Curr.Microbiol.App.Sci*. 7(2): 2552-2565**.** (…5.38)

Sanjay K. Singh, Anil Kumar, Karma Beer, Ved P. Singh and Sohan K. Patel 2018 Effect of Naphthalene Acetic acid (NAA) and Gibberellic acid (GA3) on Growth and Fruit Quality of Tomato (*Lycopersicon esculentum* Mill.). *Int.J.Curr.Microbiol.App.Sci* (2018) *7*(3).

Selvi, V., A. Raviraj, S.V. Kottiswaran, D.Suresh Kumar and V. Geethalakshmi. 2017. Impact of water harvesting structures on runoff and soil loss in Ayalur watershed, Erode district, Tamil Nadu, Indian Journal of Soil Conservation, Vol.45, No.3, pp 270-278

Selvi, V., A. Raviraj, S.V. Kottiswaran, D.Suresh Kumar and V. Geethalakshmi (2017).Assessment of potential ground water recharge from water harvesting structures in Ayalur watershed, Erode district, Tamil Nadu, India. Trends in Biosciences, 10(30):6329-6337.

Singh, D.V., S. Patra, P.K. Mishra, N.K. Sharma, D.M. Kadam, Amrut S. Morade and D.K. Tomar (2018). Spring Water Harvesting System can Double the Farmers' Income in Hilly Areas. *Indian Farming,* 68(01):91-93.

Singh, Deepak and Goyal, V.C. (2018). Planning of Agricultural Inputs in Watershed to Maximise net Benefit under Limited Resource. Indian Journal of Agricultural Sciences, 88 (2):326-332. [... 6.00]

Singh, G., Singh, S., Singh, R. M., Kumar, R., & Mishra, C. D. (2017). Assessment of natural groundwater recharge in Sonar sub-basin using HELP3 model: A case study. *Indian Journal of Soil Conservation*, *45*(2), 176-182(…5.20)

Singh, Raman Jeet (2017). Sustainable intensification of transgenic cotton in India - A review. Indian Journal of Agricultural Sciences 87 (10): 1267-1276. (... 6.17).

Yadav, S.K., Sarolia, D.K., Pilania, S., Meena, HR. and Mahawer, L.N. (2017). Studies on Keeping Quality of Preserved Guava Pulp during Storage. *International Journal of Current microbiology and applied sciences*, 6(3): 1235-1242. (…5.38)

Conference and Symposia Papers

International

Kala, S., Parandiyal, A.K.,Mina, B.L., Rashmi, I., Meena, H.R. and Singh, R.K. (2017). Selected Tree Farming Systems for Carbon Mitigation and Effective Utilization of Chambal Ravines. In Compendium of Abstract, 3rd International Conference on Bioresource and Stress Management, held during 8-11 November, 2017 at Jaipur, India: 390.

Kasthuri Thilagam, V., S. Manivannan and O.P.S. Khola (2018).Effect of fertilizer applications on water quality in Sillahalla watershed of Nilgiris District. Abstracts, International Conference on 'Emerging Synergies in Agriculture, Food Processing Engineering and Biotechnology' at Karunya Institute of Technology and Sciences, Karunya University, Coimbatore, 21- 23 February 2018

Kumar, A., Ali, Shakir, Kumar, K. and Singh, R.K.(2017). Post adoption behavior of farmers towards Soil and water conservation measures in South eastern Rajasthan. In Abstracts(souvenir) International Conference on Conservation and Management of Agricultural & Natural Resources: Strategies for Food Security in Developing Countries organized by Career point university, Kota, India, during November 08-09, p.49.

Kumar, K., Mina, B.L., Ali, Shakir, Kumar, Ashok and Singh, R.K.(2017). Conservation tillage systems for enhancing productivity and resource use efficiency in Rain fed area of south-eastern Rajasthan. In Abstracts(souvenir) International Conference on Conservation and Management of Agricultural & Natural Resources: Strategies for Food Security in Developing Countries organized by Career point university, Kota India, during November 08-09, p.16.

Meena, G. L., Singh, R. K., Meena, H. R., Sethy, B. K. and Mina, B. L. (2017). Quantitative Assessment of Runoff and Soil Loss under Predominant Land Use Systems of South-eastern Rajasthan. International conference on "Conservation and Management of Agricultural Resources: Strategies for food security in developing countries (ICFS- 2017)", held at Career Point University, Kota (Raj.), India, during November 08th -09th, 2017.

Meena, G. L., Singh, R. K., Meena, H. R., Sethy, B. K., Mina, B. L. and Rashmi, I. (2017). Determination of Crop Co-efficient Values of Soybean For Hadauti Region Using Fao 56 Penman-monteith Approach. International conference on "Conservation and Management of Agricultural Resources: Strategies for food security in developing countries (ICFS- 2017)", held at Career Point University, Kota (Raj.), India, during November 08th -09th, 2017.

Meena, H.R.; Kaushik, R.A.; Sarolia, D.K., Kala, S.; Singh, R.K.; Meena, G.L.; Mina, B.L. Mina and Rashmi,I. (2017). Effect of organic, inorganic and bio fertilizers on productivity and profitability of Sapota Cv. Kalipatti. In Souvenir, International Conference on "Conservation and Management of Agricultural Resources: Strategies for Food Security in Developing Countries" held during November 08-09, at Career Point University, Kota, Rajasthan: 24.

Mina, B.L., Rashmi, I., Kumar, K., Ali, s., Kumar, Ashok and Singh, R.K.(2017): Effect of soil amendments on yield and soil fertility status under soybean-mustard cropping system. In Abstracts(souvenir) International Conference on Conservation and Management of Agricultural & Natural Resources: Strategies for Food Security in Developing Countries organized by Career point university, Kota, India, during November 08-09, p.18.

Pawan Sharma, Vinod Kumar Bhatt, Sathiya, Krishnamurthy, Harish Sharma, and Lekh Chand (2017) Organic nutrient management and intercropping for improved rainwater conservation and productivity under rain fed maize-barley rotation. Proceedings of the Scientific Track at the Organic World Congress November 9-11, 2017 Volume 1

National

Ali, Shakir, Sethy, B.K., Parandiyal, A.K., Kumar, Ashok, . Singh, R.K and Mina, B.L. *(2018)* Effect of staggered contour trenching on effective rainfall, yields and soil properties in ravine lands of Chambal river. Abstracts Conference on "Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018), February 1-3, 2018. Indian Association of Soil and Water Conservationists, Dehradun, Uttarakhand: 17.

Bhatnagar, P.R. (2018) "Soil and Water Conservation Techniques for Horticultural Development in Degraded Lands". Paper presented in "National Seminar on Natural Resources Management for Horticultural Crops under changing climatic conditions" at Centre for Water Resources Development and Management (CWRDM) Kozhikode during 16-17, March 2017.

Bhatnagar, PR and VC Pande. 2018. Prevention of Ravine Advancement and its Reclamation Strategies in Mahi River Basin. Presented in 52nd Annual Convention of Indian Society of Agricultural Engineers (ISAE) and National Symposium on Doubling Farmer's Income through Technological Interventions, held at Anand Agricultural University, Anand during 8-10 January, 2018.

Bhatnagar, PR. 2018. Prevention measures of water erosion and rainwater harvesting. Presented in the conference on 'Farmers First for conserving soil and water resources in Western region' held at Anand Agricultural University, Anand during Fenruary 1-3, 2018.

D. Dinesh, Gopal Kumar,Vijay Kakade, P.R. Bhatnagar, A.K. Vishwakarma, Nyonand & R.S. Kurothe presented "Effect of slope land cultivation on soil loss through sediments and runoff, crop yield under rainfed pearl millet (*Pennisetum glaucum*)" in the Conference on FFCSWR-2018 organized by IAS&WC during 1-3 Feb., 2018 at AAU, Anand

D. Dinesh, Raj Kumar, V.C. Pande & P.R. Bhatnagar (2018) "Soil organic carbon stock and chemical properties of rehabilitated and un-rehabilitated land use under Mahi ravine ecosystem". Paper presented in the Conference on FFCSWR-2018 organized by IAS&WC during 1-3 Feb., 2018 at AAU, Anand

D. Dinesh, Raj Kumar, V.C. Pande & P.R. Bhatnagar presented "Soil organic carbon stock and chemical properties of rehabilitated and un-rehabilitated land use under Mahi ravine ecosystem" in the Conference on FFCSWR-2018 organized by IAS&WC during 1-3 Feb., 2018 at AAU, Anand

D. Dinesh, Gopal Kumar,Vijay Kakade, P.R. Bhatnagar, A.K. Vishwakarma, Nyonand & R.S. Kurothe (2018) "Effect of slope land cultivation on soil loss through sediments and runoff, crop yield under rainfed pearl millet (*Pennisetum glaucum*)". Paper presented in the Conference on FFCSWR-2018 organized by IAS&WC during 1-3 Feb., 2018 at AAU, Anand

Er Gaurav Singh, Scientist Participated in "All India seminar on scientific mining of river bed material and environmental impact in hilly and foot hill regions" at Dehradun on 24th and 25th October, 2017 organised by The Institution of Engineers (India), Uttarakhand State Centre Dehradun, Indian Association of Soil and Water Conservation and ICAR-IISWC, DehraDun.

Kala ,S., Mina,B.L., Kumar,Ashok, Pandey,V.C., Meena,H.R., Rashmi,I. and Singh ,R.K. (2018) Assessment of carbon sequestration potential in well-managed ravine plantations versus natural forest of Chambal ravines ecosystem. Abstracts Conference on "Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018), February 1-3, 2018. Indian Association of Soil and Water Conservationists, Dehradun, Uttarakhand: 65.

Khola, O.P.S., K. Kannan, D.V. Singh and V. Selvi (2018). Alternate Land Use and Cropping System Strategies for Increasing Farm Income – A Case Study in Semi Arid Watershed.Abstracts. Conference on Farmers First for Conserving Soil and Water Resources in Western Region, Anand Agricultural University, Anand, 01-03 Feb. 2018.

Kumar Ashok, Ali Shakir and Singh R.K.(2018): Status, uses, institutional arrangement and impact of community based water storage structures in Udaipur district of Rajasthan state. Abstracts Conference on "Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018), February 1-3, 2018. Indian Association of Soil and Water Conservationists, Dehradun, Uttarakhand: 84-85.

Meena G. L., Singh R K, Meena H R, Sethy B K and Mina B L (2018). Implications of different land use systems on soil loss and runoff generation at the plot scale in the semi-arid region of western India. National conference on "Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018)" held at Anand Agricultural University Anand (Gujarat) during 01st- 03rd February, 2018.

Meena, G.L., Singh, R.K., Meena, H.R.; Sethy, B.K. and Mina, B.L. (2018). Implications of different land use systems on soil loss and runoff generation at the plot scale in the semi-arid region of Western India. In Compendium of Abstract Papers (N.K.Sharma *et.al*, eds.) "Conference on Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018)" during February 1-3, 2018 at AAU, Anand, Gujarat: 25.

Meena, H.R., Kaushik, R.A., Sarolia, D.K., Kala, S., Meena, G.L., Singh, R.K. and Mina, B.L. (2018). Effect of integrated nutrient management on nutrient availability and fruit yield of sapota in vertisols of South-Eastern Rajasthan. In Compendium of Abstract Papers (N.K.Sharma *et.al*, eds.) "Conference on Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018)" during February 1-3, 2018 at AAU, Anand, Gujarat: 23.

Mina, B.L., Kala, S., Meena, H.R., Ali, Shakir, Kumar, Ashok, Meena, G.L. and Singh, R.K. (2018).Screening of suitable tree species for rehabilitation of stone mine spoiled areas of South-Eastern Rajasthan. Abstracts Conference on "Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018), February 1-3, 2018. Indian Association of Soil and Water Conservationists, Dehradun, Uttarakhand:4.

P Meena, Scientist Participated in "All India seminar on scientific mining of river bed material and environmental impact in hilly and foot hill regions" at Dehradun on 24th and 25th October, 2017 organised by The Institution of Engineers (India), Uttarakhand State Centre Dehradun, Indian Association of Soil and Water Conservation and ICAR-IISWC, DehraDun.

Pande, V. C, R S Kurothe, D R Sena, B K Rao, Gopal Kumar, Anand Vishwakarma, Nyonand, G L Bagdi, M L Gaur, P R Bhatnagar (2018) "*Watershed Management for Resource Conservation and livelihood Security in Central Gujarat*". Paper presented in the conference on 'Farmers First for conserving soil and water resources in Western region' being held at Anand Agricultural University, Anand during February 1-3, 2018.

Pande, V. C., P R Bhatnagar, Raj Kumar and D Dinesh (2018) "*Mahi ravine ecosystem – Farmers' Perception, Ecosystem Services and suggested Interventions for Conservation*". Paper presented in the conference on 'Farmers First for conserving soil and water resources in Western region' being held at Anand Agricultural University, Anand during February 1-3, 2018.

Raja P and K Rajan (2018). Climate smart agriculture to combat land degradation, enhance crop preoductivity and food security in water stressed arid ecosystem, Thar region, Western India. 105th Indian Science Congress, Manipur University, Canchipur, Imphal, 16-20 March 2018.

Selvi, V., D.V. Singh, K. Kannan and O.P.S. Khola (2018).Silpaulin lining of earthen storage ponds as vital intervention for boosting farmers' income in semi-arid regions of India.Abstracts. Conference on Farmers First for Conserving Soil and Water Resources in Western Region, Anand Agricultural University, Anand, 01-03 Feb. 2018.

V.C Pande, P.R. Bhatnagar, Raj Kumar, D. Dinesh and Suraj Patel. presented "Mahi ravine ecosystem- Farmer's perception, Ecosystem Services and suggested Interventions for Conservation" in the Conference on FFCSWR-2018 organized by IAS&WC during 1-3 Feb., 2018 at AAU, Anand

Vijaysinha Kakade , D. Dinesh, P.R. Bhatnagar, V.C. Pande, O.P. Meena (2018) " Root and shoot growth influenced by length of cutting in Dragon fruit: A future fruit crop for water scarce areas". Presented in the conference on 'Farmers First for conserving soil and water resources in Western region' held at Anand Agricultural University, Anand during Fenruary 1-3, 2018.

Vijaysinha Kakade, D.Dinesh, P.R. Bhatnagar, V.C. Pande and O.P. Meena (2018) "Root and shoot growth influenced by length of cutting in Dragon fruit: A Future fruit crop for water scarce areas". Paper presented in the Conference on FFCSWR-2018 organized by IAS&WC during 1-3 Feb., 2018 at AAU, Anand

Vijaysinha Kakade, D.Dinesh, P.R. Bhatnagar, V.C. Pande and O.P. Meena presented "Root and shoot growth influenced by length of cutting in Dragon fruit: A Future fruit crop for water scarce areas" in the Conference on FFCSWR-2018 organized by IAS&WC during 1-3 Feb., 2018 at AAU, Anand

Popular article

Dinesh, D., Rajan, K., Sankar, M., Manikandan, K., Kasthuri Thilagam, V. and Kannan, P. (2017). Managing plant disease by managing soils. RASHTRIYA KRISHI.12 (2): 115-117.

Naik, B. S. (2017). Roof top rainwater harvesting: a need of the hour to mitigate water scarcity. In: Technical bulletin: The Institution of Engineers (India), 50th Engineers' Day, Sunabeda Local Center, Sunabeda Koraput (Odisha): 4-6.

Ramesh Chandra Dhakar, ,R.K.Dubey, Gautam Singh Dhakarad and Hansraj Dhakar (2017) " Anar ke podhe taiyar karne ki Vidhi " published in Krishi Suraksha April, 2017 pp-15-16

Ramesh Chandra Dhakar, Gautam Singh Dhakar, R.C.Tiwari and R.K.Dubey (2017) " Bahuupyogi fasal methi" *published in krishi suraksha Krishi Surksha May ,2017 pp23-25*

D C Sahoo, Karma Beer and Mukesh Kumar Meena (2017), Jev Abhiyantriki se bhumi sanraksan, Kheti, August (28-30)

Mukesh Kumar Meena, B S Naik, Hombe Gowda, M Madhu and S. Kindal (2017), Sambuta gas se sambhav hai mrida sanraksna, Kheti, (58-60).

Karma Beer, Mukesh Meena and Vikas Yadav (2017) Strawberry Farming: Cultivation of Strawberry for Small and Marginal Farmers, *Krishi sandesh* http://www.krishisandesh.com/strawberry-farming/

Malay marut Sharma, Karma Beer, Mukesh Kumar Meena and awadesh Gupta (2017), Gunkari ausdiye podhe, Kahaar patrika ankh 4 (1-2) P 26-28.

Kala S, Meena H R, Rashmi I, Ali Shakir, Reeja S and Singh R K (2017). *Cassia auriculata* L. - An Imperative Shrub for Cultivation in Non-arable Dryland Farming Systems. *Popular Kheti*, 5(3): 02-06.

Kumar, Ashok, Kumar, K and Singh,R.K.(2017): Phasal Utpadan me Tikau vradhi. Hetu Bhoomi avam Jal Sarraksan ke Upay. *Kisan Gyan*, 1(9), Pp16-18.

Meena, H. R. (2017). *Chambal ke Beehadon ka Bael Utpadan me Sadupyog*. Krishi Amrit, 16(1): 04.

Meena, H. R., Meena, M. S., Kala, S. and Singh, R. K. (2017). Bael- The Most Natural Medicinal Fruit of Waste Lands. *Popular Kheti*, 5(1): 55-60.

Meena, H. R., Meena, M. S., Kala, S, Meena G L, Mina B L and Rashmi I (2017). Sapota- A New Introduction and Remunerative Fruit for Hadauti Region of South-Eastern Rajasthan. *Popular Kheti*, 5(1): 48-54.

Meena, H. R., Rashmi, I. and Kala S (2017). Value Addition in Pomegranate. Kisan Gyan, 1(9): 32-35.

Mina B L, Meena H R, Singh G and Stanley, J. (2017). *Soybean ki Jaivik Kheti ke Liye Uttpadan Takniki. Kisaan Kheti*, 4 (2):12-15.

Naga, K. L., Nama, C. P., Meena H R, Singh N and Meena A K (2017). *Madhumakhiyan: Ak Verdan. Kisaan Kheti*, 4(2):44-46.

Rashmi, I., Rajan K., Kartika K.S., Kala S., R.K.Singh and Shinoji K.C. (2017). Field burning of crop residues and its impact. *Kisan World* 44 (7):21-23.

Somasundaram, J., Singh, R. K. , Kumar, Ashok , Sinha, N. K. and Patra, A. K. (2017): Ratoon Pigeon Pea :An alternate source of income for rain fed farmers. *Indian Farming* 67(06): 04–05; June 2017.

Karma Beer, G B Naik, M. Madhu (2017, Odiya ke adibasi kisano dwara aloo ki kheti, Phal phul, 38(3): 23-25.

Hombe Gowda, H.C., Praveen Jakhar, Karma Beer and M.Madhu 2017 Remunerative Agroforestry systems. Kerala Karshakan, 5(4): 47-51.

D. Dinesh, K. Rajan, M. Shankar, K. Manikandan, V. Kasthuri Thilagam and P.Kannan.2017. Managing plant disease by managing soils. *Rashtriya Krishi.* 12(2): 115-117

K. Rajam, Deepthi Eswar, D.Dinesh, P. Raja. 2017. Double bean: a potential pulse crop for hilly regions. *Kirsanworld*. Feb, 2017 pp 25-27.

D. Dinesh, K. Rajan, M. Shankar, K. Manikandan, V. Kasthuri Thilagam and P.Kannan.2017. Managing plant disease by managing soils. *RASHTRIYA KRISHI*, 12(2): 115-117.

Manivannan, S., V. Kasthuri Thilagam and O.P.S. Khola (2017). Jute geo-textile: an efficient soil cover. Kissan World, 44 (5) 47-49.

Rajan, K., DeeptiEswar, D. Dinesh and P. Raja (2017).Double bean - a potential pulse crop for hilly Region.Kisan World, 44 (2): 25-28.

Rajan, K., P. Raja, K. Kannan and O.P.S. Khola (2017).Tamarillo or tree tomato: a potential fast growing tree for hill region of southern India. Kisan World, 44 (2): 48-50.

Rashmi, I., K. Rajan, K.S. Karika, S. Kala, R.K. Singh and K.C. Shinoji (2017).Field burning of crop residue and its impact.Kisan world, 44 (7): 21-23.

Books Published

Nath, V., Pandey, S. D., Kumar, A., Patel, R. K., Srivastava, K., Kumar, G., Purvey, S. K. (2017) Challenges and Options in Litchi Production and Utilization, Gyan Manthan, Vol. 6 – pp-184, published by Westville Publishing House New Delhi, ISBN 978-81-932266-2-9.

Sharma, N. K. Awasthe, R. K., Kumar, A., Mandal, D. Kaushal, R.,Singh, L, Das, A. Kumar, G. Singh, R. , Mishra, P. K. (2018) "Farmers Innovation, Initiative and Expectation in Natural Resource Conservation in North Eastern Region". IASWC, Dehradun, pp-128.

Sharma, N.K., Bhatnagar, P.R., Subbaiah, R., Ambrish Kumar, Mandal, D., Rajesh Kaushal, Gopal Kumar, Dinesh, D., Kakade Vijay and Meena, O.P. (2018). Souvenir of the Conference on "Farmers first for conserving soil and water resources in Western Region", 1-3 Feb., 2018, IASWC, Dehradun, 159p.

Sharma, N.K., Dinesh, D., Batnagar, P.R., Subbaiah, R., Ambrish Kumar, Mandal, D., Rajesh Kausha and Gopal Kumar (2018). A compendium of Abstract of Papers. In : Conference on "Farmers First for Conserving Soil and Water Resources in Western Region" (FFCSWR-2018) held at AAU Anand, Gujarat, 1to3rd Feb 2018.IASWC, Dehradun,100 p.

Kaushal, R., Kumar, A., Jayaraman, D., Mandal, D., Rao, I.V.R., Dogra, P. Alam, N.M., Gupta, A., Tomar, J.M.S., Singh, D.V., Mehta, H. and Mishra, P.K. 2018. Research Methodologies for field monitoring analysisand evaluation of resource conservation aspects of bamboo. International bamboo and rattan organization. Beijing, China. PP 124. ISBN: 978-92-990082-9-4.

Sharma, N.K., Avasthe, R.K., Kumar, A., Mandal, D., Kaushal, R., Singh, L., Das, A., Kumar, G., Singh, R. J., Mishra, P.K.2018. Farmers Innovation, Initiative and Expectation in Natural Resource Conservation in the North Eastern Region. Indian Association of Soil and Water Conservationists, Dehradun, Uttarakhand. 125p.

Mishra, P.K., Singh, Lakhan, Kumar, Ambrish, Mandal, D., Kaushal, Rajesh, Alam, N.M. 2017. Soil and Water Conservation Bulletin - 2017. Bulletin No. 2. Indian Association of Soil and Water Conservationists, Dehradun, Uttarakhand. 92p.

Manivannan.S, O.P.S. Khola and V. Kasthuri Thilagam (2017). Hand Book on Field Engineering Structures for Forest Watershed Management. ISBN: 978-81-924624-2-4. pp 185.

Manivannan.S, V. Kasthuri Thilagam and O.P.S. Khola (2017).Application of GIS and Mobile techniques in watershed management.(ISBN: 978- 93 - 87314 - 41- 2) pp 166.

Manivannan.S, V. Kasthuri Thilagam, Balaji Kannan and G.Thiyagarajan (2018).Integrated Watershed Management (Tamil), Thannambikai Publication, Coimbatore (ISBN 978-93-87314-60-3).Pp. 262.

Singh Charan, Mehta Harsh, Tomar J.M.S., Rathore A.C., Kaushal R., Jayprakash J. Singhal Vibha, Kumar Raj, Dwivedi V.K. (2017). "Conservation Forestry and Horticulture" Technical Resource Book. P. 364, ICAR-IISWC, Dehradun. ISSN No. 978-81-924624-1-7.

Book chapters

Ali, Shakir (2018). Artificial Groundwater recharging: a bone for scarce zone. Compendium of winter school on enhancing the productivity of rainfed agro-ecosystem through suitable interventions (Ed. Kothari et al.) organized during November 14 to January 3, 2018 at Dryland Farming Research Station, Maharana Pratap University of Agriculture &Technology Bhilwara, Rajasthan.pp 15-20.

Ali, Shakir (2018). Integrated watershed management for sustainable agriculture. Compendium of winter school on enhancing the productivity of rainfed agro-ecosystem through suitable interventions (Ed. Kothari et al.) organized during November 14 to January 3, 2018 at Dryland Farming Research Station, Maharana Pratap University of Agriculture &Technology Bhilwara, Rajasthan. pp 110-115.

Ali, Shakir, Meena, H.R. (2017). Groundwater recharging for hastening fruit production. Compendium of Winter school on Hi-tech interventions in fruit production towards hastening productivity, nutritional quality and value addition (Ed. Singh et al.) organized during November 01-21, 2017 at College of Horticulture and Forestry, Jhalawar (AU, Kota) Rajasthan: 216-231.

Ali, Shakir, Meena, H.R. (2017).Watershed management for fruit production. In: Compendium of Winter school on Hi-tech interventions in fruit production towards hastening productivity, nutritional quality and value addition (Ed. Singh et al.) organized during November 01-21, 2017 at College of Horticulture and Forestry, Jhalawar (AU, Kota) Rajasthan: 216-231.

Biswas, H.; Raizada, A.; Kumar, S. and Morade, A.S. (2017). Integrated natural resource management in India through participatory integrated watershed management. In: Rakshit, A. et al. (Eds.) Adaptive Soil Management: From Theory to Practices. Springer Nature Singapore Pte Ltd., Singapore pp. 513-530.

D. Dinesh, A. Baskar, T. Selvaraj, K. Rajan, V. Kasturi Thilagam and O.P.S. Khola. Enhancing Rice Productivity Through Methods of Cultivation with Nitrogen Management Strategies in Sanjay Arora and Suraj Bhan (Editors). 2017. Sustainable Farming and Soil Health Management, Soil Conservation Society of India, New Delhi. pp. 205-211

Kannan, K. O.P.S. Khola, D.V. Singh and V. Selvi. 2017. Agronomical Management Practices for Higher Productivity, Resource Use Efficiency and Farm Income in Semi-Arid Region-A Case Study in Ayalur Watershed. Sanjay Arora and SurajBhan (Editors). 2017. Sustainable Farming and Soil Health Management, Soil Conservation Society of India, New Delhi. pp. 22-32.

Kasthuri Thilagam, V. 2018.Integrated nutrient management for sustainable soil health management.In Manivannan.S, V. Kasthuri Thilagam, Balaji Kannan and G.Thiyagarajan.Integrated Watershed Management (Tamil), Thannambikai Publication, Coimbatore (ISBN 978-93-87314-60-3). Pp. 118-124.

Khola O.P.S and K. Kannan. 2017. Effect of Tillage and Organic Manuring Practices on Resource Conservation and Crop Productivity in Potato Based Cropping Systems of the Nilgiris. Sanjay Arora and SurajBhan (Editors). 2017. Sustainable Farming and Soil Health Management, Soil Conservation Society of India, New Delhi. pp. 22-32.

Krishan, Vijesh., Keil, Alwin., Arvidakshan, Sreejith and Meena, Mukesh (2017). Conservation tillage for sustainable wheat intensification: The example of south Asia. Burleigh Dodds Science publishing limited

Meena, H.R., Ali, S., Meena, G.L. and Mina, B.L. (2017). Fruit production management under degraded lands. In: Compendium of Winter school on Hi-tech interventions in fruit production towards hastening productivity, nutritional quality and value addition (Ed. Singh et al.) organized during November 01-21, 2017 at College of Horticulture and Forestry, Jhalawar (AU, Kota) Rajasthan : 317-325.

Mina, B.L. Meena, G.L. Rashmi, I. and Meena, H.R. (2017). Soil health management for sustainable fruit production. In: Compendium of Winter school on Hi-tech interventions in fruit production towards hastening productivity, nutritional quality and value addition (Ed. Singh et al.) organized during November 01-21, 2017 at College of Horticulture and Forestry, Jhalawar (AU, Kota) Rajasthan: 216-231.

Narayan, D.; Tiwari, S.P. and Biswas, H. (2017). Resource Conservation and Productivity Enhancement Through Improved Agro-Techniques at Farmers' Field in Bundelkhand Region. In "Natural management opportunities and technological options", Muruganandam, M., Mandal, D., Kausal, R., Mishra, P. K., Chaturvedi, O. P., Sharma, N. K., Ojasvi, P.R., Singh Lakhan and Sharma, Sangeeta, N. (Eds.), Satish Serial Publishing House, Delhi, pp 59-72.

Pande, V.C., Vishwakarma, A. K., Kumar, G., Dogra, P. (2017) "Identification of Suitable Cropping Systems for Resource Optimization, Productivity Enhancement and Farm Profitability in Central Gujarat". In (Eds.) Arora, Sanjay and Suraj Bhan Sustainable Farming and Soil Health Management, Soil Conservation Society of India, New Delhi, 77- 86.

Pathmanaban, G., Thangavelu, A.U., Saravanan, R., Rajan, K., Kalimuthu, N., and Rajkumar, M. 2017. Nutritional and Physiological Disorders in Horticultural Crops.Agrobios (India) Publisher, Jodhpur, India.

Patil, S.L.; M.N. Ramesha and B.N. Seshadri. (2017). Lecture on "Climate change and its effect on crop yields and watershed management" at ARS Hagari on 18.6.2017 for the Distribution Agencies of fertilizers, pesticides of Ballari district organized by UAS, Raichur at KVK, Hagari.

Patil, S.L.; M.N. Ramesha; K.K. Reddy and K.S. Rao. (2017). Jasmine Cultivation a Successful Watershed Intervention: A Case Study from Chinnatekur Watershed, India. In "Sustainable Farming and Soil Health Management" Sanjay Arora and Suraj Bhan (Editors). 2017. Soil Conservation Society of India, New Delhi. pp. 275-281.

PP Adhikary and Ch. J Dash (2017) Indicator Kriging and Natural Resource Management. In: Soil Resources and its Mapping Through Geostatistics Using R and QGIS. (Eds. Priyabrata Santra, Mahesh Kumar, N.R. Panwar, C.B. Pandey), New India Publishing Agency, New Delhi, India. pp. 153-164.

R. B.Meena,A.K.Singh, D.C.Meena and G.L.Bagdi "Post adoption behavior of farmers towards soil and water conservation technologies in Agra watershed of central India" in book National Resource management opportunities and technological options pp 311:323.

Raizada, A.; Biswas, H.; Kumar, S.; Naik, B.S.; Patil, S.L.; Morade, A.S.; Prabhavathi, M.; Ojasvi, P.R.; Dogra, P. and Shrimali, S.S. (2017). Manual of process monitoring for implementation of Sujala watershed projects. Watershed Development Department, Government of Karnataka and ICAR-IISWC, Research Centre, Ballari. 46p.

Rashmi, I, Mina, B.L. and Meena, H.R. (2017). Nutrient management for hi-tech fruit production. In: Compendium of Winter school on Hi-tech interventions in fruit production towards hastening productivity, nutritional quality and value addition (Ed. Singh et al.) organized during November 01-21, 2017 at College of Horticulture and Forestry, Jhalawar (AU, Kota) Rajasthan : 258-267.

Rashmi,I., Shirale, A., Kartika, K.S., Shinogi, K.C., Meena, B.P., and Kala. S. (2017). Leaching of plant nutrients from agricultural lands. In M. Naeem et al. (eds.) Essential Plant Nutrients - Uptake, Use Efficiency, and Management. Springer International Publishing. DOI 10.1007/973-3-319-58841-419.

Singh, R.K. and Meena, H.R. (2017). Wasteland horticulture. In: Compendium of Winter school on Hi-tech interventions in fruit production towards hastening productivity, nutritional quality and value addition (Ed. Singh et al.) organized during November 01-21, 2017 at College of Horticulture and Forestry, Jhalawar (AU, Kota) Rajasthan, pp:588-598.

Sundarambal P. 2017. Farm Women's Participation in Watershed Programme and their Extent of Adoption of Soil and Water Conservation Technologies in Sithayankottai Watershed, Dindigul District of Tamil Nadu. PP: 348-355 in the book by Sanjay Arora and SurajBhan (Editors). 2017. Sustainable Farming and Soil Health Management, Soil Conservation Society of India, New Delhi. pp. 374.

Sundarambal, P. 2018. Capacity Building, Community Organisation, Roles and responsibilities of members and Maintenance of Accounts and Registers in Watershed Management Programmes. PP: 21-26 in the book by S. Manivannan, V.KasthuriThilaham, Balaji Kannan and K.Thiyagarajan (Editors). 2018. Integrated Watershed Management in Tamil.ISBN:978-93-87314-60-3. ThannambikkaiPathippaham, Covai. Pages:258

Sundarambal, P. 2018. Common Property Resource (CPR) management and sharing of benefits from CPRs PP:258 in the book by S. Manivannan, V.KasthuriThilaham,Balaji Kannan and K.Thiyagarajan (Editors). 2018. Integrated Watershed Management in Tamil.ISBN:978-93-87314-60-3. ThannambikkaiPathippaham, Covai.

Sundarambal, P. 2018. Participatory Methods and PRA techniques used in Participatory Integrated Watershed Management. PP: 12-20 in the book by S. Manivannan, V.KasthuriThilaham, Balaji Kannan and K.Thiyagarajan (Editors). 2018. Integrated Watershed Management in Tamil.ISBN:978-93-87314-60-3. Thannambikkai Pathippaham, Covai.

Vishal Nath, Manvendra Singh, Alok Kumar Gupta, Evening Stone Marboh, and Karma Beer, 2017 Tissue Culture: Present Scenario and Future Prospects in Litchi Management,. Springer, pp: 99-108.

Yadav, R.S,; Ranjan, R; Kumar, M. and Monalisha, Pramanik (2017). Parameterization and assessment of greenhouse gases in Integrated Farming System. In: Training Manual 'Carbon sequestration and GHG measurement in IFS Models' (Eds. Dutta et al.), ICAR-IIFSR, Modipuram. Pp. 164-175.

Kumar, G., Kumar, A., Nath, V., Pandey, S. D., Kumar, V., Purbey, S. K., Kumar, P. (2017). Impact of Climate Change on Litchi Systems and its adaptation strategies, page 78-86 Gyan Manthan (6) ISBN 978-81-932266-2-9.

Parandiyal, A.K. Meena, H.R., Singh, R.K. Sethy, B.K. and Kumar Ashok (2017) :Silvipastoral and Hortipastoral land uses for productive utilization of chambal Ravines In: Natural Resources Management opportunities and technological options (*Ed*. Muruganandam *et. al*.) Satish Serial Publishing House, New Delhi: PP 211-221.

Patel, R. K., Pandey, S.D., Srivastava, K. Kumar, A. Purbey, S. K., Kumar, G., Nath V. (2017). Integrated Approach of Litchi Based Multi-enterprises Model with Pond for Sustainable 93 Production and Income Generation, pp-93-99, in the book Gyan Manthan (6) pp-185 edited by Nath et al.,2017)

U.K. Maurya, Ambrish Kumar, Santosh K. Rai, S.K. Bartarya, Ashok Kumar (2018). Delineation and development of spring shed for creation of water recourse using isotope techniques. In: Ambrish Kumar, Rajesh Kausal, U.K. Maurya, Bankey Bihari and P.K. Mishra (Eds). Training Manual "Soil and Water Conservation and Water shed Management". IISWC Publication, pp. 278-293.

Mandal, D. 2017. Soil Quality Improvement through Reverse Land Degradation. In: Anup Das, KP Mohapatra, SV Ngachan, AS Panwar, DJ Rajkhowa, Ramkrushna GI and Jayanta Layek (Eds.). Conservation Agriculture for Advancing Food Security in Changing Climate Vol. 2 (2017) : 581-602 Today & Tomorrow's Printers and Publishers, New Delhi - 110 002, India.

Bankey Bihari (2018). "Participatory Social Tools for Watershed Management" Training Manual on International Training Programme on Soil & Water Conservation and Watershed Management" under India-Africa Forum Summit-III, Published by Advanced Skill Development Centre, HRD & Social Science Division, ICAR-IISWC, DehraDun.

Bankey Bihari (2017). "Overview of participatory approaches in integrated watershed management" Training Manual on Ravine Reclamation Published by Advanced Skill Development Centre, HRD & Social Science Division, ICAR-IISWC, DehraDun, pp.114-124.

Bankey Bihari (2018). "People,s Participatory Watershed Management" Training Manual on Soil and Water Conservation. Published by Advanced Skill Development Centre, HRD & Social Science Division, ICAR-IISWC, DehraDun, pp.9-12.

Bankey Bihari (2017). "People,s Participatory Watershed Management" Training Manual on Watershed Treatment Plan. Published by Advanced Skill Development Centre, HRD & Social Science Division, ICAR-IISWC, DehraDun, pp.12-15.

Bankey Bihari (2017). "Overview of participatory approaches in integrated watershed management" Training Manual on Application of Remote Sensing and GIS in Natural Resource Management (ARSGN) Published by Advanced Skill Development Centre, HRD & Social Science Division, ICAR-IISWC, Dehradun, pp.101-110.

Kaushal R., Durai Jayaraman, D. Mandal, I.V. Ramanuja Rao, P. Dogra, N. M. Alam, Anand Gupta, J.M.S. Tomar, D.V. Singh, H. Mehta and P.K. Mishra (2018) research Methodologies for field monitoring, analysis and evaluation of resource conservation aspect of bamboo. International Bamboo and Tattan Organisation (INBAR) Indian Institute of Soil and Water Conservation.

Singh Charan, Mehta Harsh, Tomar J.M.S., Rathore A.C., Kaushal R., Jayprakash J. Singhal Vibha, Kumar Raj, Dwivedi V.K. (2017). "Germplasm Maintenance and Propagation Techniues" pp. 100-109.

Training Manual/Report

Ambrish Kumar, Rajesh Kausal, U.K. Maurya, Bankey Bihari and P.K. Mishra (2018). Training Manual "Soil and Water Conservation and Water shed Management". IISWC Publication, pp. 293.

Patil, S.L.; Biswas, H.; Raizada, A.; Naik, B.S.; Morade, A.S.; Ojasvi, P.R.; Dogra, P.; Dupdal, R.; Prabhavathi, M. and Shrimali, S.S. (2017). Technical report on progress under monitoring and evaluation in respect of Sujala-3 watersheds. ICAR-IISWC, RC, Ballari. p 31.

Patil, S.L.; Raizada, A.; Biswas, H.; Suresh Kumar.; Ramesha, M.N.; Prabhavathi, M.; B. Mondal.; N. Loganandan; Naik, B.S.; Morade, A.S.; Adhikari, R.N.; and Dupdal, R. (2018). QRT report for the period 2012-2017. ICAR-IISWC, RC, Ballari. p 90.

Kasthuri Thilagam V., and S. Manivannan (2018). Participatory watershed development, farm production and livelihood support systems (In Tamil) for training programmes conducted during 12-14 March 2018 and 15-17 March 2018. ICAR – IISWC, Udhagamandalam

Manivannan, S., Kasthuri Thilagam, V. and Khola, O.P.S. (2017). Application of GIS and mobile Techniques in Watershed Management, ICAR - IISWC Regional Centre, Udhagamandalam, Tamil Nadu.

Rajan, K., Raja, P and K. Kannan.(2017).Advanced Technologies in Natural Resource Management to Mitigate Climate Change Impacts. ICAR - IISWC Regional Centre, Udhagamandalam, Tamil Nadu.

Selvi, V., P. Sundarambal and K. Kannan (2018).Participatory watershed development, farm production and livelihood support systems (In Tamil) for training programmes conducted during 19-21 March 2018, 22-24 March 2018 and 26-28 March 2018. ICAR – IISWC, Udhagamandalam

Bulletins/Brochures/Policy paper/Leaflets and others

Mishra, P.K., Lakhan Singh, Ambrish Kumar, Mandal, D., Rajesh Kaushal and Alam, N.M. (2017). Soil and Water Conservation, Bulletin No.2, IASWC, DehraDun, pp 1-92.

Kumar, A., Pandey, S.D., Patel, R.K., Kumar, P., Kumar, G., Pongener, A., Ganeshamurthy, A.N., and Nath, V. (2017). Soil Fertility and Nutrition in Litchi: Delineation, Deficiencies and Management of Nutrients. Technical Bulletin (NRCL-TB-12). ICAR-NRCL, Muzaffarpur. Pp: 34

Ch. Jyotiprava Dash, Partha Pratim Adhikary, M. Madhu, U.K. Maurya, P.K. Mishra (2017). Mapping and characterization of Jhola system 'a rice bowl' of tribals of Koraput district, Odisha: Status and Road. IISWC Publication under review.

Singh, C., Dhyani, B.L., Bihari, B., Kumar, A., Muruganandam, M., Mandal, D.and Dwivedi, V.K. 2017. Enhance fodder production through plantation of Hybrid Napier on field bunds. Publication No. EB-02/DD/E-2017. ICAR-Indian Institute of Soil and Water Conservation, DehraDun.

Ranjan Rajeev, Sharma, N.K., Tiwari, Ambrish Kumar and Mehta Harsh (2018) Plastic Mulching in Maize + Cowpea Intercropping for Higher Productivity and Profitability Under Rainfed Condition in Doon Valley. ICAR-Indian Institute of Soil and Water Conservation, 218, Kaulagarh Road, Dehradun-248 195, 6 p.

Naik, B. S.; Hombegowda, H. C.; Madhu, M. and Sudhishri, S. (2017). Sumo ghasara abarodha purbaghata malaanchalare mrutika o jalasamrakshyana pain eka upajukta upaya (Sambuta - A suitable vegetative barrier for soil and water conservation in sloping highlands of Eastern Ghats region) (In Odiya language). ICAR-IISWC, RC, Sunabeda, Koraput, Odisha: 4p.

Sahoo, D.C.; Naik, B.S. and Madhu, M. (2017). Jaibayantika padhhatire purbaghata parbatyaanchalara gadania jamire mrutika kshyayara niyantrana (Bio-engineering measures for soil eriosion control in sloping highlands of Eastern Ghats region) (In Odiya language). ICAR-IISWC, RC, Sunabeda, Koraput, Odisha: 4p.

Pankaj Panwar, V.K. Bhatt, Sharmistha Pal, Ram Prasad, A.K. Tiwari (2017) Sloping Agricultural Land Technology for Sustainable Production, Resource Conservation and Economic Improvement in Shivalik Himalayas. Technical Brochure No. TB-02/C/E-2017. ICAR-IISWC, Chandigarh

Pankaj Panwar, Sharmistha Pal, V.K. Bhatt, S.L. Arya, A.K. Tiwari and P.K. Mishra (2017). Managing sloping lands: status, constraints, Opportunities and strategies. Policy paper: PP-03/C/E-2017. ICAR-IISWC, Chandigarh.

Ram Prasad, Sharmishtha Pal, S.L. Arya, Pawan Sharma and A.K. Tiwari (2017), "Shivalik ki Apradit Bhumiyo Hetu Aadu Adharit Krishi Baghwani Pranaliyan". Azad Offset Printers: page: 1-31, TB – 04/0/H-2017.

Manivannan. S, V. Kasthuri Thilagam, R.Ragupathyand O.P.S. Khola (2017) . Artificial recharge structures for enhancing ground water (Tamil).

Radio/ Television Talk

Ali, Shakir. *Varsha Jan Ka Sangrahan* (Live phone in programme) on 14.06.2017 at All India Radio, Kota.

Meena, H.R. *Phaldar paudhon avam Sabjiyon me hormones avam paushak tatv prabandhan* (Live phone in programme) on 19.04.2017 at All India radio, Kota.

Meena, H.R. *Swachh paryavaran adharit krishi* on 28.09.2017 at All India radio, Kota**.**

Singh, R. K. Improved practices of water management at All India Radio, Kota on 24.10.2017

Meena, G.l. (*Rabi Phaslon Me, Paudh Sanrakashan Karya* in Chaupal program at All India Radio, Kota on 19.01.2018.

Dr S. Manivannan, Principal Scientistgave radio talk on FM radio, Ooty on 09th May 2017 on the topic of Rainwater harvesting and its multiple use.

Dr. K. Rajan, Principal Scientist gave radio talk on "Soil Management for Hill Crops of the Nilgiris" at All India Radio, Udhagamandalam on 30.10.2017.

Dr. S. Manivannan, Principal Scientist delivered a talk in Nakkubetta TV on "Soil and Water Resources in Nilgiris" on 23.08.2017

Dr Ambrish Kumar, Principal Scientist delivered a Radio talk on *Jal Sanrakshan ki Aadhunik Vidheeya va Mahatava* at AIR Dehradun on 28/11/2018.

Dr. H. Mehta, Recorded radio talk on 02-05-2017 in Akashwani Najibabad "Girta bhoo jal star" aired on 07.05.2017.

Dr. H. Mehta, Recorded radio talk on 21.01.2017 in Akashwani Najibabad " Kharif main Dalhani Faslon ki Unnat Kheti" aired on 26-07-2017.

Dr. H. Mehta, Recorded radio talk on 12.11.2017 in Akashwani Dehradun " Rabi main Surajmukhi ki Kheti " aired on 16.11.2017.

07 APPROVED ON-GOING RESEARCH PROJECTS

P-1: WATER EROSION APPRAISAL IN DIFFERENT AGRO-ECOLOGICAL REGIONS

1.1 Inventory and database of erosion status using modern tools and procedures

Development of intensity-duration-frequency curves using rainfall data for different agro-ecological regions of India.

Assessment of soil erosion fluxes of Uttarakhand.

Impact of land use land cover changes on soil erosion susceptibility in Bundelkhand region using Remote Sensing and GIS technique.

1.2 Soil erosion process modeling and climate change studies

National Mission on Sustaining Himalayan Eco-system (NMSHE) - Task force on Himalayan agriculture for lower and middle Himalayan region.

Application of integrated spatial science tools for prediction of soil erosion map under changing climate scenario for the Uttarakhand state.

Study of atmospheric and soil carbon dioxide fluxes in temperate mountainous ecosystem of Western Ghats with reference to climate change impact assessment.

1.3 Soil carbon dynamics and erosion productivity studies

Erosion productivity relationships for evaluating vulnerability and resiliency of soils under different agro-climatic regions of India.

Assessment of soil organic carbon in transit under erosion processes: A source or sink for atmospheric CO_2.

Environmental tracer based study on erosion induced loss of soil organic carbon and its impact on agronomic productivity and environmental quality.

Development and validation of a spatially explicit simulation framework to quantify runoff-erosion-carbon flux at watershed scale.

Assessing the vegetation and SOC recovery potentials of abandoned / fallowed shifting cultivated sites in Central Eastern Ghats.

Land use effect on soil carbon stock and soil quality in Mahi ravine ecosystem of semi-arid tropics.

P-2: CONSERVATION MEASURES FOR SUSTAINABLE PRODUCTION SYSTEM

2.1 Resource conservation measures for arable lands

Development of conservation agriculture practices for rainfed production systems in North-western Himalayan region.

Evaluation of conservation tillage based *Arundo donax* mats for resource conservation and enhancing cropping intensity on sloping crop lands.

Determining resource conservation potential of bio-degradable waste and their on-farm utilization to increase crop productivity and profitability.

Evaluating the effect of organic amendments on resource conservation and productivity of rainfed semi-arid vertisols.

Effect of varying water regimes on Zn and N dynamics and rice productivity in saline vertisols.

In situ moisture conservation practices under aonla based agro-forestry system for sustainable production in red soils of Bundelkhand.

Restoration of shifting cultivated lands for resource conservation and sustainable production in Eastern Ghats.

*Jhola kund*i based vegetable farming with soil moisture conservation practices for increasing profitability of tribal farmers of Eastern Ghats High Land region.

Conservation tillage systems for enhancing productivity and resource use efficiency under rainfed area of South-eastern Rajasthan.

Resource conservation and productivity enhancement through organic and inorganic amendments in soyabean-mustard cropping systems.

Cover crops and reduced tillage for enhancing productivity and soil health in rainfed farming system in the hilly areas.

2.2 Resource conservation measures for non-arable lands

Improvisation of soil working techniques for enhancing tree establishment under rainfed conditions of North-Western Himalayas.

Soil fertility restoration and carbon sequestration potential of five agro-forestry trees in Himalayan foothills.

Evaluation of traditional minor millet based agro-forestry systems under recommended agri-silvi-cultural practices of North-Western Himalayas.

Efficacy of different soil and water conservation measures on bamboo productivity and resource conservation in Himalayan foothills.

Development and characterisation of quality planting material of important MPT's for degraded lands of North-West Himalayas.

Evaluation of *Bael* and Olive based agro-forestry system with soil amendments in Doon Valley.

Evaluation of rooting media and rootstocks of major sub-tropical fruits spp. For raising quality planting materials on degraded lands.

Promotion and expansion of Lemon grass (*cymbopogon flexuosus*) cultivation as an alternative crop for livelihood security in SC and ST communities in Dehra Dun District.

Up scaling research assessment of productivity, hydrological behaviour, resource conservation and intangible benefits of selected commercial bamboo species in Uttarakhand.

Assessment and improvement of nutritional quality of horticultural crops on sloping lands in North-Western Himalayas.

Phyto-rehabilitation of saline - sodic vertisols through *Prosopis juliflora* based silvipastoral system.

Regulated deficit irrigation and canopy architecture management for fig(*Ficus carcia L.*) in semi-arid vertisols.

Peach based agri-horticulture land use system for degraded Shiwaliks.

Evaluation of moisture conservation techniques for sustainable production of Tree Borne Oil Seeds (TBOS) in Bundelkhand.

Evaluation of promising fruit species with different moisture conservation practices in red soils of Bundelkhand region.

Evaluation of cover crops under cashew and mango plantation for improving soil health and productivity in Eastern Ghats High Land Region of Odisha.

Evaluation, characterization and development of elite genotypes of *Cassia auriculata* for cultivation *in* arid and semi-regions.

Effect of shade trees on productivity and soil health in rejuvenated tea plantations in Nilgiris.

Resource utilization and productivity of Dragon fruit based horti-silviculture system under rainfed agro eco-systems of Central Gujarat.

P-3: WATERSHED HYDROLOGY FOR CONSERVATION PLANNING

3.1 Hydrological behaviour of land uses and management practices

Hydrological evaluation of recommended forest grasses in Himalayan foothills.

Evaluation of hydrological behaviour and production potential of recommended land use system / practices under different agro-ecological regions of India.

Hydrologic systems analysis across multiple spatial scales and its implications on hydro-logic processes in sub-humid catchment of Eastern Ghat High Land Region of Odisha.

Modelling the nutrient movement in agricultural watersheds and their impact on surface water resources of Nilgiris.

3.2 Water harvesting, groundwater recharge and management

Development and rejuvenation of natural springs through soil and water conservation measures

Consortia Research Platform-Water Theme 1 Water Resources Augmentation/ Conservation.

Efficient groundwater management for enhancing adaptive capacity to climate change in sugarcane based farming systems in Muzaffarnagar district, U.P.

Quantitative and qualitative assessment and management strategy for sustainable development of the ground water resources in Haridwar Diatrict.

Employing system approach on zero energy drip irrigation system in bench terrace farming for hill region.

Water quality assessment and its impact on adjacent soil and vegetation in riparian areas of Hindon and Kali rivers.

Study on pollution status of Yamuna river and its impact on soil and crop health in Western U.P.

Evaluation of direct recharge filter for revival of defunct and low yielding bore well vis-à-vis augmentation of ground water table in semi-arid region of Karnataka.

Estimation of water budget components for predominant land uses of south-eastern Rajasthan for conservation planning.

- Strategies for rainwater harvesting and its multiple uses in rainfed agriculture in Central Gujarat.
- Field evaluation of ground water recharge filters developed by ICAR-IISWC, Vasad.

P-4: REHABILITATION OF AREAS AFFECTED BY MASS EROSION

4.1 Development and refinement of technologies for rehabilitation of ravines, landslides, mine spoils, riverbed mining, stream banks, torrents etc.

Assessment of impact of extraction of RBM (River bed material) on physiography of stream flow courses of Himalayan foot hill streams.

Ecological restoration of stone mine spoil area in south-eastern Rajasthan.

Field evaluation of refinement of ravine reclamation technology in a model ravine area development project at Lohli-Bagli village in district Bundi (Rajasthan).

Field evaluation of design of trenches under different agro-climatic regions.

Enhancing productivity of ravine lands by plantation of *A. sapota* with intercropping systems.

P-5: INTEGRATED WATERSHED MANAGEMENT FOR SOCIO-ECONOMIC GROWTH AND POLICY ADVOCACY

5.1 Participatory watershed management and integrated farming system (IFS)

Evaluation of criteria and techniques for classification of fisheries - sensitive watersheds for conservation and production management

Socio-economic analysis of farming/livelihood systems of farmers across different land categories in Yamuna ravine area.

Refining methodologies for data validation, planning, monitoring and evaluation of watersheds.

Socio-economic analysis of tribal farming system in different topo-sequence in Koraput District, Odisha.

P-6: HUMAN RESOURCE DEVELOPMENT AND TECHNOLOGY TRANSFER

6.1 Capacity development approaches and information and communication technology (ICT)

Developing ICT based e- learning tools for conservation measures and watershed management.

Role of soil and water conservation technologies for climate resilient agriculture in Himalayan ecosystem - An action research.

6.2: Participatory technology dissemination and adoption

Ensuing sustainable agricultural development and livelihood security in lower Shiwalik range of Uttarakhand.

Assessing farmer's knowledge, vulnerability and adapting capacity of soil and water conservation technologies under changing climatic scenario.

Determination of heterogeneity in agro-forestry practices and acceptability alongwith altitude gradient in Western Himalayas.

Assessment of sustainability factors for soil and water conservation projects.

Farmer participatory technology application for sustainable resource management and livelihood security in North-West Himalayas.

Role of women in conservation and management of natural water resources for domestic and irrigation uses.

Documentation and validation of ITKs in soil and water conservation practiced by tribal farmers of Tamil Nadu.

08 CONSULTANCY

The consultancy projects under taken at Institute Head Quarters and its Regional Centers, during the period under report are as under.

Title of the Consultancy Project	Name of the Client Department	Date of Start	Date of Completion	Category of Consultancy	Total Amount (Rs.)
Head Quarters, DehraDun					
Assessment of erosion and CAT plan of Beglihar Reservoir, BHEP, J&K for erosion control.	Director, Soil and Water Conservation Department, Jammu	01 April., 2017	September., 2017	Institutional	15,53,930/-
Replenishment study for extraction of river bed material from the river Ganga in reserve forest of district Haridwar for the year 2017-18.	Managing Director, UKFDC, Dehradun, Uttarakhand	01 October., 2017	March., 2018	Institutional	4,97,440/-
Replenishment study for extraction of river bed material from the river Rawasan I & II and Kotawali tributaries of Ganga in reserve forest of district Haridwar for the year 2017-18.	Managing Director, UKFDC, Dehradun, Uttarakhand	01 October., 2017	December., 2017	Institutional	4,73,300/-
Assessment of extractable river bed material from river Sharda (Tanakpur) for the year 2017-18.	Divisional Logging Manager (Khanan), UKFDC, Tanakpur, Uttarakhand	01 October., 2017	December., 2017	Institutional	3,37,010/-
Assessment of extractable river bed material from river Gaula for the year 2017-18	Managing Director, UKFDC, Dehradun, Uttarakhand	01 October., 2017	December., 2017	Institutional	4,05,590/-
Assessment of extractable river bed material from river Kosi for the year 2017-18	Managing Director, UKFDC, Dehradun, Uttarakhand	01 October., 2017	December., 2017	Institutional	3,08,840/-
Assessment of extractable river bed material from ri ver Dabka for the year 2017-18.	Managing Director, UKFDC, Dehradun, Uttarakhand	01 October., 2017	December., 2017	Institutional	2,38,150/-
Assessment of river bed material from the river Malan (Kotdwar) for the year 2017-18.	DFDM, UKFDC, Kotdwar, Uttarakhand	15 October., 2017	March., 2018	Institutional	2,35,500/-
Study on conservation, remedial and management measures for Nainital Lake, Uttarakhand.	Executive Engineer, Irrigation Division, Nainital on behalf of Governor of Uttarakhand.	December., 2017	August., 2018	Institutional	13,85,158/-
Research Centre Chandigarh					
Study on conservation of subsoil water in Shiwalik Hills of Punjab.	Principal Chief Conservator of Forests, Department of Forest and Wildlife Preservation, Punjab	April., 2017	July., 2017	Institutional	27,00,367/-
Research Centre Udhagamandalam					
Advisory services for soil conservation measures while undertaking soil remediation process in mercury contaminated site of HUL, Kodaikanal.	Hindustan Unilever Limited, Kodaikanal, Dindigul District, Tamil Nadu	January., 2018	December., 2019	Institutional	13,49,253/-

09 RAC, IMC, IRC Meetings

Research Advisory Committee:

RAC Members [06-12-2017 to 05-12-2020]

During the period under report one meeting of Research Advisory Committee was held under the chairmanship of Dr. V. N. Sharda, during 06-07March.2018. Progress of ongoing research projects was presented by respective programme leaders. New research proposals submitted to RAC were also discussed.

Dr. V. N. Sharda Former member, Agricul tural Scientist Recruitment Board (ASRB) Flat No. - 202, Tower No. - 3 A, Suncity Parikarama Housing Complex, Sector - 20, Panchkula - 134 116, (Haryana) Email id: vnsharda2@gmail.com, Mobile No.-9810505328	Chairman
Dr. M. N. Jha , Former Head, Soil Science Division, FRI House No.-11,Vasant Vihar, Phase -II Dehradun-248006, Uttarakhand Email: m.yogimn2003@gmail.com, Mob No. - 91-9412055048	member
Dr. R. K. Panda Professor & Head of the School of Infrastructure (Civil Engineering) and Dean (Research & Development) IIT, Bhubneshwar, Toshali Bhawan, Bhubneshwar -751007, Email.id:rkpanda@iitbbs.ac.in: rkpanda56@gmail.com Mob: +91-7894435400	member
Dr. D. S. Rana Emirates Scientist, Agronomy, IARI, New Delhi-110012 Email.id:dsrana5554@yahoo.com, dsrana5554@gmail.com, Mob: +91-9868200898	member
Dr. M. C. Nautiyal, Former Dean CF&HA Lane - 4, Doon Enclave, Nakraunda Road, Harrawala, Dehradun-248001, Uttarakhand Email: mcnautiyal@rediffmail.com, Mob: +91-9412076770	member
Dr. R. L. Shiyani Professor and Head **(Agril Economics)** Block No: B-109,Radha Krishna Nagar, Vanthali Road, Junagarh-362001, GujaratEmail: rlshiyani@yahoo.com , Mob: +91-9427228486	member
Sh. Matbar Singh Kandari 33/1, Shastri Nagar, Lane No. 3 DehraDun-248009, Uttarakhand, Mob:-8433084175	member
Sh. Ram Sharan Nautiyal 183-Rajpur Road, Dehradun-248009, Uttarakhand	member
Dr. S. K. Chaudhary ADG (SWM), ICAR KAB-II, Pusa, New Delhi-110012, Email: adgswm@gmail.com, Mob:-	member
Dr. P. K. Mishra Director ICAR-Indian Institute of Soil and water Conservation, 218-Kaulagarh road, DehraDun, Uttarakhand-248195 Email id: directorsoilcons@gmail.com, Mob-9412053251	member
Dr. Gopal Kumar Senior Scientist ICAR-Indian Institute of Soil and water Conservation, 218-Kaulagarh road, DehraDun, Uttarakhand-248195 Email id: gkcswcrti@gmail.com, 9409545159, 7033401808	member secretary

Salient Recommendations of RAC

1. The Institute should develop a methodology for quantification and valuation of intangible benefits accruing out of watershed development programmes in different agro-ecological regions of India by assigning appropriate weightage to different governing parameters (Action: Dr. V. C. Pandey to develop collaborative project).
2. The design of recharge filters developed by different organizations should be evaluated comparatively in terms of scope, suitability, efficiency, cost and limitations and procedure for design should be standardized for different agro-ecological zones (Action: Head, RC-Vasad for evaluation of different designs of Filters).
3. Nutrient losses through water erosion should also be estimated by compiling and analyzing the experimental data on nutrient losses along with runoff and soil losses collected at Headquarters and Regional Centre's of the Institute for the past 50/60 years and also using data from other organizations engaged in such studies to holistically assess production, monetary and nutrient losses due to water erosion in different states, zones and the country as a whole (Action: All the heads of the Divisions/Centre's to provide nutrient loss data to Dr. N. K. Sharma for further compilation)
4. Assessment of extension of ravines (temporal trends) in different river systems needs to be undertaken employing remote sensing and GIS techniques and should be correlated with the governing factors including land use. The ravine dynamics should be linked up with reclamation data available under various ongoing schemes. There is a need of long term monitoring strategy for ravines extension and reclamation measures. (Action: Dr. Gopal Kumar for assessing ravine dynamics of 1-2 ravine districts)
5. A spatially explicit web based decision support system for watershed planning, execution and monitoring should be conceptualized and developed in a project mode and in a specified time frame. It is high time for the Institute to take up leadership in this endeavour, being the pioneering organization in the country to evolve the concept of watershed management, by compiling and analyzing the available research data of the past 50/60 years collected by different divisions and centers of the Institute (Action: Dr. P. R. Ojasvi, Head Hydrology and Engineering Division, to initiate the work. All the heads of the Divisions/Centres to provide desired information to Dr. Ojasvi)
6. Attempt should be made to bring projects having identical objectives and procedures under the umbrella of a core or network project in order to reduce the number of projects and save on time and cost due to limited funds availability (Action: OIC, PME Cell).

Management Committee:

Status of Institute Management Committee [29.6.2015 to 28.6.2018]

49th meeting of Institute Management Committee was held on08/02/2017 at the Institute Head Quarters, DehraDun. The Following members were present in the meeting.

Name of the Member	Status
Dr. P.K. Mishra, Director, IISWC, DehraDun	Chairman
Dr. Abdul Islam, Pr. Scientist, [Nominee of ADG (S&WM/A&AF), ICAR, New Delhi]	Council's Nominee
Dr. S.K. Jena, Pr. Scientist (SWC Eng.), IIWM, Bhubaneswar	Member
Dr. R.S. Chaudhary, Head, Division of Soil Physics, IISS, Bhopal	Member
Dr. N.K. Sharma, Head, Division of Soil Science & Agronomy, IISWC, DehraDun	Member
Dr. (Smt.) S.L. Arya, Pr. Scientist, IISWC, Research Centre, Chandigarh.	Member
Prof. Chandra Mohan Sharma, Dean (PG), College of Forestry & Hill Agriculture, University of Horticulture & Forestry, Ranichauri, Tehri Garhwal.	Member
Sh. Matbar Singh Kandari	Non official Member
Sh. Ram Sharan Nautiyal	Non official Member
Director, Agricultural & Soil Conservation, Nanda –Ki-Chowki, Prem Nagar, Dehra Dun, Uttarakhand	Member
Director, Soil Conservation, Shimla-5, Himachal Pradesh	Member
Sh. K. K. Sharma, Finance& Accounts Officer, IICAR, Krishi Bhawan, New Delhi	Member
Chief Administrative Officer, IISWC, DehraDun	Member

The meeting was chaired by Dr. P.K. Mishra, Director of the Institute. The Chairman apprised the committee members of the establishment, mandate, research achievements and other related activities, initiatives undertaken by the institute viz. Tribal Sub Plan, Transfer of Technology, Consultancy Projects, Training Programmes being under taken by the Institute and its eight (08) Research Centres.

Institute Research Committee:

Salient Recommendations of IRC Meeting – 2017

1. Action is again assigned by the IRC-2017 to Dr. P.R. Ojasvi, Head, H&E Division for completing the printing process of the bulletin on runoff and erosion prediction models by December, 2017 positively.
2. Action is again assigned by the IRC-2017 that a bulletin / brochure on the concluded project entitled "Design and development of site specific artificial groundwater recharge filters" may be published by Dr. D.R. Sena, Pr. Scientist (Engg.) and Dr. Gopal Kumar, Sr. Scientist (Soils) by August 31, 2017 positively.
3. Action is again assigned by the IRC-2017 that a bulletin / brochure may be published on the results obtained from concluded projects entitled "Productivity enhancement in fruit and flower based two tier horticulture systems through integrated nutrient management and mulching" and "Enhancement of guava productivity through canopy management and mulching in rainfed bouldery riverbed lands" by Dr. A.C. Rathore, Pr. Scientist (Hort.) by August 31, 2017 positively.
4. Action is again assigned by the IRC – 2017 that a technical bulletin may be published on the results obtained from the concluded project entitled "Enhancement in land productivity and livelihood security of small farmers of Nilgiris through multiple use of harvested water" by Dr. S. Manivannan, Pr. Scientist (Engg.) by Sept. 30, 2017 positively.
5. Action is again assigned by the IRC – 2017 that a policy paper may be brought out from the concluded project entitled "Prototype field study on application of potentially important Jute geo-textiles for hill slope stabilization" for Nilgiris area alongwith economic returns by Dr. S. Manivannan, Pr. Scientist (Engg.) by August 31, 2017 positively.
6. Action is again assigned by the IRC – 2017 that a policy paper on "Present status of shifting cultivation in Odisha and to suggest action plan" may be prepared by Dr. M. Madhu, Head, Research Centre, Koraput by August 31, 2017 positively.
7. Action is again assigned by the IRC – 2017 that the document of 60 years research in Soil and Water Conservation may be published by the Head, Research Centres, Bellary, Kota, Udhagamandalam & H&E and HRD&SS Divisions on or before Sept. 30, 2017 and Research Centre, Agra by Dec. 31, 2017 positively. Similar document for 30 years of Research Centre, Datia and 25 years of Research Centre, Koraput may be published by August 31, 2017 positively.
8. The complete module on user friendly DSS for planning of watershed development project need to be developed by Dr. P.R. Ojasvi, Head (H&E Division) from the support of Institute for use by the stakeholders to justify the time spent on such project and to arrive at logical conclusion. The action taken may be presented in the IRC meeting 2018.
9. The testing comparison of the field level sediment sampler may be done during monsoon season by Er. Deepak Singh, Scientist (Engg.) and the report may be submitted by September 30, 2017 positively.
10. A policy paper on peach may be brought out from the project entitled "Peach based agri-horticulture landuse system for degraded Shiwaliks" by Dr. Ram Prasad, Pr. Scientist (Hort.) by December 31, 2017.
11. A meeting may be organized by Dr. B.L. Dhyani, Sr. Scientist (Ag. Eco.) and Dr. Pradeep Dogra, Pr. Scientist (Ag. Eco.) during Nov., 2017 with all scientists of Headquarters and scientists of Economics discipline from Research Centres for discussion on "Intangible benefits of NRM interventions in different projects in different climatic regions and network project formulation". The recommendations of above meeting may be utilized for formulation of core project on above issue for presentation in the next IRC meeting.
12. A DSS for generating optimal IFS plan of a farmer may be worked out by Dr. Pradeep Dogra, Pr. Scientist (Ag. Eco.) and leader of concluded core project entitled "Multiple criteria decision for identifying suitable Integrated Farming Systems in different agro-ecological regions for optimizing resource conservation and productivity" with the help of Ms. Chayna Jana or a computer programmer.
13. Preparation of Ravine Atlas of India including the scientific method for delineating the affected areas due to ravines may be completed by Dr. R.K. Singh, Head, Research Centre, Kota and Dr. G.L. Meena, Scientist (Soils) in association with Dr. Gopal Kumar, Sr. Scientist (Soils) by Dec. 31, 2017.
14. A policy paper on Jhola land may be published by Dr. (Ms.) Ch. J.P. Dash by August 31, 2017 related to the concluded project entitled "Mapping and characterization of Jhola land areas in Koraput district". The technologies developed from the above project may be transferred under TSP. RPP IV on the above project may be submitted. A bulletin on Jhola land may also be prepared.

15. The comparative cost estimate with other standard check dams constructed with standard construction materials may be worked out by Dr. P.R. Bhatnagar, Head, Research Centre, Vasad related to a concluded project entitled "Development of cost-effective plastic check dams for water harvesting in rainfed regions". Patenting of plastic check dams may also be explored.
16. The concluded project entitled "Creation of ICT network to disseminate knowledge about the soil and water conservation technologies to farmers in Himalayan region" may be continued as Transfer of Technology (ToT) for one year by Mr. Rajesh Bishnoi, Scientist (Ag. Extn.) to study the effectiveness of the project and collection of data for good statistical analysis.
17. The comparative analysis of different cover materials with tiles related to the concluded project entitled "Water budgeting of a ravine watershed pond for optimum crop planning under semi-arid region" may be completed by Dr. K.K. Sharma, Sr. Scientist (Engg.) by August 31, 2017 positively. Technologies may also be prepared on the above project.
18. The statistical analysis about trend in borewell depth related to the concluded project entitled "Socio-economic implication and vulnerability of farmers to ground water exploitation in hard rock region of the Deccan" may be done by Mr. Suresh Kumar, Scientist (Ag. Econ.) by August 31, 2017. A policy paper from the above project including techno-economical anlaysis may also be prepared.
19. The DSS from the concluded project entitled "Decision Support System (DSS) for identifying best management practices in erosion risk area" need to be sent for copy right. The action taken will be presented in the next IRC meeting.
20. A new proposal entitled "Evaluation and improvement of water and nutrient use efficiency for potato based cropping sequence through efficient use of harvested rain water" may be conducted as demonstration at the Research Centre, Udhagamandalam by Dr. P. Raja, Dr. K. Kannan and Dr. K. Rajan and DSS may be developed with the existing information and presented in the next IRC meeting.
21. Digitization of data of research farm at the Headquarters and all Research Centres may be completed and reported accordingly to Er. S.S. Shrimali, Sr. Scientist (CAA) and Co-ordinator for compilation of data digitization by December 31, 2017 positively.
22. Seminar on foreign papers may be conducted every month at Headquarters and all Research Centres for sharing of new thinking in research. One scientist may be identified at all Research Centres for organizing seminar every month. At the Headquarters, a roaster may be prepared by Dr. Pradeep Dogra, Pr. Scientist (Ag. Econ.) for organizing seminar on monthly basis.
23. Status report of Gauging devices / Silt Monitoring Stations (SMS) working at Headquarters / Research Centres may be prepared by the Head, H&E Division by June 30, 2017. Further, the format may be discussed with the concerned scientists and published by Sept. 30, 2017 by Dr. P.R. Ojasvi, Head, H&E Division and co-ordinator of this assignment.
24. On-site monitoring and evaluation of running projects of remaining Research Centres and Divisions may be co-ordinated and completed by the PME Cell of Headquarters visiting the project sites at Research Centres and Divisions after finalizing the dates with the Head of Research Centres and Divisions.
25. All RPPs of research projects should be filled-up, submitted and maintained as per ICAR guidelines on RPPs and the presentation made by Mr. S.K. Sinha, Assistant Chief Technical Officer, PME Cell on "Proper filling and maintaining RPP I, II, III & IV of Research Projects", discussed in the IRC meeting, 2017.
26. The maximum total percent time spent by a scientist in approved running research projects should not be exceeded 80% and minimum 20% of his / her time should be kept spare for other scientific assignments of the Institute. Further, minimum 20% time as PI and 10% time as Co-PI should be devoted by a scientist in a research project.
27. Paper / Abstract sending for publication / presentation should invariably be discussed in the monthly STMIM at the Research Centre / Headquarters in front of all scientists. The proceedings must be attached with the paper / abstract while submitting to the Director for approval through the Head.
28. An externally funded NICRA project entitled "Comprehensive assessment of climate change implications on watershed development component of PMKSY (WDC-PMKSY) approved during July, 2017 for three years (2017-18 to 2019-20) may be conducted by Dr. D.R. Sena, Pr. Scientist (Engg.) as PI at the Headquarters, Dehradun. Names of Dr. P.K. Mishra, Er. Uday Mandal, Dr. Gopal Kumar, Dr. Ramanjeet Singh, Dr. M. Sankar and Dr. Pradeep Dogra are included as Co-PIs of this project.
29. While taking up new R&D projects and upscaling the technologies, the scientist should focus on the location specific research, priorities on ongoing Government programmes, low cost and appropriate technology development, upscaling participatory research etc. The senior level scientists should act as mentor to the newly recruited scientists.

10 Participation

[Participation (Workshop/Coordination/Training / meeting/Symposium)]

DehraDun:

Attended the Group meeting on "Strategies for Doubling of Farmers' Income in Uttarakhand" chaired by Hon'ble Secretary, DARE and DG, ICAR, New Delhi at ICAR-IISWC, DehraDun.

Attended Interactive meeting with ICAR SMDs/Institutes on 11 April 2017 at NIAP, Pusa New Delhi.

Attended the meeting with Sh. Sunil Kumar Singh, Addl. Secretary & FA (DARE/ICAR) at IIISWC, Dehra Dun.

Attended the meeting with Hon'ble Agriculture & Farmers Welfare Minister and Hon'ble Chief Minister of UK at Secretariat of UK, Dehra Dun.

Attended Technical program Workshop of AICRPDA/NICRA at CRIDA, Hyderabad.

Attended Capacity Building Support for Neeranchal National Watershed Management Project- Dept of Land Resource, Ministry of Rural Development at ICAR-IISWC, Dehra Dun.

Attended the first meeting of the reconstituted ICAR-CWC Joint Panel on 2nd June at NASC Complex, New Delhi.

Attended the State level Regional Committee No.1 Meeting of H.P. at Nauni, Solan on 7th June, 2017.

Assisted the UPSC Selection Board as a member for the post of Dy Commissioner (NRM)/Rainfed Farming System in UPSC, New Delhi.

Attended the State level Regional Committee No.1 Meeting of Uttarakhand at ICAR-IISWC, DehraDun.

Attended the Brainstorming Workshop on National Mission on Himalayan Studies (NMHS) at Teestha Hall, Indira Prayavaran Bhawan, MOEF&CC, New Delhi.

Attended the 3rd meeting of Land Degradation and Restoration Assessment (LDRA) (deliverable 3bi) in UN FAO Hqrs. Rome, Italy during 17th July to 21st July, 2017.

Attended 44th meeting of the RAC of NTRF on 23rd August and 11thBiennial Worksop on 24th August at Kolkata.

Attended the Assessment Committee Meeting of CAS at ASRB, Pusa, New Delhi on 27.9.2017

Attended the State Coordination Committee meeting for Doubling Farmers Income by 2022 with Hon'ble Secretary, DARE and DG, ICAR, New Delhi on 10.10.2017

Attended the Assessment Committee Meeting of CAS at ASRB, Pusa, New Delhi on 16.10.2017

Attended the All India Seminar on "Scientific Mining of River Bed Material and Environmental Impact in Hilly and Foothill Region at Institution of Engineers (India), DehraDun.

Attended the Workshop on "Economics of Land Degradation Initiative in India" on 26th October, 2017 at New Delhi organized by Deutsche Gesellschaft fur, Internationale Zusammenarbeit (GIZ), New Delhi.

Attended the meeting with all stakeholders of NARES and Hon'ble VC, GBPUAT at Pantnagar regarding State Coordination Committee meeting for Doubling Farmers Income by 2022 .

Attended the State Coordination Committee meeting for Doubling Farmers Income by 2022 with Prof. M.S. Swaminathan and Secretary, DARE and DG, ICAR, New Delhi on 03.11.2017

Attended the Meeting between Scientists of ICAR-IISWC, DehraDun and NIRD-PR, Hyderabad regarding project/ Consultancy project on " Agro-climatic planning and Information Bank (APIB) for Uttarakhand State"

Delivered lecture on "Status and Prospects of Integrated Watershed Development Program in India" to IFS Officers during one day training program on Watershed Module at IGNFA, DehraDun on 29.11.2017.

Discussed on Water Platform with Director, IIWM and delivered lecture on ITK on IISWC at ICAR-IIWM, Bhubaneswar

Attended the 4th Board of Management Meeting of Uttarakhand University of Horticulture & Forestry (UUHF), Bharsar as a Member of Board Management at ICAR-IISWC, DehraDun.

Attended meeting with Sh. R.P. Singh, Hon'ble Governing Body Member of ICAR and Dr Gopal Lal, Director, ICAR-NRCSS, Ajmer on 7.1.2018 at ICAR-IISWC, DehraDun.

Assisted the UPSC Interview Board as a member for the post of Assistant Commissioner (NRM/RFS in UPSC, New Delhi.

Delivered lecture on "Over view of Watershed Management Concept in India" to Training Program of SWLM Sessions for IFS Probationers at IGNFA, FRI DehraDun on 15.1.2018.

Delivered lecture on "Climate Change and Water Management Strategies in Rainfed Agriculture" as a resource person in the FEED THE FUTURE – INDIA TRIANGULAR TRAINING (FTF-ITT) program on "Strategies for Enhancement of Farmers Income in Dryland Agriculture on 17.1.2018.

Delivered lecture on "Indigenous technical knowledge for improved water management in rainfed areas" in Training Program for field level officers of Govt. of Odisha under PMKSY at ICAR-IIWM, Bhubaneswar on 19.1.2018 as a resource person.

Attended the meeting regarding "Intangible benefits of NRM interventions in different projects in different climatic regions and network project formulation" at Institute Hqrs. DehraDun on 20-21 January, 2018.

Attended the Divisional Review Meeting of NRM Institutes at NASC Complex, Pusa, New Delhi.

Attended the conference on Farmers first for conserving soil and Water Resources in Western Region (FFCSWR-2018)" at Anand (Gujarat).

Attended the 5th Board of Management Meeting of Uttarakhand University of Horticulture & Forestry (UUHF), Bharsar as a Member of Board Management at ICAR-IISWC, DehraDun.

Attended the 89th Annual General Meeting of the ICAR Society at NASC Comlex, Pusa, New Delhi.

Delivered lecture on "Planning and management strategies for controlling land degradation under present climate change scenarios : A smart watershed approach" to the trainees of International Training Programme on Soil –water Conservation and watershed Management under India –Africa Forum Summit-III on March 06 2018 at ICAR-Indian Institute of Soil and Water Conservation, DehraDun.

Attended the Director's Conference on 8-9 March, 2018 at NASC Complex, Pusa, New Delhi.

Attended the Seminar on "High Tech Cultivation of Vegetable & Flowers" on 10th March, 2018 at the Institute of Engineers (India), DehraDun and presented a paper on "Hi-tech cultivation of vegetable and flowers: status, potentials and strategies in Indian Himalayan region".

Attended the Conference on "Food Processing & Kisan Sampada Yojna" on March 13, 2018 at Hotel Pacific, DehraDun and delivered the welcome address.

Attended the Expert Consultation Workshop on Hindu Kush Himalayan Mountain Soils from 20 to 21 March, 2018 at Kathmandu, Nepal and presented a paper on "Infiltration and Recharge : as a soil function"

Dr. P.K.Mishra

Coordinated and attended the State level Annual Review Meeting of Regional Committee No.1 of J.&K. at Srinagar and meeting with Director, ICAR-CITH and Head, CAZRI Regional Centre, Leh regarding NMSHE project.

Dr(s). P.K.Mishra and N.K.Sharma

Acted as Chairman and Coordinator, Organizing Committee for celebrating Institute Annual Day at IISWC, DehraDun on 7th April, 2017.

Coordinated and conducted D.G., ICAR visit at Research Farm, Selakui on 7th April, 2017.

Organized and attended the review meeting of NMSHE project at IISWC, Dehradun on 8th April, 2017.

Conducted the visit of Dr. S.K. Dhyani, Nodal Officer (TSP), ICAR HQ. to Utpalta village on 13.4.2017.

Chaired "Fifteenth Regional Research Advisory Committee" meeting on 26.6.2017 at Regional Sericulture Research Station, Central Slk Board, Sahaspur, Dehradun.

Acted as a member the Annual State Level Joint Review Meeting of ICAR Regional Committee No.I for Uttarakhand organized by V.C.S.G. Uttarakhand University of Horticulture and Forestry, Bharsar at ICAR-IISWC Dehradun on 1st July, 2017.

Acted as Chairman of assessment of Technical personnel – Functional Group I – Field/Farm Technicians (Category-II) on 11.7.2017 at ICAR-VPKAS, Almora.

Delivered a lecture on "Preparation of Land" in the Green Skill Development Programme of MoEF&CC jointly organized by BSI and ZSI at Botanical Survey of India, Northern Regional Centre, DehraDun on 18.7.2017.

Conducted the visit of Shri Satpal Maharaj, Hon'ble Cabinet Minister of Irrigation, Flood Control, Tourism and Culture of Uttarakhand Govt at ICAR-IISWC, Dehradun on 22nd August, 2017.

Acted as Coordinator to organise the "Sankalp Se Siddhi" programme for Dehradun district. The programme was organized jointly by ICAR-IISWC, Dehradun and KVK, Dhakrani on 26th August, 2017..

Visited ICAR-IISWC, Research Centre, Datia on 28.8.2017 and reviewed the ongoing research project for agronomy discipline.

Chaired the meeting of CAS at CAFRI, Jhansi on 29.8.2017.

- Coordinated and conducated the visit of Dr. J.C. Katiyal, Ex-DDG (Edn.) at Research Farm, Selakui and also attended the meeting on 22.9.2017 at IISWC, Dehradun.

Invited as Chief Guest in training programme on "Application of remote sensing and GIS in natural resource management (ARSGN)" for technical staff of ICAR on 27th September, 2017 at IISWC, Dehradun.

Coordinated and conducated the visit of Dr. K. Algasundaram, DDG (NRM) at Research Farm, Selakui and also attended the meeting on 09.10.2017 at IISWC, Dehradun.

Participated UNESCO, IMS &IMD South Asian Conference on Strengthening of Early warning system for DRR in Himalayan Agriculture from 25-26th October, 2017 at Palampur, HP. Acted as Co-chairman of Technical Session 2: Country presentation.

Attended the meeting of brainstorming on "Assessing the state ecosystem health for the Indian Himalayan region" at Wildlife Institute of India, Dehradun on 29th October, 2017.

Attended the meeting with all stakeholders of NARES and Hon'ble V.C., GBPUAT regarding State Coordination Committee meeting for doubling Farmers Income by 2020 at GBPUAT, Pantnagar on 31.10.2017.

Invited as Chief Guest in training workshop on "Methodological framework for implementation on FFP" on 6th November, 2017 at IISWC, Dehradun.

ICAR-IISWC, DehraDun and ICAR-IVRI, Mukteswar jointly organised farmers' training and animal health camp at Kotha Tarli village, Kalsi Block, Dehradun under NMSHE and TSP programme on 27 December, 2017.

Conducted and participated a review meeting, organised on 5.1.2018 at Jyur Kafoon village, Almora, Uttarakhand to review the progress and discussed the subsequent future of plan under NMSHE of lower middle Himalaya.

Acted as Chairman in the DPC held at VPKAS, Almora under CAS on 5.1.2018 on agronomy discipline.

- Conducted training programme under "*Mera Gaon Mera Gaurav*" on 6nd Jan. 2018, for the farmers of Ichhla village, Kalsi Block, DehraDun.

Acted as Chairman in the selection committee of the temporary position of Junior Research Fellow under the NMSHE project at IISWC, DehraDun on 6th February, 2018.

As Incharge Director participated in *Kisan Goshthi* at Utpalta village, Kalsi, Dehradun on 17.03.2018.

As Incharge Director conducted the valedictory function of "International Training Programme on Soil and Water Conservation and Watershed Management" under IASF-III on 20th March, 2018 at IISWC, DehraDun. Dr. Savita, Director, FRI, DehraDun invited as Chief Guest in the function.

As Incharge Director inaugurated the Training Programme on "Skill Development for Skilled Supporting Staff of ICAR-IISWC, DehraDun" on 22nd March, 2018 at IISWC, DehraDun

Dr. N.K. Sharma

Attended the Himalayan Day Celebration on the eve of "Himalaya Day" at IISWC, Dehradun on 08-09-2017.

Dr(s). N.K.Sharma; D.V.Singh; D. Mandal; U.K.Maurya; N. Alam;
M. Shankar; Raman Jeet Singh; Ashok Kumar ;Gambhir Singh and Sh. Deepak Kaul

Conducted and participated in training programme under "Mera Gaon Mera Gaurav" on 6nd Jan. 2018, for the farmers of Ichhla village, Kalsi Block, Dehradun.

Dr(s). N.K.Sharma; U.K.Maurya;
M. Shankar; N.Alam; Raman jeet Singh

Attended 3 days conference on Farmers First for Conserving Soil and Water Resources (FFCSWR-2018) for Western Region ended on February 01-03, 2018 at Anand Agricultural University (AAU), Anand, Gujarat.

Dr(s). N.K.Sharma; D.Mandal: D.V. Singh; U.K.Maurya; Gambhir Singh

Attended the research seminar on 'Research Needs and Networking Opportunities in Soil Science' at FRI, Dehradun on 24th January, 2018.

Dr(s).N.K.Sharma and M.Shankar

Visited Research Centre, Vasad, Gujarat on 23rd and 24th November, 2017 for On-site evaluation of the on-going research projects in the centre.

Dr(s).N.K.Sharma and D.Mandal

Attended the conference on "Food Processing and Kisan Sampada Yojana" in collaboration with ASSOCHAM, New Delhi and organized by ICAR-IISWC, Dehradun and inaugurated by Hon'ble Governer, Uttarakhand on 13th March, 2018 at Hotel Pacific, Dehradun.

Dr(s). N. K. Sharma; U.K.Maurya and Sh. Ashok Kumar.

Attended the "Sankalp Se Siddhi" programme for Dehradun district. The programme was organized jointly by ICAR-IISWC, Dehradun and KVK, Dhakrani on 26th August, 2017.

Coordinated and organised "World Soil Day" at ICAR-IISWC, DehraDun on 5th December, 2017.

Participated and presented Institute's achieivements in a meeting chaired by Hon'ble Cabinet Minister, Govt. of Uttarakhand at Secretriate, Dehra Dun on 17th January, 2018.

Attended the seminar on 'Research Needs and Networking Opportunities in Soil Science' and delivered a lecture on "Modern research trends and networking opportunities in soil science" in Technical Session at FRI, Dehradun on 24th January, 2018.

Participated and delivered lecture in workshop on 'Mera Gaon Mera Thirth' organized by Uttarakhand Uthan Parishad at HNBG University, Srinagar on 28th Jan., 2018.

Dr. D.V. Singh

Attended the Annual State Level Joint Review Meeting of ICAR Regional Committee No.I for Uttarakhand organized by V.C.S.G. Uttarakhand University of Horticulture and Forestry, Bbharsar at ICAR-IISWC Dehradun on 1st July, 2017.

Dr(s). D.V.Singh; U.K.Maurya; N. Alam; Raman Jeet Singh and Sh. Ahok Kumar

Attended two days National Brainstorming workshop on "National Soil Management Policy" at MANAGE, Hyderabad during July 20-21, 2017.

Dr. D. Mandal

Attended the meeting with Shri Satpal Maharaj, Hon'ble Cabinet Minister of Irrigation, Flood Control, Tourism and Culture of Uttarakhand Govt at ICAR-IISWC, Dehradun on 22nd August, 2017.

Dr(s). D. Madal; U K Maurya; N. M.Alam and Raman jeet Singh.

Attended the meeting for discussion on "Intangible benefits of NRM interventions in different projects in different climatic regions and network project formulation" on January 20-21, 2018 at IISWC, DehraDun.

Dr(s).D.Mandal;U.K.MauryaN.M.Alam

and M.Shankar.

Chairman -Technical Evaluation Committee (TEC) at ICAR-NRCL from 1-4-2017 to 30-6-2017,
Chairman Spot Purchase Committee (SPC), at ICAR-NRCL from 1-4-2017 to 30-6-2017,
Chairman- Climate Change Study (CCS), at ICAR-NRCL from 1-4-2017 to 30-6-2017,
Co- Chairman-Store and purchase committee (SPAC), at ICAR-NRCL from 1-4-2017 to 30-6-2017,
Co-Chairman- Works Committee (WC), at ICAR-NRCL from 1-4-2017 to 30-6-2017,
Co-Chairman Sports and Recreation Committee (SRC), at ICAR-NRCL from 1-4-2017 to 30-6-2017.

Dr.Gopal Kumar

Atended the Annual State Level Joint Review Meeting of ICAR Regional Committee No.I for Uttarakhand organized by V.C.S.G. Uttarakhand University of Horticulture and Forestry, Bbharsar at ICAR-IISWC Dehradun on 1st July, 2017.

Participated in All India Seminar on "Scientific Mining of River bed Material and Environmental Impact in Hilly and Foothill Region" organised by the Institute of Engineers, Uttarakhand, during 24-25 Oct. 2017 at IEI, DehraDun, and presented paper on "Environmental impact of River Bed Mining-a review" and Chaired Technical Session I as its Rapporteur.

Attended Conference on State Science and Technology Conclave organised by Uttarakhand Science Education and Research Centre (U-SERC), Dept of Science & Technology, Govt. of Uttarakhand in collaboration with Graphic Era (Deemed to be University), and Graphic Era Parvatiya University, Dehradun at Graphic Era during 23-24 Feb. 2018, and delivered invited talk on "Isotope techniques in spring rejuvenation".

Delivered invited lecture on "Delineation and development of spring shed for creation of water recourse" on 8th March, 2018, in the International Training Programme under India-Africa Forum Summit-III at ICAR-IISWC, DehraDun.

Acted as Coordinator of National Seminar on Hi-Tech Cultivation of Vegetables and Flowers at Institute of Engineer, Dehradun during 10-11 March 2018, organized jointly by Institute of Engineers (India) and ICAR-IISWC, at Institute of Engineer, Dehradun.

Organised International Training Programme on Soil and Water Conservation and Water shed Management under India-Africa Forum Summit- III, during 6-20 March, 2018 at Dehradun as Course Coordinator.

Organised Field Day under Farmers FIRST Project, for the farmers of adopted villages at Raipur Block of Dehradun Dist. on 24th March, 2018.

Dr.U.K. Maurya

Conducted training programme under "Mera Gaon Mera Gaurav" on 2nd Jan. 2018, for the farmers of Phateu village, Kalsi Block, Dehradun.

Dr(s). U.K. Maurya, M. Shankar; and Raman Jeet Singh

Attended the demonstration on "Application of Electrical Resistivity Meter (ERM) in Groundwater Exploration" at IISWC, DehraDun on 5.1.2018.

Dr(s).U.K.Maurya; M. Shankar; N.M.Alam; Raman jeet Singh.

Discussed paper entitled "Nationwide soil erosion assessment in India using radioisotope tracers Caesium-137 (^{137}CS) and Lead-210 (^{210}Pb) : the need for fallout mapping" at IISWC, Dehradun.

Dr. M. Sankar

Delivered lecture on Statistical Methods for Watershed Management in the In-Plant Training of M.Sc. (Ag.) Previous students of Banaras Hindu University during 23 May to 7th June 2017 at IISWC, Dehradun.

Dr. N.M. Alam

Oorganized and participated a training programme under Mera Gaon Mera Gaurav at Kalsi Johan village on 19.9.2017.

Dr(s).N.M.Alam and Ramann Jeet Singh; Ashok Kumar;

Gambhir Singh and Sh. Deepak Kaul

Worked as Assistant tour conducting officer during 19.11.2017 to 24.11.2017 of study tour of 117th batch of officer trainees.

Assisted in arrangement for Agriculture Education day celebrations on 03.12.2017 at IISWC, Research Farm Selaqui.

Assisted in 60 demonstrations conducted under transfer of technology (TOT) programme during 2017-18, in adopted villages of kalsi block, Dehradun.

Sh.J.S. Deshwal

Attended follow up action committee meeting under the chairmanship of DS (Adm.) at ICAR, New Delhi on 8.2.2018.

Sh.Deepak Kaul

Invited as expert to finalize standards for course on "Water Elucation, Water Conservation, Water Quality and Health Hygiene' being prepared by USERC, Dehradun for farmers and students, 27th May, 2017.

Attended Consultation meeting on Mitigating land degradation at NAAS, New Delhi on 20th June, 2017.

Invited as 'Guest of Honour ' in Inaugural fundtion of Tier-II training programme on "Watershed Managementand and Ground Water Recharge" organized by CGWB, Dehradun 11-13 Sept., 2017.

Delivered invited lecture on Drainage Line Treatment in the Tier-II training programme on Watershed Management and Ground Water Recharge organized by CGWB, MoWR, RD&DR, Dehradun 11-13 Sept., 2017.

Delivered lecture in one day waterhed module for IFS officers in IGNFA on 29th Nov., 2017.

Attended workshop on "Science and Tecnology in Rejuvenation of Nani Lake" organized by UNDP (India) under the Chairmanship of Governor of Uttarakhand at Raj Bhawan on 27.11.2017.

Delivered lecture to IFS probationers on SWLM session- Rain water harvesting on 16th Jan., 2018.

Invited as an expert to Seminar "Basin Scale Scientific Planning for Sustainable Management of Water and Land Resources: Case study of Ghod Basin, District Pune organized by CII-ACWADAM-ITC at New Delhi on 21.3.2018.

Attended review meeting of CRP on Water Project at ICAR, New Delhi on 23.3.2018.

Dr.P.R.Ojasvi

Attended National Conference on "Badalti Jalwayu mein Uchch takniki Parvatiya Bagwani ke Ubharate Rujhan" organized by CITH, Mukteshwar on 6-7 March, 2018.

Gave oral presentation on "Study the Soil Moisture Distribution Pattern under ZEDIS organized by CPCR, Lucknow during 28th Feb., to 1st March, 2018.

Er. Deepak Singh

Attended National workshop on "Revisiting AFCARS: Reflexations and feedback of trained Scientists" from March 15-16, 2018 at ICAR, NAARM, Hyderabad.

Er. Uday Mandal

Attended Interaction meeting on Capacity Building Support for Neeranchal National Watershed Management project (NNWMP) between DoLR (MoRD) and ICAR- IISWC at DehraDun on 31.5.2017.

Attended "Regional Workshop on Skill Development in Agriculture" organised by Ministry of Agri. & Farmers Welfare at Hotel Mount view, Sector-10, Chandigarh on Sept. 15, 2017.

Attended "Workshop on issues of Agricultural Development in District Haridwar" chaired by Dr. A.K. Singh, DDG (Agril. Extn.) at KVK, Dhanauri, Haridwar on Sept. 16, 2017.

Attended "National Workshop on Developing Road Map for Agricultural knowledge Management in India" organized by DKMA at NASC, Pusa, New Delhi on Sept. 27&28, 2017.

Attended Training cum Workshop on "Capacity Building Programme on Management Framework for Implementation of FFP" at ICAR-IISWC, DehraDun during 6-9 November, 2017.

Attended Annual Review Workshop of Farmer FIRST Project at New Delhi on 21 & 22 February, 2018.

Attended Brainstorming Meeting on "Intangible benefits of NRM interventions in different projects in different climatic regions and network project formulation" organized at ICAR-IISWC, Dehradun on Jan.20&21, 2018.

Attended Annual State Level Joint Review Meeting of ICAR Regional Committee No.1 for Uttarakhand on July 1, 2017.

Attended Institute Advisory Committee meeting under Farmer FIRST Project at ICAR-IISWC, DehraDun on Aug.29,2017.

Attended Conference on Food Processing and Kisan Sampada Yojana organized by ICAR-IISWC in collaboration with ASSOCHAM, New Delhi at Hotel Pacific, DehraDun on March 13, 2018.

Coordinated four months regular "certificate course on Soil and water conservation and watershed management" (116th batch) at IISWC, DehraDun during April 22-Aug.21, 2017.

Coordinated visit of Dr. V.P. Chahal, ADG (Agril. Extn), ICAR, New Delhi to the adopted villages of Farmer FIRST Project on 15.06. 2017.

Organised four months certificate course on Soil and Water Conservation and Watershed Management (October 9, 2017 to February 8, 2018).

Coordinated showcasing of conservation technologies during Sankalp Se Siddhi (New India Manthan) celebrations organized by ICAR-IISWC, Dehradun and KVK, Dhakrani on Aug.26, 2017 at Kisan Bhawan, Dehradun.

Coordinated visit of Dr. Alagusundaram, Hon'ble DDG (Engg. & NRM). He inaugurated 4 months Regular Training for Certificate Course on "Soil and Water Conservation and Watershed Management" (117th batch) commenced from 9th October, 2017.

Coordinated Training cum Workshop on "Capacity Building Programme on Management Framework for Implementation of FFP" at ICAR-IISWC, Dehradun during 6-9 November, 2017.

Coordinated Advisory Committee meeting under Farmer FIRST Project at ICAR-IISWC, Dehradun on Aug.29,2017.

Coordinated visit of the farmers to institute sponsored by HPKCCC under NIMSHE project on June 29,2017.

Coordinated Kisan Gosthi at village Sindhwal Gaon, Raipur Block under Farmer FIRST Project on 18.11.2017.

Coordinated Kisan Gosthi at village Bhagwanpur, Raipur Block under Farmer FIRST Project on 22.11.2017.

Coordinated Animal Health Camp at village Bhagwanpur, Raipur Block under Farmer FIRST Project on 28.11.2017.

Coordinated Animal Health Camp at village Koti Maichak, Raipur Block under Farmers FIRST Project on 29.11.2017.

Coordinated visit of farmers for two days National workshop on Farmers feedback for doubling farmers income by 2022 at ICAR-NAARM, Hyderabad during December to 22-23, 2017. Farmers narrated their experiences in augmenting their resources and also flagged issues, challenges and opportunities in achieving the targeted double income.

Coordinated visit of Sh. R.P. Singh, Hon'ble Member of ICAR Governing Body who visited ICAR-IISWC, Dehradun on Jan.7, 2018.

Coordinated Swachhata Pakhwara Celebrations from 15-31 May, 2017.

Coordinated students visit from Nepal on Nov. 17, 2017.

Worked as Organizing Secretary for Conference on Food Processing and Kisan Sampada Yojana in collaboration with ASSOCHAM, New Delhi at Hotel Pacific, Dehra Dun on March 13, 2018.

Dr. Bankey Bihari

Participated in the Training workshop on methodological framework for implementation of FFP at ICAR- IISWC, DehraDun, organized by ICAR-NAARM, Hyderabad during 6-9 Nov 2017.

Participated in All India Seminar on "Hi-tech cultivation of Vegetables & Flowers" at IE(India), UKSC, Dehradun during March 10-11, 2018, jointly hosted by IE(India), ICAR-Indian Institute of Soil and Water Conservation and Horticulture Department, Uttarkhand.

Participated in All India Seminar on 'Scientific Mining of River Bed material and environmental impact in hilly and Foothill region' at IE(India), UKSC DehraDun during 24-25 October 2017, jointly hosted by IE(India), Indian Association of Soil and Water Conservation and ICAR-Indian Institute of soil and water conservation.

Participated in International Conference on Sustainable Technologies for Intelligent Water Management" organized jointly by the Department of WRD&M, IIT Roorkee, and IWRS at IIT Roorkee during Feb. 16-19, 2018

Attended the meeting convened by Secretary, Irrigation, Govt. of Uttarakhand in his chamber on 27/6/2017.

Attended as an expert the interview committee for promotion of Scientist at IIRS, DehraDun on 27/6/2017.

Participated as an external expert in the Project Expert Group Meeting of ICFRI, held on 16/2/2018 at ICFRI DehraDun for evaluating the AICRP projects.

Attended doubling farm income meeting held at IISWC DehraDun, chaired by DG, ICAR on 7/4/2017

Chaired Assessment Committee of T-4 held at CAFRI, Jhansi on 18/4/2017.

Participated in the meeting , chaired by DG, DoLR (MoRD), New Delhi held at Nirman Bhawan, New Delhi to finalize the Training Course for state line departments on 7/7/2017

Attended NMSE meeting at Delhi, chaired by Dr S.K Chaudhary, ADG on 15/1/2018.

Acted as an observer at Roorkee Centre-I in Stenographer grade –III examination conducted by ASRB on 29 October 2017.

Coordinated a 15-day International training Program on Soil - water conservation and watershed Management at ICAR-Indian Institute of Soil and water conservation during 6 – 20 March 2018. Fifteen senior level officers/academician from 7 African countries participated in the programme.

Coordinated and conducted a 5-day training course on Environmental Metrics – Hydrological and sediment monitoring at Injibar, Ethiopia during 1-5 August 2017 at Injibara, Ethiopia.

Coordinated and conducted a 5-day training course on Environmental Metrics – Hydrological and sediment monitoring at Injibar, Ethiopia during 7-11 August 2017 at Kibaha, Tanzania.

Coordinated and conducted a 5-day training course on Environmental Metrics – Hydrological and sediment monitoring at Injibar, Ethiopia during 14-18 August 2017 at Toamasina, Madagascar.

Organised All India Seminar on 'Scientific Mining of River Bed material and environmental impact in hilly and Foothill region" at IE(India), UKSC DehraDun during 24-25 October 2017, jointly hosted by IE(India), Indian Association of Soil and Water Conservation and ICAR-Indian Institute of soil and water conservation.

Organised All India Seminar on "Hi-tech cultivation of Vegetables & Flowers" at IE(India), UKSC, DehraDun during March 10-11, 2018, jointly hosted by IE(India), ICAR-Indian Institute of Soil and Water Conservation and Horticulture Department, Uttarakhand.

Convened a session on community based decentralized soil and water management under changing scenario of climate in which Dr K.G. Tejwani Memerial lecture was delivered by Dr Rajendra Singh, Tarun Bharat sangh, Alwar Rajasthan in the National conference on farmers first for conserving soil and water resources in western region.

Conducted training-cum-exposure visit to 19 trainee delegates of 9 African countries in Langha watershed and Research farm Selakui.

Dr. Ambrish Kumar

Attended state level ICAR-Regional Committee No. 1 at SKUAST-K, Shalimar , Srinagar on 20.6.2017

Participated in 15th NIAS-DST course on Multidisciplinary prospective on Science Technology and Society at National Institute of Advanced Studies during December 11-22, 2017 at Bangaluru.

Attended workshop on "Contingency Plan and Communication Strategies for El Nino/Drought/delayed Sowing rains during *kharif* season" on January 31, 2018 at Directorate of Watershed Management, DehraDun.

Dr. Lekh Chand

Participated in a National Conference on 'Intervention of climatic change in sustainable development of agriculture, food and nutrition security and its amelioration' organized by Subharti Institute of Technology and Engineering, Swami

Vivekanand University, Meerut during 24-25 March 2017 and presented a paper as oral presentation on the topic 'Potential of ripe banana peel powder as food ingredient: a step towards waste utilization'.

Attended a National Seminar on 'Transforming Agriculture to doubling farmers' income' which was organized by Samagra Vikas Welfare Society (SVWS) in association with Babasaheb Bhimrao Ambedkar University, Lucknow during Feb. 10-11, 2018. I presented a paper as oral presentation on the topic 'Use of banana peel powder in food fortification'.

Dr. Indu Rawat

Attended "*National Seminar on "Micronutrients and Pollutants in soil-plant-animal-human continuum for sustaining soil, food and nutritional security"* held at BCKV, Kalyani, West Bengal during 9-10th June, 2017 and delivered an Oral presentation on the topic "Temporal variation in chemical and biological properties of sludge obtained from different sources and their suitability for agriculture"

Attended the training workshop on "Methodological Framework on Implementation of FFP" from Nov 6-9, 2017 organized by ICAR-NAARM in collaboration with ICAR-IISWC, DehraDun.

Attended the FFCSWR-2018 at AAU, Gujarat from 1st-3rd February, 2018 and presented a poster in the Conference.

Dr. Trisha Roy

Attended the Kisan Gosthi and live telecast of the Krishi Unnati Mela, IARI, New Delhi a Village Udpalta, Dehradun on March 17, 2018.

15-day International Training Programme on 'Soil and Water Conservation and Water Conservation (IISWC), Dehradun under aegis of India-Africa Forum Summit-III from 6th to 20th March, 2018 sponsored by the Ministry of External Affairs, Govt. of India.

Attended the interaction meeting on capacity building support for Neeranchal Watershed Management Project(NNWMP) between DoLR(MORD) and ICAR IISWC DehraDun at DehraDun. Mr. G. Sajeevan, DDG(WM), DoLR and Director (WM) Mr. Amit Kumar DoLR, New Delhi. Preparation of draft proposal for funding by the DoLR, New Delhi. 31.5.2017

Attended the Annual State Joint Review Regional Committee No1 Meeting, at SKAUST Shalimar, Srinagar J&K.

Attended the Workshop on Public Private Partnership held at ISTM, New Delhi during 3rd & 4th August, 2017 at Institute of Secretariat Training & Management Department of Personnel & Training Administrative Block. Opp: Bersarai Market JNU Campus (Old), New Delhi-110067.

Dr. Harsh Mehta

Agra

Visited ICAR-CPRI RC Gwalior on 20th June, 2017for Survey of water harvesting structures was conducted on farm of CPRI RC Gwalior

Chaired the programme on World Bee Keeping Day celebrated at KVK Mathura on 19 August, 2017.

Participated in awareness camp and training of farmers on PPVF& FR Act 2001 was organized at the centre on 17 October, 2017

Conducted two days practical field training on Soil & Water Conservation measures at Dr. Salim Ali Conference Hall, Keola Deo National Sanctury Bharatpur Sponsored by Deputy Conservator of Forest Bharatpur Rajasthan on 20-21 December, 2017.

Attended Scientific advisory committee (SAC) at KVK Firozabad on 11 January,2018

Dr. S.K.Dubey

Attended one day pre Rabi Ghosthi organized at nayabansh, Agra on 24 October, 2017.

Attended one day pre Rabi Ghosthi organized at Garhi Udairaj, Fatehabad, Agra on 26 October, 2017.

Dr(s). S.K. Dubey; A.K.Parandiyal;

K.K. Sharma and R.K.Dubey

Participated in awareness camp and training of farmers on PPVF& FR Act 2001, organized at the ICAR - IISWC, Research centre, Agra on 17 October, 2017

Attended DPC for promotion of Assistant Professors as expert (Agroforestry) at Rajmata Krishi Vishv Vidyalaya, Gwalior on 9 October, 2017

Participated in training programme on ".Management Development Programme on Leadership development (a pre-RMP programme) from 12-23 december, 2017 at ICAR-NAARM Hyderabad.

Dr. A.K.Parandiyal

Delivered two lectures in training of Forest at DFO, Office Bharatpur, Rajasthan in a training on Mukhyamatri Jan swabhiman Abhiyan on SWC measures during 20-21 december,2017.

Dr.K.K. Sharma

Participated in awareness camp and training of farmers on PPVF& FR Act 2001 was organized at the centre on 17 October, 2017.

Dr(s). K.K.Sharma and R.K.Dubey

Attended the selection committee meeting as member for interview of SRF in the Project on " National Innovation on Climate Resilient Agriculture (NICRA)' under ICAR sponsored Dry land Agriculture Project at Bichpuri Campus of R.B.S.college Agra on 1st Septemper, 2017

Delivered lecture on advances in management of degraded lands to 71 participitants of winter school organized by RVRS agriculuture university, Gwalior on 17 February, 2018.

Delivered lecture on description of On Farm Development Works in command area to participants of district technical resource team and block technical resource team of district Agra and Firozabad on 13,22 & 29 December, 2017 at regional Rural development institute, Bichpuri Agra.

Dr. R.K.Dubey

Coordinated various exposure visits of farmers and students from different States.

Coordinated and delivered lecture in two days training organized at Beelpura and Gari Udayraj, Fatehabad during March 7-8, 2017 and March 9-10, 2017, repectively

Delivered lectures on "Socio-economic analysis of soil and water conservation measures and related issues" in 15 days (01-30th June, 2017) summer practical training in soil & water conservation conducted by IISWC, RC, Agra for B.Tech. (Agril. Engg) students.

Participated in the Hindi workshop organized at the Centre on June 28, 2017.

Delivered lectures on "Socio-economic analysis of soil and water conservation measures and related issues" in 15 days (01-31th July, 2017) summer practical training in soil & water conservation conducted by IISWC, RC, Agra for B.Tech. (Agril. Engg) & M. Tech. (Agril. Engg) students.

Organised and coordinated Kharif kisan gosthi at Behrampur, Etmadpur and Manikpura, Pinhat block on August 16, 2017 and August 17, 2017, respectively.

Successfully completed training programme on Impact assessment of agricultural research and technology at NAARM, Hyderabad during 12-16 September, 2017

Participated in the Hindi workshop organized at the Centre on September 27, 2017

Smt. M. Prabhavathi

Chandigarh

Chaired a session and Presented an invited paper 'Organic manure and Biofertilizer" in National seminar on promotion of skills and technologies for sustainable rural development in India, held from 31st August to 1st September,2017 at National Institute of Technical Teachers Training and Research (NITTTR), sector 26, Chandigarh.

Attended 19th organic world congress, New Delhi. Nov 9-11, 2017. Organized by ISOFAR, NCOF and TIPI, Page: 325-328.

Attended the Video Conference at Haryana Secretariat , Sector-1, Chandigarh on 10/8/2017

Attended Hindi Rajbhasha Narakas meeting at Kisan Bhawan, Sector 35-B, Chandigarh on 30/8/2017

Attended and organized Sankalp se Siddhi programme on 7/9/2017

Attended Orientation workshop at UT Guest House, Sector-6, Chandigarh on 7th Nov., 2017. Organized by Director, Deptt. Of Field Publicity, Ministry of Information and Broadcasting.

Attended Regional Committee meeting at CSSRI, Karnal on 12/12/2017.

Attended viva-voce Exam at Y.S> Parmar University Solan on 14/12/2017.

Dr. (Mrs.) Pawan Sharma

Attended a workshop on "Intangible benefits of NRM interventions in different projects in different climatic regions and network project formulation" at IISWC, Dehradun for January 20-21, 2018 at Dehradun.

Attended a meeting of Institute Management Committee (IMC) at ICAR-IISWC, Dehradun on 8th February 2018.

Attended Regional Workshop on Skill Development on 15th September, 2017, held at Hotel Mount View, Chandigarh.

Dr. (Mrs.) S.L.Arya

Participated and delivered a lecture on Hill Watershed, its Concept and Principles at Regional Seminar on "Soil & Water Conservation Strategies in Himalayan region: The Fragile Ecosystem" held in Shimla (Himachal Pardesh) on August 28, 2017.

Participated All India Seminar on "Scientific mining of River bed material and Environmental impact in hilly and foothill region" held in Dehradun (Uttrakhand) on October 24-25, 2017.

Delivered a lecture on "Soil and Water Conservation Measures for Arable and Non arable lands" on 8th August and on 25th January 2018 in Training programme on Watershed Management at State Institute of Rural Development (SIRD) MohalI (Punjab)

Delivered a lecture on "Watershed Management" in training programme on "Water budgeting and management at local level" at Nature camp, Thapli, Panchkula(Haryana) organized by Central Ground Water Board, Chandigarh.

Delivered lecture on Soil and Water Conservation Projects and Schemes in one day seminar organized by Press Information Bureau, Chandigarh in August 2017.

Dr.V.K.Bhatt

Attended and participated in Hindi Workshop held at IISWC, RC, Chandigarh on 5/1/2017.

Attended Hindi Workshop at IISWC, RC, Chandigarh on 11/1/2017.

Attended meeting with the Chief Secretary, Deptt of Agriculture, Haryana at village Paarwala, Haryana. Dr. Abhilaksh Likhi on 12/1/2017.

Attended Swarn Jayanti Krishi Sammelan, Mela and Gosthi at New Market, Barwala, Haryana on 28/2/2017.

Attended and participated in Hindi Divas Workshop organized at IISWC, RC, Chandigarh on 7/3/2017.

Attended Meeting at IISWC, RC, Chandigarh with the Vigilance Director, R.K. Aggarwal on 29/4/2017.

Attended meeting and conducted Farm visit of R.K. Singh, ICAR Governing Body Member on 12/5/2017.

Attended meeting and conducted field visit of Dr. Yadu Ram, Asst. Professor, Dolphin PG College, Chunikalam, Mohali on 25/5/2017. One PG student also visited with Research Farm, Horticulture Nursery.

Attended and participated in Hindi Workshop organised by IISWC, RC, Chandigarh.

Attended Exhibition at NITTTER, Sector 26, Chandigarh on 1/9/2017.

Attended Golden Jubilee National Seminar on 1/9/2017 on Promotion of Skills and Technologies for Sustainable Rural Development in India from August 31, 2017 to September 1, 2017 at NITTTER, Chandigarh (MoHRD, GOI).

Attended and participated in the "Kisan Sammelan: New India Manthan-Sankalp Se Siddhi" at IISWC, RC, Chandigarh on 7/9/2017.

Attended Assessment Committee Meeting for the promotion of Technical & other staff at National Agri-Ford Bio-Technology Institute, Knowledge City, Sec-81, Mohali (Pb) on 18/12/2017.

Attended 3rd Meeting of the Executive Committee of the State Level Nodal Agency, Haryana: Department of Rural Development held at Room 406, Haryana Civil Secretariat, Sector 17, Chandigarh on 23/1/18.

Attended 21 days Winter School on "Advanced Technologies in Natural Resource Management to Mitigate Climate Change Impacts" from 9.11.2017 to 29.11.2017.

Special Training Programme visit was conducted for 116th Batch of Special Officer Trainees (26 no.) on 16.06.2017 and field visit was also conducted to Mandhala watershed.

Dr.Ram Prasad

Participated in seminar on "Soil and Water Conservation Strategies in Himalayan Region : The fragile ecosystem" organised by HP state CAMPA on 28th September, 2017

Dr.Pankaj Panwar

Participated in meeting at Mini Secretariat , Sector 9 , Chandigarh, held under the chairmanship of Sh. Satish Chandra , IAS, Additional Chief Secretary Govt of Punjab, on 30th January, 2018

Dr(s).V.K.Bhatt, Pankaj Panwar & (Mrs.) Sharmishta Pal

Attended the Video Conference at Haryana Secretariat , Sector-1, Chandigarh on 10/8/2017

Attended and participated in the "Kisan Sammelan: New India Manthan-Sankalp Se Siddhi" at IISWC, RC, Chandigarh on 7/9/2017. It was organized in collaboration with KVK, Mohali. P.S. Chandumajra was the honorable Chief Guest.

Attended 3rd Meeting of the Executive Committee of the State Level Nodal Agency, Haryana: Department of Rural Development held at Room 406, Haryana Civil Secretariat, Sector 17, Chandigarh on 23/1/18.

Dr. (Mrs.) Sathiya K.

Datia

Participated in foundation day of ICAR-CAFRI, Jhansi on May 08, 2017.

Participated in workshop on 'Assessment of Agro forestry Areas in India' at ICAR-CAFRI, Jhansi on Oct. 06, 2017.

Participated in ICAR Regional Committee no. VII - Mid Term Review meeting organized by ICAR - NBSS&LUP, Nagpur at ICAR – CIAE, Bhopal on Nov. 10, 2017.

Participated in 24th Zonal Workshop of KVKs of Zone IX organized at Burhanpur by ICAR-ATARI, Jabalpur during Nov. 24 - 26, 2017.

Participated & exhibited technologies of the center in National Water Convention on 'Drought, famine and river rejuvenation' at Shilpgram, Khajuraho during December 2-3, 2017.

Participated in training programme on 'MDP for Leadership Development' (a pre-RMP leadership programme) during Dec. 12 – 23, 2017 at ICAR - NAARM, Hyderabad.

Participated as Guest of Honour in 'Fodder Technology and Machinary Demonstration' meet on Feb. 16, 2018 at ICAR-IGFRI, Jhansi organized by ICAR-IGFRI, Jhansi.

Dr. R. S. Yadav

Participated in foundation day of ICAR-CAFRI, Jhansi on May 08, 2017.

Participated in a workshop on "Construction of check dam and farm pond" organized by District Agriculture Department, Jhansi on May 11, 2017.

Participated in exhibition in "Krishi Vigyan Mela cum Fasal Beema Sammelan" organized by Dptt of agriculture datia on May 12, 2017

Participated in interface meeting of ICAR-KVK-ATMA-other line department for finalization of programme for doubling farmers' income by 2022 at ICAR-CIAE, Bhopal organized by ICAR-ATARI, Jabalpur (MP) on Aug. 09, 2017.

Participated & exhibited technologies of the center in National Water Convention on "Drought, famine and river rejuvenation" at Shilpgram, Khajuraho during Dec. 2-3, 2017.

Participated in governing board meeting of ATMA at Collectorate, Datia on Aug. 23, 2017

Participated as a Member selection committee at RSKVV Gwalior on Sept. 26, 2017

Dr. S.P. Tiwari

Participated as Chief Guest in Scientific Advisory Committee of KVK RajmataScindiaKrishiVishwaVidhyalaya, Datia on May 17, 2017.

Participated in "Kharif 2017 Interface Workshop" organised (Aug. 10-11, 2017) by Deputy Director, ATMA, Datia.

Participated in training on 'Management Development Programme' organised by ICAR-NAARM, Hyderabad during June 13 – 24, 2017.

Participated 2 days "*Kharif* 2017 Interface Workshop" and delivered a lecture "Bhumi evum Jal Sanrakchan hetu upyogi taknikii aur unka kharif utpadan mein upyog" organised by Deputy Director, ATMA, Datia during Aug. 10-11, 2017.

Participated and presented a paper and worked as Convener in one of the session in Conference on "Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018), February 1-3, 2018, Anand;Gujarat.

Dr. Dev Narayan

Participated in programme on "New India Manthan – Sankalp se Siddhi" and delivered a lecture "Importance of soil and water conservation techniques in augmentation of crop production in Bundelkhand region" on Aug. 26, 2017.

Dr. Dev Narayan and Sh. M.K. Meena

Participated in workshop on 'Research and Management of Drought' organized by NRM Division, ICAR at NASC, New Delhi on July 22, 2017.

Participated in programme on "New India Manthan – Sankalp se Siddhi" organized by KVK, Datia on Aug. 26, 2017.

Participated in 10 days ICAR short course on 'Advances in nutrient dynamics for improving nutrient and water use efficiency of crops' during Sept. 5-14, 2017 at ICAR-IISS, Bhopal.

Participated in 56th Foundation Day of IGFRI, Jhansi and displayed the different SWC technologies in Agricultural Technologies Exhibition on Nov. 01, 2017.

· Participated in World Soil Health Day organized by KVK Datia on Dec. 05, 2017

Attended as Chief Guest and Judge on the Science Exhibition to appraise the models prepared by the students of RLP School, Datia on Jan. 19, 2018.

Dr. Rajeev Ranjan

Participated in the workshop on "Construction of check dam and farm pond" at Jhansi on May 11, 2017.

Participated in 56th Foundation Day of ICAR - IGFRI, Jhansi and displayed the different SWC technologies in Agricultural Technologies Exhibition on Nov. 01, 2017

Attended as Chief Guest and Judge on the Science Exhibition to appraise the models prepared by the students of RLP School, Datia on Jan. 19, 2018.

Er. MonalishaPramanik

Participated & exhibited technologies of the centre in National Water Convention on 'Drought, famine and river rejuvenation' at Shilpgram, Khajuraho during December 2-3, 2017.

Participated in two days meeting on "Estimation of intangible benefits, specifically impact of our watershed development projects and technical interventions on ecosystem services" during Jan., 20-21, 2018 at ICAR-IISWC, Dehradun.

Participated in 21 days CAFT training on "Quantitative methods for agricultural policy analysis" during Jan. 23 – Feb. 12, 2018 at ICAR- IARI, New Delhi.

Participated in 56th Foundation Day of ICAR - IGFRI, Jhansi and displayed the different SWC technologies in Agricultural Technologies Exhibition on Nov. 01, 2017

Mr. M. K. Meena

Koraput

Attended brainstorming session on Mitigating Land Degradation due to Water Erosion at NASC, New Delhi on 20th June 2017, which was organized by NAAS, New Delhi.

Attended the seminar on "Role of engineers in developing India" held at HAL on 15th September, 2017 organized by Institution of Engineers (India), Sunabeda local center, Koraput Odisha.

Presented a published international paper on effect of soil erosion on microbial population and enzyme activity in black soil of northeastern Chaina in monthly meeting on Auguest, 2017 at ICAR-IISWC, Research Centre, Koraput.

Attended conference on Tribal Rights – Issues and Challenges held at Koraput on 8th and 9th January 2018.

Participated and presented a poster in the conference on "Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018)" at AAU, Anand during February 01-03, 2018.

Invited as a guest speaker for Radio Kisan Diwas Mela on 16th February 2018 at Kukudabai village in Nabarangapur District by All India Radio, Jeypore.

Organised and participated in one day workshop on "Doubling Farm Income" on 3rd December, 2017 at the conference hall of the ICAR-IISWC, Research Centre, Sunabeda, Koraput, Odisha.

Organised and participated in "Farm Innovators Day-2018 cum Exhibition" on 28th February, 2018 at ICAR-IISWC, Research Centre, Sunabeda, Koraput, Odisha

Participated in Scientific advisory meeting at KVK, OUAT, Semliguda, Koraput on 16th December, 2017.

Organised and participated in 14 training programmes organized under MGMG at ICAR-IISWC, Research Centre, Sunabeda, Koraput from 15th June, 2017 to 23rd March,2018.

Attended and inaugurated Science Exhibition at Govt. High School at Dudhari, Semiliguda Block, Koraput on 20th October, 2017.

Dr.M. Madhu

Presented a research paper on "Effect of permanent ground cover on soil moisture in jujube orchards under sloping ground: A simulation" study on 27th June 2017.

Attended interaction meeting chaired by Honourable DG, ICAR with collector, Rayagada and district level officers and attended the inauguration of hot water treatment and grading plant for mango in state horticultural farm Rayagada on 8th July, 2017.

Attended State level meeting at OWDM, Bhubaneswar under Neeranchal project on 1st August, 2017.

Attended one day training programme on gender friendly farm tools as a resource person conducted by KVK, Koraput on 9th August 2017.

Attended one day training programme on Hydrological study and monitoring of watersheds as a resource person conducted by IIWM, Bhubaneswar on 10th August 2017.

Delivered lecture in the Capacity building training programme on "Concept of standard design and layout of different structural measures in watersheds" under PMKSY for APD/ASCO/AAE of Directorate of Soil Conservation & Watershed Development, Govt. of Odisha on 10-11-2017 and 23-11-2017.

Attended Farmers' first conference held at Ananda, Gujarat during 1st -3rd February 2018.

Dr.D. C. Sahoo

Attended training on MGMG in Kokriguda – 15th September,2017

Attended training on MGMG in Tentuliguda – 22nd Sept.,2017

Dr.D. C. Sahoo; Dr.P.P. Adhikary; Sh.P. Jakhar ;

Sh. H.C.Hombe Gowda; Mrs. Ch. J Dash; Sh. Karma Beer

Attended State level meeting at OWDM, Bhubaneswar under Neeranchal project on 1st August, 2017.

Attended conference on Tribal Rights – Issues and Challenges held at Koraput on 8th and 9th January 2018.

Presented a published research paper on 23rd January 2018 (Effect of Single and Multisite Calibration Techniques on the Parameter Estimation, Performance, and Output of a SWAT Model of a Spatially Heterogeneous Catchment).

Dr.P.P. Adhikary

Attended Farmers' first conference held at Ananda, Gujarat during 1st -3rd February 2018.

Dr.P.P. Adhikary and

Sh. H.C.Hombe Gowda

Attended interaction meeting chaired by Honourable DG, ICAR with collector, Rayagada and district level officers and attended the inauguration of hot water treatment and grading plant for mango in state horticultural farm Rayagada on 8th July, 2017.

Attended conference on Tribal Rights – Issues and Challenges held at Koraput on 8th and 9th January 2018.

Co-ordinated three month In-plant practical training on "Soil and Water conservation and Watershed Management" from 6th June, 2017 to 5th October, 2017.

Co-ordinated one day work shop on "Doubling Farm Income" on 3rd December, 2017 at the conference hall of the Research Centre.

Co-ordinated "Farm Innovators Day-2018 cum Exhibition" on 28th February, 2018 at the conference hall of the Research Centre.

Participated and presented a paper in the national seminar on "Tribal Rights: Issues and Challenges" at Council of Analytical Tribal Studies (COATS), Koraput, during January 08-09, 2018.

Delivered the invited lecture on "Importance of snakes in agriculture crop production" at Saraswati Vidya Mandir, Damanjodi on 8-02-2018.

Sh. H.C.Hombe Gowda

Attended training programme on "Gender friendly farm tools" as a resource person at KVK, Koraput on 10th and 16th August 2017.

Attended workshop on "Gender friendly farm tools" at KVK, Koraput on 16th January 2018.

Attended one day training programme on gender friendly farm tools as a resource person conducted by KVK, Koraput on 8th and 11th August,2 018, respectively.

Presented a published research paper on 24th February 2018 (Sensitivity analysis of kinetic energy –intensity relationships and maximum rainfall intensities on rainfall erosivity using a long-term precipitation dataset).

Presented a published research paper entitled "Effect of four storm patterns on soil loss from five soils under natural rainfall" on 21st March 2017.

Mrs. Ch. J Dash

Attended a meeting of NARAKAS in NALCO and awarded Shrestha Rajbhasa Karmi Award-2017 on 29/01/2018.

Participated in "Farm Innovators Day-2018 cum Exhibition" held on 28th February, 2018 at the conference hall of the Research Centre.

Sh. Karma Beer

Kota

Attended a MJSA Impact Assessment meeting on 23.06.17 at Aravali Bhawan, Jaipur as an expert members of sub-group appointed for monitoring change in Green Cover in respect to MJSA activities.

Attended a 'Monsoon Preparedness Meeting' organized by CRIDA at Pant Krishi Bhawan, Jaipur on 16.06.2017.

Attended a meeting with Principal Secretary (Ag.) Govt. of Rajasthan at Secretariat, Jaipur and a meeting with Addl. Director and other officials of Department of Watershed Development and Soil Conservation, Govt. of Rajasthan at Pant Krishi Bhawan on 15.06.2017 regarding approval of DPR for MRADP Lohali-Bagli.

Delivered a Key Note Address on 'Managing Natural Resources of Rajasthan for Rural Livelihood Security' in ***a*** All India Seminar on "New Technical Guidelines 2015 (Samarthya) of MGNREGS-A Boon for sustainable Rural Development-Make in India", on 26th to 27th August 2017 at Institution of Engineers (India) Kota Regional center.

Attended Scientific advisory committee meeting at KVK, Kota on 05th October, 2017

Delivered Keynote address on "Role of Soil and water conservation technologies for rural livelihood security in India "in inaugural session of International Conference on Conservation and Management of Agricultural & Natural Resources: Strategies for Food Security in Developing Countries organized by Career point University, Kota on 8-11-2017

Delivered guest lecture on "Wastelands horticulture" at winter school on "Hi-Tech interventions in fruit production towards hastening productivity, nutritional quality and value addition" (Nov. 01- 21st, 2017) organized by College of Horticulture and Forestry at Jhalawar (Rajasthan) on 14th November, 2017

Attended organizing committee meeting for organizing FFCSWR-2018 at Anand Agricultural University, Anand (Gujarat) on 24th November 2017.

Attended a meeting with DG ICAR to brief him about the accomplishments of IISWC with respect to ravine restoration technology development, field demonstration and consultancy activities on Feb.18, 2018 at New Delhi.

Dr. R.K. Singh

Attended meeting on "intangible benefits of NRM interventions in different projects in different climatic regions and network project formulation "at IISWC, Dehradun during January 20-21, 2018.

Attended MDP Training programme (Pre RMP) on "Leadership development" held during 12-23 December, 2017 at ICAR-NAARM, Hyderabad

Attended Selection Committee Meeting as an external Expert for selection of Young Professionals at ICAR-CSWRI, Avikanagar (Tonk) on 30th November,2017

Attended meeting on Midterm review of regional committee of zone VI on 22nd September, 2017 at CAZRI, Jodhpur.

Attended a meeting; in which Union Minister of state for agriculture Hon'ble Shri G.S. Shekhawat interacted with VCs of Agricultural universities and Head of ICAR institutes of Gujarat and Rajasthan states on 23rd September,2017 at CAZRI, Jodhpur

Attended Workshop on World Bank Assisted Project "Neeranchal" for the Watershed Component (Erstwhile Integrated Watershed Management Programme) of the Pradhan Mantri Krishi Sinchayi Yojana in Rajasthan state at pant Krishi Bhawan, Jaipur on 24th August, 2017

Participated in a " *Kota Nagar Rajbhasha Karyawayan Samitee"* meeting organized by NPCIL, *Rawatbhata*, Chittorgarh, on April 26, 2017

Delivered Guest lectures on "*Krishi ko Labhkari kaise banaye avam* WTO" and Market survey for establishing Food processing industries in foundation course for newly recruited agricultural supervisors from Rajasthan state government at State institute of agriculture management (SIAM) Kota during the year 2017-2018.

Dr. Ashok Kumar

Delivered two lectures on "Watershed management for fruit production" and "Groundwater recharging for hastening fruit production" on Nov. 15, 2017 in a winter School on "Hi-tech interventions in fruit production towards hastening productivity, nutritional quality and value addition" in College of Horticulture and Forestry, Jhalawar, Rajasthan.

Delivered a guest lecturere on "Groundwater recharging techniques" in a training programme for agricultural supervisors from Rajasthan state government on Nov 12, 2017 at State Institute of Agriculture Management (SIAM), Kota.

Delivered two lectures on "Artificial Groundwater recharging: a bone for scarce zone" and Integrated watershed management for sustainable agriculture on Dec. 27, 2017 in a winter school on "Enhancing the productivity of rainfed agro-ecosystem through suitable interventions" organized during November 14 to January 3, 2018 at Dryland Farming Research Station, Maharana Pratap University of Agriculture &Technology, Bhilwara, Rajasthan.pp 15-20.

Delivered a guest lecturere on "In-situ moisture conservation techniques for dry land areas" in a training programme for agricultural supervisors from Rajasthan state government on Dec. 10, 2017 at State Institute of Agriculture Management (SIAM), Kota.

Attended an exposure visit to Bangalore under Neeranchal project during January 19-20, 2018.

Delivered a guest lecturere on “Soil and water conservation techniques” in a training programme for agricultural supervisors from Rajasthan state government on Feb. 21, 2018 at State Institute of Agriculture Management (SIAM), Kota.

Delivered a guest lecturere on “Drip irrigation systems for Horticultural crops” in a training programme for agricultural supervisors from Rajasthan state government on Feb. 23, 2018 at State Institute of Agriculture Management (SIAM), Kota.

Dr. Shakir Ali

Delivered lecture on "Soil health management for sustainable fruit production" on Nov 15, 2017 in a winter School on “Hi-tech interventions in fruit production towards hastening productivity, nutritional quality and value addition” in College of Horticulture and Forestry, Jhalawar, Raj

Dr. B.L. Mina

Delivered a guest lecture on Role of horticulture in watershed management programme on 05.06.2017.

Delivered a guest lecture Agro-forestry systems and role of multipurpose trees in resource conservation and income generation on 07.06.2017.

Delivered a guest lecture Role and technique of horticultural crop production in low tunnels, shade net house on 31.10.2017.

Delivered guest lecture on “Fruit production management under degraded lands” at winter school on "Hi-Tech interventions in fruit production towards hastening productivity, nutritional quality and value addition" (Nov. 01- 21st, 2017) organized by College of Horticulture and Forestry at Jhalawar (Rajasthan) on 15th November, 2017

Delivered a guest lecture on Improved cultivation of cucumber and tomato in polyhouse on 13.12.2017.

Delivered a guest lecture Maturity indices of vegetables and value addition in onion and garlic on 13.12.2017.

Delivered a guest lecture Nursery management, developing layout plan and Israeli technique for mandarin production on 19.02.2018.

Delivered a guest lecture Postharvest management of citrus fruits on 19.02.2018.

Sh. H.R. Meena

Delivered guest lecture on “ Plant Nutrient management for hi-tech fruit production" at winter school on "Hi-Tech interventions in fruit production towards hastening productivity, nutritional quality and value addition" (Nov. 01- 21st, 2017)organized by College of Horticulture and Forestry at Jhalawar (Rajasthan) on 15th November, 2017.

Dr. I.Rashmi

Conducted practical examination of Fourth year students on B.Sc. Ag. (Hons.) from College of Agriculture: Lalsot (Dausa) on 29.12.2016 (Course: SOILS 4111-Vermicomposting and Organic Farming).

Dr. G.L. Meena

Participated in ICAR-North Zone Sports Meet held at NDRI, Karnal from April 16-19, 2016

Participated in*KishanSangoshthi* on Present Status and Future Scope of Agricultural Development in *Hadoti* Region on August 24, 2016.

Participated in a farmers' fair organized by KVK, Borkheda, Kota on 7th April, 2016 for making the farmers aware about revamped PM Crop Insurance Scheme of Govt. of India.

Dr. Kuldeep Kumar

Organised 21st ICAR-All India Entrance Examination (AIEEA) for Admission to B.Sc. (Ag.) and allied courses in various Agricultural Universities at Kota centre on June 10, 2017.

Dr(s) R.K. Singh and Ashok Kumar

Attended Heads of Centres/AAOs meeting at IISWC, Dehradun on May 1, 2017

Dr(s) R.K. Singh and Ashok Kumar

Attended Global Rajasthan Agritech meet-2017 at Kota Rajasthan organized by Rajasthan State Government in collaboration with FICCI during May 24-26, 2017 at RAC Ground, Kota, Rajasthan.

Dr (s). R.K. Singh, Ashok Kumar, Shakir Ali, B.L. Mina,
H.R. Meena, I.Rashmi, Kuldeep Kumar and G.L. Meena

Participated as an subject expert in Krishi Chopal(Jajam) programme of Global Rajasthan Agritech meet 2017 organized by Rajasthan State Government in collaboration with FICCI during May 24-26, 2017 at RAC Ground, Kota,

Dr (s). Ashok Kumar and Shakir Ali

Participated and demonstrated kitchen waste management methods in the progrmme organized by Kota horticultural society on the eve of world environment day at Kota Municipal Corporation, Kota on June 4, 2017.

Dr(s). R.K.Singh and Kuldeep Kumar

Attended one-day workshop on "Inter comparison of survey methods for Soil and Water conservation Planning" organised by IISWC, RC, Kota with sponsorship of Directorate of Watershed Management & Soil Conservation, Govt. of Rajasthan on July 21, 2017 at Pant Krishi Bhawan, Jaipur (Rajasthan).

Dr(s) R.K.Singh, Shakir Ali and G.L. Meena

Organised and participated in Parthenium Awareness Week' organized at the centre on August 22, 2017.

Organised and participated in cleaning of office campus under Swacchh Bharat Abhiyan on August 21, 2017.

Dr (s) R.K. Singh, Ashok Kumar, Shakir Ali, B.L. Mina,
H.R. Meena, Kuldeep Kumar and G.L.Meena

Attended workshop on World Bank Assisted Project "Neeranchal" for the Watershed Component (Erstwhile Integrated Watershed Management Programme) of the Pradhan Mantri Krishi Sinchayi Yojana in Rajasthan state at pant krishi Bhawan, Jaipur on August 24, 2017.

Dr (s) R.K. Singh and Ashok Kumar

Organised and participated in Hindi Karyashala on "Use of Hindi in day to day office work" at the Centre on August 28, 2017.

Organised and participated in Hindi Divas on Sep. 14, 2017 at the Centre.

Organised and participated in Hindi Kavya Gosthi on Sept. 20, 2017 at the Centre

Organised and participated in Sewa Divas under Swacchh Bharat Abhiyan on Sept.17, 2017.

Organised and participated in Samagra Swachhta Divas under Swacchh Bharat Abhiyan on Sept. 24,2017

Organised and participated Sarwatra Swachhta Divas under Swacchh Bharat Abhiyan on Sept. 25,2017

Organised and participated in Tourism spot Swacchta Divas under Swacchh Bharat Abhiyan on Oct. 1, 2017

Organised and participated in Swachhta Pakhwara award ceremony under Swacchh Bharat Abhiyan on Oct. 2,2017

Organised and participated in Foundation day of Research centre, Kota was celebrated on Oct. 18, 2017

Attended and presented papers in a International Conference on "Conservation and Management of Agricultural Resources: Strategies for Food Security in Developing Countries" held during Nov. 8-9, 2017 at Career Point University, Kota (Rajasthan

Organised and participated in Agriculture Education day was celebrated on Dec. 4, 2017.

Attended and presented poster papers in a national conference on "Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR) -2018" held during Feb. 1-3, 2018 at at Anand, Gujarat.

Organised and participated in School Childern sensitization toward clean India mission under Swacchh Bharat Abhiyan on Feb. 9, 2018.

Dr (s) R.K. Singh, Ashok Kumar, Shakir Ali, B.L. Mina,
H.R. Meena, S.Kala, Kuldeep Kumar and G.L.Meena

Organised and participated in two (1-day) training on soil and water conservation technologies for sustainable agriculture in Lohli and Bagli villages of Bundi districts during Feb. 26-27, 2018.

Dr (s) Ashok Kumar, A.K. Singh, B.L. Mina, H.R. Meena and Kuldeep Kumar

Organised and participated in six (2-days) training programmes on soil and water conservation technologies for sustainable agriculture in ten villages of Baran and Bundi districts under Mera Gaon Mera Gaurav during March 5-9, 2018.

Dr (s) Ashok Kumar, A.K. Singh, B.L. Mina, H.R. Meena, G.L.Meena and Kuldeep Kumar

Organised and participated in Vigilance oath taking ceremony on Oct. 30, 2017 under Vigilance awareness week (30th October to 4th November)

Organised and participated in a workshop on "Role of vigilance for corruption free India" on Nov. 3, 2017 under Vigilance awareness week (30th October to 4th November)

Dr (s) Ashok Kumar, Shakir Ali, B.L. Mina, H.R. Meena, Kuldeep Kumar and G.L.Meena

Chaired and co-chaired the technical sessions in a International Conference on "Conservation and Management of Agricultural Resources: Strategies for Food Security in Developing Countries" held during Nov.8-9, 2017 at Career Point University, Kota (Rajasthan

Dr (s) Ashok Kumar, Shakir Ali, H.R. Meena, and Kuldeep Kumar

Udhagamandalam

Guest of Honour during the Inaugural Function of Youth Engagement Workshop on Nature and Lab organized by CPR Environmental Centre, Chennai on 17.07.2017.

Participated and exhibited / displayed the technologies of the Centre in the 3rd Indian International Science Festival Expo – 2017 held at Anna University, Chennai during 13-16 October, 2017.

Visited catchment and command areas of Panaimarathupatti lake, Salem and examined the specifications and site selection criteria for the constructed check dams during 14-15th November 2017.

Participated in The Nilgiris stakeholder workshop for LANDSLIP" held on 14.12.2017 organised by Keystone Foundation, Kotagiri.

Attended and Chaired the Ooty-Coonoor Town Official Language Implementation Committee Meeting at Cordite Factory, Aruvankadu on 29 June 2017 (AN).

Participated in The Nilgiris stakeholder workshop for LANDSLIP" held on 14.12.2017 organised by Keystone Foundation, Kotagiri.

Dr. O.P.S. Khola

Conference on 'Farmers First for Conserving Soil and Water Resources in Western Region (FFCSWR-2018)' at Anand Agricultural University, Anand during Feb 1-3, 2018 and presented paper on 'Alternate land use and cropping system strategies for increasing farm income – a case study in semi arid watershed'.

Dr(s). O.P.S. Khola and V. Selvi

Delivered Guest Lecture on "Biodiversity and Environment" in Youth Engagement Workshop on Nature and Lab organized by CPR Environmental Centre, Chennai on 17.07.2017.

Participated in Scientific Workers Conference organised at TNAU, Coimbatore on 18.08.2017.

Attended district level Disaster Management Committee meeting for Nilgiris district at Collectorate on 05.09.2017.

Delivered a lecture on Role of Water Harvesting and Recycling in Integrated Farming Systems on 21.09.2017 at Madithorai village, The Nilgiris District, Tamil Nadu during one day Workshop on Application of Science and Technology for Rural Areas.

Participated and presented a paper on "Water harvesting in Himalayas and its Foothills" conducted at HP STATE CAMPA and Forest Department, Shimla, Himachal Pradesh on 28.09.2017.

Attended Scientific Expert Committee Meeting at Tamil Nadu Pollution Control Board, Chennai on 21.11.2017.

Delivered lecture on “Soil and water conservation practices in Nilgiris” in Working Module for UNCS Executives on 24.01.2018.

Delivered special lecture on “Soil and water conservation” in Creation of Scientific Awareness programme for Students organized by Government Arts College, Ooty on 29.01.2018.

Delivered lecture on “Soil and water conservation practices in Nilgiris” in Working Module for United Nilgiris Conservation Society Executives on 24.01.2018 at Kothagiri.

Delivered inaugural address as Chief Guest in the inaugural function of VelaanThiruvizha 2018 (Agriculture Fair 2018) organized by Sakthi Institute of Engineering and Technology on 06.01.2018.

Attended Policy Workshop on 'Big Data Analytics in Agriculture' at NAARM, Hyderabad during February 8-9, 2018.

Attended Scientific Expert Committee Meeting at Tamil Nadu Pollution Control Board, Chennai on 19 .03.2018.

Attended Policy Workshop on Big Data Analytics in Agriculture at NAARM, Hyderabad from February 8-9, 2018 .

Dr S. Manivannan

Participated in the interviews conducted at RAC, TIFR, Ooty during 20.09.2017 to 25.09.2017 as selection committee member for selection of Technical and Administrative trainee posts.

Delivered lectures on 'SWC measures for field crops' in the training programme on Integrated Pulses Production Programme organised under ATMA by State Agriculture Department at Vadavalli and Vadambachery villages of Sultanpet block, Coimbatore district on 7.2.2018 and 8.2.2018.

Participated in the Women Cell meeting conducted on 01.04.2017

Attended Brainstorming workshop conducted at Dehradun on 01.05.2017 for the core project on Assessing Farmers Knowledge, Vulnerability and Adapting Capacity of Soil and Water Conservation Technologies under Changing Climatic Scenario.

Participated the Inaugural function of Rigid poly houe and field visit at Centre for Research on Ayurvedic Medicines Emerald, Ooty

Attended Hindi workshop on ShaamanyaVviyakaran conducted on 27.06.2017.

Attended Hindi Quarterly meeting conducted on 29.06.2018, 05.09.2017.

Attended Hindi Diwas on 14.09.17

Attended Hindi workshop on RajbhashaniyamaurAdhiniyam on 20.09.2018.

Attended Swacch hi sewa campaign at Melkavatti on on 23.09.2018

Attended Hindi Chetana Mas inauguration function on 14.09.2017 and closing ceremony on 13.10.2017.

Participated in the interviews conducted at RAC, TIFR, Ooty during 20.09.2017 to 25.09.2017 as selection committee member for selection of Technical and Administrative.

Dr. P. Sundarambal

Delivered Seminar on 27.09.2017 during STMIM on his Popular Article to be sent for approval to the Institute for publication in Indian Farming.

Delivered lecture on 'Nutrient and water management in organic agriculture' during one day training on Organic Agriculture conducted by Department of Horticulture and Plantation Crops, The Nilgiris on 27.02.2018.

Dr. K. Rajan

Participated as expert member in the panel discussion on "Climate Change Implications on Monsoonal Changes” on 17th August, 2017 in XXVI Indian Colloquium on Micropaleontology and Stratigraphy (ICMS - 2017) organized by Department of Geology, University of Madras, Guindy Campus, Chennai during 17-19 August, 2017.

Attended XXVI Indian Colloquium on Micropaleontology and Stratigraphy (ICMS - 2017) organized by Department of Geology, University of Madras, Guindy Campus, Chennai during 17-19 August, 2017.

Delivered an invited lecture on "Soil - Water Conservation and Management in the context of Climate Change"at Rotary Club of Udhagamandalam on 20th July, 2017.

Participated in the workshop on 'National Information System for Climate and Environment Studies (NICES) Data Products' at NIT, Calicut on 26 Feb. 2018.

Dr P. Raja

Participated and exhibited the technologies developed by the Centre in the MAATRAM 2017-A green expo held at HADP hall, Ooty during 30th November-01st December 2017.

Attended 406th district level monthly zonal workshop organized by Joint Directorate of Horticulture , Udhagmandalam, Government of Tamil Nadu on 12.12.2017.

Participated in International Conference on 'Emerging Synergies in Agriculture, Food Processing Engineering and Biotechnology' at Karunya University, Coimbatore from 21- 23 February 2018 and presented paper on 'Effect of fertilizer applications on water quality in Sillahalla watershed of Nilgiris district'.

Attended 406th district level monthly zonal workshop organized by Joint Directorate of Horticulture , Udhagmandalam, Government of Tamil Nadu on 12.12.2017.

Participated in The Nilgiris stakeholder workshop for LANDSLIP" held on 14.12.2017 organised by Keystone Foundation, Kotagiri.

Dr V. Kashturi Thilagam

Vasad

Attended National Seminar on Natural Resources Management for Horticultural Crops under Changing Climatic Conditions at Kozhikode during 16-17 March, 2017

Attended the meeting regarding transfer of land to NHAI with DS(NRM) and Secretary (ICAR) on 31 March, 2017

Attended National Fish Farmers' Day at ICAR-CIFA, Anand on 10 July, 2017

Attended the meeting for organizing 52nd Annual Convention and National Symposium organized by AAU and ISAE to be held in Jan. 2018 on 28 July, 2017

Attended Inauguration function of New Scientist's Home at CHES, Vejalpur, Godhra on 19 August, 2017 and participated in Kisan Gosthi and Sankalp se Siddhi at KVK, CHES, Godhra on same day

Participated in Sankalp se Sidhhi programme at village Malataj, Anand organized by KVK, Devataj, Anand on 24 August, 2017

Attended Farmers camp under Sankalp to Sidhdhi programme at KVK, Mangalbharti, Golagamdi on 29 August, 2017

Attended the Mid-Term Review – ICAR Regional Committee No. IV meeting at CAZRI, Jodhpur on 22 Sept. 2017

Attended the Kisan Mela at ICAR-CAZRI, Jodhpur on 23rd Sept. 2017

Participated in meeting in Vasad Gram Panchayat Bhawan organized by Smt. Dharmishtaben Patel, Sarpanch, Gram Panchayat Vasad in view of planning for clearing and maintenance of Vasad on 29 Sept. 2017

Attended 2nd Meeting with VC, AAU, Anand for Farmers First Conference on 02 November, 2017

Attended 3rd Meeting with VC, AAU, Anand for Farmers First Conference on 24 November, 2017

Visited ATARI, Pune to meet the Director and state govt. officials related to TOT and other issues related to extension at Pune on 18-19 Dec. 2017

Attended 10th meeting of Research Council of Anand Agricultural University at Anand on 21 Dec. 2017

Attended 27th Scientific Advisory Committee meeting at KVK, Devataj, Gujarat on 16 January, 2018

Attended 16th Scientific Advisory committee meeting at KVK, Vadodara on 24 January, 2018

Attended and organized Farmers First conference at AAU, Anand during 1-3 February, 2018

Attended 14th Agri. Engineering Sub-Committee meeting at CAET, NAU, Dediapada on 12 Feb. 2018

Delivered a lecture on "Prevention Measures of Water Erosion and Rainwater Harvesting" at CAET, AAU, Godhra on 13 Feb. 2018

Dr. P.R. Bhatnagar

Acted as Member in Departmental Promotion committee at ICAR-IINRG, Namkum, Ranchi from 5-6 Oct. 2017

Attended 2nd Meeting with VC, AAU, Anand for Farmers First Conference on 02 November, 2017

Attended 3rd Meeting with VC, AAU, Anand for Farmers First Conference on 24 November, 2017

Dr. V.C. Pande

Invited as External Examiner & Convener for Ph. D Thesis at Manonmanium sundaranar University, Tirunelveli on 07 June, 2017

Attended short course on "Advances in nutrient dynamics for improving nutrient and water use efficiency" held at ICAR-IISS, Bhopal and received Best Trainee Award during short course on "Advances in nutrient dynamics for improving nutrient and water use efficiency of crops" at IISS, Bhopal during 5-14 Sept. 2017

Participated in a six week *on line* course on "Basics of Entrepreneurship Development in Agriculture". Successful completion certificate is awarded on 06 Nov. 2017 by IIT, Kanpur and Commonwealth of Learning

Dr. D. Dinesh

Coordinated the visit of 26 students (17 boys and 9 students) of Horticulture Polytechnic, JAU, Junagadh on 04 March, 2017

Coordinated the visit of 29 student of krishi diploma from Krishi Vidhayala, Halwad on 05 March, 2017

Coordinated the visit of B.Sc. Horti. 66 students from ASPEE college of Horti. and Forestry, NAU, Navsari on 04 April, 2017

Participated in "Certificate course on soil and water conservation and watershed management" from April 22 to August 21, 2017

Participated in North Zone Sport Meet at ICAR-IISR, Lucknow from 30th Oct. to 4th Nov. 2017

Dr. V.D. Kakade

Successfully completed four months certificate course on "Soil & Water Conservation and Watershed Management" in 117th batch of officers trainees from 09 states at ICAR-IISWC, Dehradun during 09 Oct. 2017 to 08 Feb., 2018

Participated in "All India seminar on scientific mining of river bed material and environmental impact in hilly and foot hill regions" at Dehradun organised by the Institution of Engineers (India), Uttrakhand State Centre Dehradun, Indian Association of Soil and Water Conservation and ICAR-IISWC, Dehradun during 24-25 October, 2017

Coordinated 1 month implant training of 32 B.Tech. (Agril. Engg.) II and III year students from 6 state agricultural universities during 2017

Coordinated 2 days training on topic "Soil and Water Conservation technologies for arable and non-arable land in semi-arid areas of Gujarat" at ICAR-IISWC, Research Farm Vasad and field visit to Pawagadh on 24-25 January, 2018

Dr. Gaurav Singh

Participated in North Zone Sport Meet at ICAR-IISR, Lucknow from 30th Oct. to 4th Nov. 2017

Participated in the ICAR Zonal Sports Meet held at ICAR-NAARM, Hyderabad during 21-25 Feb. 2018

Sh. O.P. Meena

11 Infrastructural development

Dehra Dun:

Repair of boundry wall at research farm Selaqui, Dehra Dun.

Koraput

Construction of new type-V quarter at main campus under progress.
Minor repair, maintenance and painting of office building at main and farm office under progress.
Minor repair, maintenance and painting of residential quarters at main campus and farm under progress.
Renovation of vehicle shed at main office and Research Farm.
Rain water harvesting pond construction / Renovation.
Vehicle shed for officer of research centre at main office and research farm.

Udhagamandalam:

Refurnishing of office toilets
Procurement of Coffee pulping machine
Procurement of Tea plant pruner
Procurement of Diesel pump
Procurement of Improved farm tools
Procurement of Conveyance pipes

Vasad:

Construction of second floor scientist-cum-training hostel at the cost of Rs. 60,42,000/-
Procurement of digisol wireless repeater of Rs. 1600/-
Procurement of Router digital of Rs. 1520/-

12 Workshops Summer Schools, Farmers day etc.

In order to generate awareness among the target stake holders as per the mandate assigned to the institute a wide range of activities are envisaged and under taken at institute Head Quarters and its Eight Research Centers located in different Agro Climatic Zones of the country. The type of activities conducted/under taken includes interaction meets, workshops, seminars, training programmes, participation in exhibitions at local, regional and national level etc. A brief description of important events conducted/organised and participation made by the institute during the period are summarised as under.

Dehra Dun

Four Month's Certificate Course on Soil &Water Conservation and Watershed Management (116th Batch) was successfully conducted at during April 22, 2017 to August 21, 2017.

Hindi week was observed during 14-20 September, 2017 .

Parthenium Awareness Week was observed during August16 -22, 2017.

Observed Himalayan Day on September 08, 2017 under the 'Save Himalaya' campaign.

"3rd International Yoga Day" was celebrated on June 21, 2017.

World Soil Day was celebrated on December 5, 2017.

One day conference on "Food Processing and Kisan SAMPADA Yojna" was organised in collaboration with ASSOCHAM, New Delhi on 13th March, 2018 at DehraDun, Uttarakhand.

Conference on "Farmers First for Conserving Soil & Water Resources in Western Region" was organised in association with Indian Association of Soil and Water Conservationists during 1-3 February 2018 at Anand Agricultural University.

Organised Seminar on "Scientific Mining of River Bed Material and Environmental Impact in Hilly and Foot Hill region" Organised in association with IE(I), UKSC and Indian Association of Soil and Water conservationists (IASWC) during 24-25 October, 2017 at IE(I), DehraDun.

A Wide range of events; Training-cum-demonstration; exposure visits etc were organised under Mera Gaon Mera Gaurav. MGMG.

National Agricultural Education Day was celebrated on 3rd December, 2017.

Vigilance Awareness Week was conducted during 30 October2017-4 Novembe 2018.

Wide range of acivities were planned and accomplished under Swachh Bharat Abhiyan.

Four Month's Certificate Course on Soil and Water Conservation and Watershed Management (117th Batch) was successfully conducted at IISWC, Dehra Dun (9th October, 2017 to 8th February, 2018).

Five day training progamme for administrative (up to AAO Level) staff members from institute Head Quarters and its eight Research Centres was organised during 18-22 December 2018.

National Productivity wek was celebrated during 12-18 February 2018 at Research farm, Selaqui, Dehra Dun.

Agra

Hindi karysala was organised on 2nd June, 2017 in the conference hall Sh. R. P. Singh Dy. Commissioner Goods & Services Department Agra U.P. and Sh. Kshetra Pal Singh Ex Joint director, Department of Labour, Gov. of India chaired the meeting.

Hindi Diwas was organised on 14 September, 2017 in the conference hall Shri.Kamesh sharma and Smt. Rekha Sharma recited poem

Hindi karysala was organised on 27 September, 2017 in the conference hall Dr. A.K.Parandiyal explained importance of using hindi in offices.

Hindi karysala was organised on 29 December, 2017 in the conference hall Dr.R.S.Tiwari Secretery NARKAS Agra and Sh. Shaiendra Vashitha Ec Hindi Offier PNB Agra. Chaired the meeting.

Organised a Kharif Kishan Gosthi at Village Behrampur on 16th August 2017 to under MGMG programme.

Organised a Kharif Kisan Gosthi at Village Manikpura, Block, Bah, District Agra on 17th August 2017 to under MGMG programme

Organised a awareness camp and training of farmers on PPVF& FR Act 2001 was organized at the centre on 17 October, 2017

Organised one day pre Rabi Ghosthi at Nayabansh, Agra on 24 October, 2017.

Organised one day pre Rabi Ghosthi organized at Garhi Udairaj, Fatehabad, Agra on 26 October, 2017.

Conducted two days practical field training on Soil & Water Conservation measures at Dr. Salim Ali Conference Hall, Keola Deo National Sanctury Bharatpur Sponsored by Deputy Conservator of Forest Bharatpur Rajasthan on 20-21 December, 2017.

Conducted two days practical training for 60 Forest Officers of Dholpur district Rajasthan during 26-27 February 2018.

Ballary

Celebrated International Yoga Day, (June 21, 2017) with farmers of Hanumapur village in Mokalmuru Taluka of Chitradurga District.

- Celebrated Hindi day on 14/09/2017.

Organised the World Food Day on 16th Oct 2017 at Lakshminagar camp, Ballari District .

Organised "World Rural Women's Day on 15th October 2017 at Lakshminagar camp, Ballary district to interact with rural women.

Organised World Food Day on16th October at Laxminagar Camp in Ballary District.

"Swacchata hi seva" was organized on occasion of anniversary of Swacch Bharat mission from 15/09/2017 to 01/10/2017.

Swacchh Bharat Quiz was organized and celebration of Mahatma Gandhi Jayanti on 01/10/2017 at Office.

Tree planting programme at Hanmapura village on 07/06/2017 and Office campus on 17/09/2017.

Awareness programme about toilets was conducted in Laksmi Nagar Camp on 24/09/2017.

Vigilance awareness week was observed from 30th October to 4th November, 2017.

Interactive Workshop on "Establishment of Common platform for Monitoring and Evaluation Agency (M&E), Land Resource Inventory partners (LRI) and Implementing agencies of Sujala-III Watershed" was held on 07-11-2017

The Agriculture Education Day was celebrated on 3rd December 2017. On the occasion, an Essay competition on topic "Importance of Agriculture in Indian Economy" was also conducted for students.

Celebrated Farmers Day 2017 at Hanumapur Village in Molakalmur Taluk of Chitradurga District.

Conducted a number of activities under MGMG on different occasions.

Chandigarh

Organised International Day of Yoga on 21st June, 2017.

Van mahotsava was organized at Research Farm - Mansadevi on 22-Jul-2017.The plants were provided by Department of Forestry, Government of Haryana.

One day orientation training was organised on 21-July-2017 at village Nolta, Block Pinjore, Distt. Panchkula, Haryana.

A training programme was organized in Johranpur Village, District Solan, Himachal Pradesh on 31st August, 2017.

"New India Manthan: Sankalp Se Siddhi" programme was organized on 07-Sep-2017.

A training programme was organized at Village Kajiyana, Dist. Panchkula, Haryana, on 16-Sep-2017.

Swachhta Hi Sewa Hai' programme organized at this centre on 02-Oct-2017.

Organised Hindi Pakhawada during the period 15 -30 September 2017.

Conducted a number of activities under MGMG on different occasions.

Conducted three Education and Training Programme on different occasions 18-20 April 2017; 25-27 April 2017 and 26-28 July, 2017.

Conducted three summer practical Trainings on 19-22 November 2017; 15-18 November 2017 and 1-30 June 2017.

Datia

Organised International Yoga Day on 21 June 2017

Organised one month summer practical training during June 01 -30, 2017 for B. Tech (Agril. Engg) Students.

Celebrated 31st foundation day on 18 September 2017.

Organised National Productivity Week during 12-18 February 2018.

Swachhta Abhiyan was conducted on 04 May 2017.

Koraput

Conducted two in-plant training Programmes for graduates during 01-30 June2017 and 04June to 04 October 2017.

Conducted two Training cum Exposure visit on June 29, 2017 and 22 September2017.

Vigilance awareness week was observed from 30th October to 4th November, 2017.

Wide range of assignments were planned and accomplished under Swachh Bharat Abhiyan.

National Agriculture Education day was organised on 3rd December, 2017.

Kota

One day workshop on "Inter comparison of survey methods for Soil and Water conservation Planning" was organised at Pant Krishi Bhawan,Jaipur on July 21, 2017.

Conducted Parthenium Awareness Week on 22nd August, 2017.

Organised Agriculture technology Week during 22 August 2017 to 02 September 2017.

Organised Hindi Workshop on 28 August 2017.

Celebrated Hindi Diwas on 14 September 2017.

Organised Hindi Kavya Goshthi on 20 September 2017.

Samagra Swachhta Diwas was observed on 24 -25 September 20174.

Celebrated 64th Foundation Day on 18 October 2017.

Vigilance week was observed during 31 October 2017 to 05 November 20017.

Udhagamandalam

Conducted 21 days Winter School on "Advanced Technologies on Natural Resources Management to Mitigate Climate Change Impact" during 9th to 29th, November, 2017.There were 23 scientist participated in the winter school from 15 states of India.

Conducted One Month Institutional Training on Soil and Water Conservation for B.Tech Students from 01st to 30th June 2017 .

Organised Capacity building programme on Field Engineering Training on Forest Watershed Management for Forest Range Officers. This training module consists of lectures on site selection and design of soil conservation structures, drainage line treatments, water harvesting and recharge structures, application of GIS in watershed management and benchmark survey for watershed planning. 38 Forest Range Officers from Maharashtra, Gujarat and Karnataka participated in this training programme

Organised One Month Institutional Training on Soil and Water Conservation for B.Tech Students

Conducted Swatch Bharat activities on different occasions, 16-31 May 2017; 15.09.2017 to 02.10.2017; 28.11.2017; 06.12.2017 and 15.12.2017

The Celebrated International Yoga Day on 21.06.2017.

Organised Four months Institutional Training on Soil and Water Conservation for B.Tech Students

Conducted One day capacity building programme on "Water harvesting , Sharing and efficient utilization" on 05.12.2017 under TSP

Organised Three months Institutional Training on Soil and Water Conservation for B. Tech Students from 04th September to 02ndDecember2017

Organised World Soil Day celebrated at Neelampathy Village, Coimbatore district on 5th December 2017

Participated in National Science Day Exhibition at Radio Astronomy Centre, Udhagamandalam, Tamil Nadu on 28th February 2018

Organised Training on Soil and water conservation measures for plantation and vegetables crops conducted on 25-10-2017

Organised One day capacity building program on "Water Harvesting, Sharing and Efficient Utilization" on 18.11.2017 under TSP

Organised One day Training programmeonValue addition in Plantation Crops and Vegetables in The Nilgiris

Organised Training ProgrammeonOrganic Farming practices forPlantation Crops and Vegetables in The Nilgiris

One day capacity building programme on "Water harvesting , Sharing and efficient utilization" on 05.12.2017 under TSP.

Conducted Three months Institutional Training on Soil and Water Conservation for B. Tech Students from 04th September to 02ndDecember2017

Vasad

Celebrated National Productivity Week during 12-18 February, 2017

Organised Farmer's Innovators Day (FID) celebrations on 28 February, 2017

Celebrated Centre's Foundation Day on 20th May 2017.

Organised International Yoga Day on 21st June, 2017.

Organised Hindi Pakhwada celebrations during 14-28 September 2017.

Organised various activities under Swatchh Bharat Programme on 17th Sept. 2017 ; 22 September 2017 and 25 September 2017.

Organised Vigilance Awareness Week during 30th Oct. to 4th Nov. 2017

Organised Conference on Farmers First for Conserving Soil and Water Resources (FFCSWR-2018) for Western Region during Feb. 1-3, 2018 at Anand Agricultural University (AAU), Anand, Gujarat

Conducted Short Course Training programme for Skilled Supporting Staff during 16-17 March, 2018

Organised a nuber of activities under MGMG on various occasions.

13 Distinguished Visitors

Dehra Dun

Dr. Alagusundaram, DDG (Engg. & NRM), ICAR-New Delhi; Dr. V.N. Sharda, Ex- Member ASRB, N. Delhi; Dr. Savita, Director, FRI, DehraDun, Dr. V. P. Chahal, ADG (Agriculture Extension), ICAR-New Delhi; Dr. Pratap Narain, Chairman QRT; Dr. G.R. Maruthi Sankar; Dr. S.P.S. Kushwaha; Dr. M.V. Rangha Swami; Dr. B.D. Behera- Members QRT; Dr. M.N. Jha, Ex-Head Soil Science Division, FRI; Dr. M.C. Nautiyal, Ex-Dean, College of Forestry and Horticulture, Ranichauri; Dr. D.S. Rana, Emiretus Scientist, IARI, New Delhi; Dr. R.L. Shyani, Ex Professor and Head (Ag. Economics); Dr. R.K. Panda, Head, School of Earth, Ocean and Climate Sciences, IIT Bhubneswar; Sh. Matbar Singh Kandari, Member RAC. Sh. Satpal Maharaj, Hon'ble Cabinet Minister of Tourism, Culture, Irrigation Minister, Govt. of Uttarakhand; Dr. Trilochan Mohapatra, Secretary DARE & DG, ICAR, New Delhi; Sh. C. Roul, Addl. Secretary, DARE and Secretary, ICAR, New Delhi; Dr. V.N. Sharda, Member, ASRB; Sh. Desh Raj Sharma, Dy. Director, ATMA, Bilaspur (HP); Dr. Arun Kaushal, Professor (SWCE), PAU, Ludhiana.

Agra

Dr. R.C.agarwal Registrar General PPV&FRA, New Delhi, Dr. O.P. Chaturvedi, Director ICAR-CAFRI, Jhansi

Ballary

Er. S. Ramesh Chandra, Senior Scientist (Agri. Engg.)LAM FARM, Guntur (A.P), Er. V. Raghavendra, Assistant Professor (Ag. Engg.), College of Agri. Engineering, UAS, Dr Pratap Narain, Dr. G.R. Maruthi Sankar, Dr. SPS Kuslhwaha, Dr. M.V. Rangha swami, Dr. B.D. Behera, Dr. Harsah Mehta,

Chandigarh

Dr.J.S.Samra, Ex-CEO, NRAA,Dr.P.K.Mishra, Director, Sh.Rakesh Kumar, Joint Director (Admn.), IVRI, Izatnagar,Dr.S.P.Kimothi, ADG ©, ICAR, New Delhi,Sh.Chhabilendra Roul, Additional Secretary, DARE & Secretary, ICAR,Sh.R.P.Singh, G B Member, ICAR,Dr.K.P.Sharma, VC, CCSHAU, Hissar,Dr.D.R.Thakur, Associate Director, CSK HPKV, Bajaura, Kullu,Dr.D.S.Ananth, G B Member, ICAR & MP, Sh.H.S.Dhaliwal, G B Member, ICAR & MP,Dr.S.K.Jain, Regional Director, CGWB, Jaipur,Sh.P. Prain, ADG, ICAR, New Delhi,Sh.Ranjan Aggarwal, Director DARE, New Delhi ,Dr.H.K.Verma, Director of Extension and Education, GADVASU, Ludhiana, Prof. P.R.Chandumajra, Hon'ble member of parliament, Dr.U.N.Roy, Professor, NTTTI, Chandigarh

Datia

Dr. T. Mohapatra, Secretary, DARE and Director General, ICAR, New Delhi,Sh. R.K. Singh,SFAO, ICAR-IISWC, DehraDun,Dr. A. Tiwari,Pr. Scientist, , ICAR-IISWC, DehraDun, Dr. A.K. Singh, Vice Chancellor, RVRSAU, Gwalior,Dr. Arvind Kumar, Vice Chancellor, RLBCAU, Jhansi,Dr. P.K. Ghosh,Director, ICAR – IGFRI, Jhansi,Dr. O.P. Chaturvedi,Director, ICAR – CAFRI, Jhansi,Dr. Anupam Mishra,Director, ICAR – ATARI, Jabalpur,Sh. C. Roul,Additional Secretary, DARE and Secretary, ICAR, New Delhi,Dr. Arvind Kumar,Vice Chancellor, RLBCAU, Jhansi,Dr. M. Srivastava,Registrar, RLBCAU, Jhansi,Dr. N.K. Sharma,Head, SSA Division, ICAR-IISWC, DehraDun,Dr. K.P. Mohapatra,Pr. Scientist, ICAR Research complex for NEH Region, Umiam, Meghalaya,Dr. R.V. Kumar,Director, ICAR-IGFRI, Jhansi,Dr. R.K. Tiwari,Pr. Scientist, ICAR-CAFRI, Jhansi,Dr. S.K. Mahanta,Pr. Scientist, ICAR-CAFRI, Jhansi.

Koraput

Dr P.K. Pattajoshi, Manager (Env.) NALCODamanjodi ;Rashmi NayakSr. Foreman (Horticulture)NALCO, Damanjodi;Smt. Geetanjali Patra,O/O The P.D. Watershed Kandhamal ,Phulbani, Odisha;Amit Kumar Naik;Dr S.S. Singh, Director, ICAR – ATARI, Kolkata; Prof. P.K. Roul, Dean Extension Education, OUAT, Bhubaneswar,M.Palanisamy,Dhan Foundation-Madurai ; P.S. Brahmanand, ARSGuinness World Reward Holder in Longest Speech Marathan, Guinness world Reward

Holder in Faster Time to Identity , Au Element of Periodic Table & Principal Scientist, ICAR – IIWM, Bhubaneswar ;Dr SPS Kushwaha,Dr V M Ranghaswami,Dr GR Maruthi Sankar ; Dr Basudev Behera.

Kota

Dr. Pramod Khatariya, Pr. Sci. ICAR-IARI, New Delhi;Dr. Vinod Chandra, Scientist ICAR-IARI, New Delhi;Dr. Vikram S. Meena, Scientist ICAR-IARI, New Delhi;Dr. Madan Pal, Scientist ICAR-IARI, New Delhi;Dr. Dharmpal , Scientist ICAR-IARI, New Delhi;Dr. Mohd. Athar, Pr. Sci ICAR-IARI, New Delhi;Dr. Shankar Pratap, Scientist ICAR-IASRI, New Delhi;Dr. Raj Kumar, Scientist ICAR-CSWRI, Avaika Nagar;Dr. L.R. Gurjar, Scientist ICAR-CSWRI, Avaika Nagar;Dr. Chandra Shaker, Pr. Sci ICAR-IIPR, Kanpur;Dr. Baldev Ram (Agronomist) Agriculture University, Kota;

Dr. Bharat Prakash Meena, Scientist, ICAR-IISC, Bhopal;Dr. Sanjeev Kumar Verma, ICAR-CIRC, Meerut;Dr. Shiv Pratap Singh, Pri. Scientist, ICAR-CPRI, RC, Gwalior;Dr. Vijay Singh Beniwal, Professor, Haryana Agriculture University, Hisar;Dr. Amar Pal, Head, ICAR-IVRI, Izatnagar, Bareilly;Dr. P.G. Patil, Director, ICAR-CIRCOT, Matunga, Mumbai;

Udhagamandalam

Dr.Pratap Narain, Ex vice Chancellor, RAU, Bikaner;Dr. M.V. Ranghaswami, Dean Agril, Engg. Bannari Amman Institute of Technology, Sathiyamangalam, Tamil Nadu;Dr.Basudev Behera, Head, Agronomy Divison, OUAT, Bhubaneswar;Dr.S.P.S. Kushwaha, Ex Director, IIRS, Dehradun, Uttarakhand;Dr.G.R.Maruthi Sankar, Bengaluru;Dr.H. Mehta, I/c Head, Division of Plant Sciences, IISWC, DehraDun;Ms.InnocentDivya, IAS, Collector, Nilgiris, Tamil Nadu;Sh. Amar Kushawha, IAS, Project Director, SADP, Ooty, Tamil Nadu;Dr. WangdopBhutia, IFS, Principal, Central Academy of forest education, Darjeeling;Sh. S.Kalanithi, DFO, The Nilgiris, Tamil Nadu;Mr. S.B. Thampi, Dy. DGM (IMD) and Head, RMC, Chennai;Sh. K. Mohanan, Asst. Dir. Of Agri. Moovatupuzha, Kerala;Dr.L. VijayaBharathi, Professor, ANGRAU, AP;Sh. S.Ganesh, Asst. Prof., SNSCT, Coimbatore, Tamil Nadu;Dr. G. Thiyagarajan, Forest college, Mettupalayam;Sh. Nikhil, Assistant Prof. MIC college of technology, Andhra Pradesh;Dr. B. Manjula, Asst. Prof., Dept. of Agrl. Processing and food Engg. CAE, Madkasira, ANGRU, A.P.;Sh. Jitendra Kumar, AEC&RI, Kumulur, Trichy (TNAU);Dr. T. Parthiban, TNAU, Coimbatore;

Vasad

Sh. R.L. Kurdani, ATMA Project, Junagadh; Dr. P. K. Mishra, Director, ICAR-IISWC, DehraDun ;Dr. Nayna Brahmbhatt, Professor, V.P. Science College, V.V. Nagar;Dr. V.K. Sood, Associate Professor, Dept. of Engineering, BACA, AAU, Anand;Dr. G. Ramana Murthy, IFS, Chief Conservator of Forests, Gandhinagar Circle, Gandhinagar;Dr. N.K. Sharma, Pr. Sci. (Agro.), Dr. D. Mandal, ICAR National Fellow and Sh. S.K. Sinha, T.O., ICAR-IISWC, DehraDun; Dr. Gopal Kumar , Sr. Scientist, ICAR-IISWC, DehraDun ; Raulji Ajitsinhji Budhdhdev Vidhayalaya, Rayka ;Sh. Khodsinhbhai R. Solanki, Sarvodaya Uttar Buniyadi Vidyalaya, Fajalpur, Vadodara;Dr. Mohammad Sajid, Dr. Azad Damor, Asstt. Professor, College of Agriculture, AAU, Jabugam; Dr. Paresh Rathod, Dr. Punit Mehta, Asstt. Professor, College of Agriculture, AAU, Vaso; Sh. M.D. Vora, Asstt. Professor, CAET, AAU, Godhra;Dr. B.C. Mal, V.C. JIS University, Kolkata (WB);Dr. Ramadhr Singh, PS and Former Head, CIAE, Bhopal;Sh. S.V. Kaid, Asstt. Professor, College of Horticulture, SPAU, Jagudan alongwith students;Dr. Anil K. Srivastava, Almora;Dr. M.K. Tiwari, Asstt. Prof. & HOD (Dept. of Irri. & Processing), CAET, AAU, Godhra;

14 PERSONNEL

(Promotion, Appointement, Transfer, Retirement etc.)

Dehra Dun

Appointments/Joining:

Dr. Gopal Kumar, Sr. Scientist joined on transfer from NRC, Litchi Muzffarpur on 05.07.2017.
Dr. Madan Singh, Scientist joined on 11.10.2017.
Sh. DL Chaudhary, Assistant; joined on transfer from RC Datia on 01.05. 2017
Sh. Inder Singh Chauhan, Sr. Technician, joined on transfer from IISR Lucknow on 09.03.2018.
Sh. Sunil Kumar UDC joined on transfer from RC Chandigarh on 01.05.2017.

Promotion:

Dr. Rajesh Kaushal promoted to Principal Scientist (Forestry) w.e.f 21.12.2017.
Dr. Matish Chandra promoted to Chief Technical Officer w.e.f 01.01.2016.
Sh. Swarn Singh, promoted to Technical Officer w.e.f 29.06.2016.
Sh. Ajay Pal Singh promoted to Sr.Technical Assistant w.e.f 29.06.2016.
Sh. Sarvesh Kumar promoted to Sr.Technical Assistant w.e.f 29.06.2016.
Sh. Tilak Ram promoted to Sr.Technical Assistant w.e.f 29.06.2016.
Sh. Vikram Singh promoted to Sr.Technical Assistant w.e.f 22.08.2016.
Sh. Santosh promoted to Assistant w.e.f 28.04.2017.

Financial upgradation under the MACP Scheme

Sh. Alok Khandelwal, Assistant, granted IIIrd MACP w.e.f 04.03.2017.
Sh. Kuldeep Singh, Upper Division Clerk, granted IInd MACP w.e.f 29.04.2017.
Smt. Savitri Devi, SSS, granted IInd MACP w.e.f 07.05.2017.
Sh. Prem Singh Rawat, SSS, granted Ist MACP w.e.f. 11.06.2017.
Sh. Om Pal, SSS, granted Ist MACP w.e.f 12.06.2017.
Sh. Navin Kumar, SSS, granted Ist MACP w.e.f 01.09.2016.

Transfer:

Sh. Rakesh Hadda, Technical Assistant; transferred to RC Kota w.e.f. 31.05.2017.
Sh. Dalbir Singh, UDC; transferred to RC Chandigarh w.e.f 28.4.2017.
Smt. Neha Dobhal, Asstt. Admn. Officer; transferred to RC Chandigarh on 29.8.2017
Sh. L. S. Rawat, Asstt. Admn. Officer; transferred to RC Koraput on 03.03.2018.

Retirement:

Sh. Banwari Lal, SSS; retired on superannuation on 30.06.2017.
Dr. J.P. Singh, CTO; retired on superannuation on 31.07.2017.
Sh. Bachan Singh, Sr. Technician; retired on superannuation on 31.07.2017.
Sh. Om Prakash, F/G; retired on superannuation on 31.07.2017.
Sh. Raj Pal, SSS; retired on superannuation on 31.07.2017.
Sh. Ramesh Singh, SSS; retired on superannuation on 31.10.2017.
Mrs. Saroj Semwal, Asstt. Admn. Officer; retired on superannuation on 30.11.2017.
Dr. B.L. Dhyani, Senior Scientist; retired on superannuation on 31.01.18.
Sh. Kripal Singh, SSS; retired on superannuation on 31.01.2018
Sh. A. K. Singh, Chief Administrative Officer; retired on superannuation on 28.02.2018

Obituaries:

Sh. Babu Singh, SSS; expired on 11.08.2017.
Sh. Balbir Singh, SSS; expired on 27.08.2017.

AGRA

Appointment/Joining:

Sh. Manglu , SSS; joined on transfer from RC Koraput on 11. 09. 2017.
Sh. Krishan Kumar, TO; Joined on transfer from RC Datia on 10.12.2017.

Promotion:

Dr. K.K. Sharma promoted to Principal Scientist, w.e.f. 14.3.2017
Sh. B. P. Joshi promoted to Senior Technical Officer, w.e.f. 01.01.2015

Sh. Laxman Singh promoted to Senior Technical Assitant, w.e.f. 29.06.2016
Smt. Parmila Rathore promoted to Upper Division Clerk, w.e.f. 24.04.2017

Transfer:

Dr. Dileep Kumar, Scientist (Agro.) transferred to ICAR-IISR Lucknow on 05.07.2017.
Dr. A.K. Singh, Principal Scientist (Engg.) transferred to RC Kota on 16 .11.2017.

Retirement:

Sh. Rakesh Singh, TO; retired on superannuation on 30.11 2017.
Sh Brajesh kumar, TO; retired on superannuation on 31.12 2017.
Sh. Sorti Lal,SSS; retired on superannuation on 31.12 2017.

Obituaries:

Sh. P.S. Sharma, T.O. expired on 23. 01. 2018.

Bellary

Appointments/Joining:

Dr. Ravi Dupdal, Scientist (Ag. Econ.); Joined on transfer from CRIDA, Hyderabad on 29.09.2017.
Sh. M. Balakumar, Technial Officer; joined on transfer from IISWC, RC, Chandigarh on 06.12.2017.

Promotion:

Sh.W. Muralidhar promoted to Senior Technical Officer w.e.f. 01-01-2015.
Smt T. Padmaja Gupta promoted to Asstt. Adm. Officer w.e.f. 11.01.2018.
Sh. K. Nataraj promoted to Administrative Officer at ICAR-IISS, Calicut (Kerala).

Transfer:

Sh. D. Venkatesh, LDC; transferred to RC, Udhagamandalam w.e.f. 20.06.2017.
Sh. S.K. Srivatsava, Scientist (SWC Engg.); transferred to ICAR-IINRG, Ranchi w.e.f. 30.06.2017.
Dr. A. Raizada, Pr. Scientist (Forestry); transferred to ICAR-NRCIF, Motihari (Bihar) w.e.f. 11.08.17.

Retirement:

Smt. D. Fathima Bi, SSS; retired on superannuation on 31.12.2017.

Chandigarh

Appointments/Joining:

Sh. Dalbir Singh, UDC; joined on transfer from IISWC, DehraDun on 29.04.2017.
Smt. Neha Dobhal, Asstt. Admn. Officer; joined on transfer from IISWC, Dehra Dun on 30.8.2017.
Sh. Nanda, TSCL; regularised to the post of SSS on 10.03.2017.
Sh. Amrit Lal, TSCL; regularised to the post of SSS on 10.03.2017.
Sh. Kallu, TSCL; regularised to the post of SSS on 10.03.2017.
Sh. Raj Kishore, TSCL; regularised to the post of SSS on 10.03.2017.

Promotion:

Sh. H. C. Sharma promoted to Sr. Technical Officer w.e.f 29.05.2017.

Transfer:

Sh. Sunil Kumar, UDC;, transferred to IISWC, DehraDun on 30.04.2017.
Sh. M. Bala Kumar, Technical Officer; transferred to R C, Bellary on 30.11.2017.

Retirement:

Dr. A K Tiwari, Principal Scientist/Head; retired on superannuation on 31.07.2017
Sh. Surender Singh, CTO; retired on superannuation on 31.05.2017

Datia

Appointment/ Joining:

Sh. M. K. Meena, Scientist; joined on April 10, 2017 on transfer from RC, Koraput.

Promotion:

Sh. A.K. Ahirwar promoted to AAO w.e.f. May 19, 2017

Transfer:

Sh. D.L. Chaudhary, AAO; transferred to join as assistant at IISWC, DehraDun on April 29, 2017
Sh. Krishna Kumar, TO; transferred to join at RC, Agra on Dec. 07, 2017.

Retirement:

Sh. N.K. Sharma, STO; retired on superannuated on 31/12/2017.

Koraput

Appointment/ Joining:

Sh. L. S. Rawat, AAO; joined, on transfer from IISWC, Dehra Dun on 07.03.2018.

Promotion:

Dr. D.C. Sahoo promoted to Principal Scientist 08.08.2016

Transfer:

Sh. M. K. Meena, scientist (Agril. Econ.) Transferred to R C, Datia on 07.04.2017.
Sh. Mangalu, S.S.S. Transferred to R C, Agra on 08.09.2017.

Kota

Appointment/Joining:

Dr. A.K. Singh, Principal Scientist (SWC Engg.); joined on transfer from RC Agra on 28.11. 2017.
Sh. Rakesh Hadda, Technical Assistant; joined on transfer from IISWC, DehraDun on 01.06. 2017.

Promotion:

Dr. B.L. Mina promoted to principal scientist (Soils); w.e.f. 02.08. 2017.
Sh. B.B. Singh promoted to Sr. Technical Officer; w.e.f. 01.08. 2013.
Sh. Ajay Kumar promoted to Sr. Technical Assistant; w.e.f. 15.10.2015.

Retirement:

Sh. Ram Dayal, SSS; superannuated on 31.07.2017
Sh. Anil Kumar Chaturvedi, Technical Assistant; superannuated on 28.02. 2018.

Obituary:

Sh. B.K. Upadhayay, Senior Technical Officer; expired on 31.12. 2017.

Udhagamandalam

Appointment /Joining:

Sh. D. Venkatesh, LDC; joined on transfer from Research Centre, Bellary on 01.07.2017.

Promotion:

Dr. P. Raja, Sr. Scientist; promoted to Principal Scientist w.e.f 28.12.2017.

Retirement:

Sh. S. Natesan, SSS; retired on superannuation on 30.04.2017

Vasad

Appointment /Joining:

Dr. Gaurav Singh, joined as Scientist (LWME) on 11.08.2016
Dr. Om Prakash Meena, joined as Scientist (Soils) on 12.08.2016
Sh. R.C. Meena, joined as Assistant on transfer from RC Agra on 19.10.2016
Sh. M.K. Kureel, joined as Assistant on transfer from RC Kota on 02.01.2017

Promotion:

Sh. Nyonand promoted to CTO w.e.f. 01.01.2016
Sh. Ramesh K.S promoted to UDC w.e.f. 01.05.2017

Retirement:

Sh. J.K. Vankar, Technical Officer; retired on superannuation on 31.05.2017
Sh. Ramanbhai Mangalbhai Chuhan, SSS; retired on superannuation on 31.05.2017

Transfer:

Dr. Rajkumar, Scientist (Forestry) relieved on 15.07.2017 to join at ICAR-CSSRI, Karnal

List of Staff

Appendix-1

[As on 31st March, 2018; not a gradation list]

Dr. P. K. Mishra, Director

Director Cell

Sh. Sunil Kumar, PS
Sh. Ram Lal, Sharma, SSS
Sh. Narendra Singh, SSS

Division of Soil Science & Agronomy

Scientist

Dr. N.K. Sharma, Pr. Scientist & Head
Dr. D.V. Singh, Pr. Scientist
Dr. D. Mandal, National Fellow
Dr. U.K. Maurya, Sr. Scientist
Dr. Gopal Kumar, Sr. Scientist
Dr. M. Shankar, Scientist
Dr. N.M. Alam, Scientist
Dr. R. J. Singh, Scientist

Technical

Sh. Ashok Kumar, Chief Tech. Officer
Dr. Gambhir Singh, Asstt. Chief Tech. Officer
Sh. J.S. Deshwal, Sr. Tech. Officer
Mrs. Sarita Gupta, Sr. Tech. Officer
Sh. Deepak Kaul, Tech. Officer.

Administration

Mrs. Mamta Negi, PS

Supporting (SSS)

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Mrs. Chyna Jena, Scientist
Sh. Uday Mandal, Scientist
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Sh. H. S. Bhatia, Tech. Officer
Sh. U.C. Tiwari, Tech. Officer
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Sh. Narayan Singh, Tech. Officer

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Sh. B. V. Baria

The metrological data recorded at Research Farm Selaqui (DehraDun) and Research Centre's during 2017-18

Parameters		Apr.17	May.17	Jun.17	Jul.17	Aug.17	Sep.17	Oct.17	Nov.17	Dec.17	Jan.18	Feb.18	Mar.18
Dehra Dun													
Rainfall (mm)		30.0	47.6	252.7	438.2	434.4	335.0	0	0	20.3	16.5	15.7	6.1
Number of rainy days		5	5	10	14	18	7	0	0	2	1	3	1
Mean Maximum Temp (°C)		35.4	37.0	34.0	31.5	31.2	31.5	31.8	26.2	22.7	20.6	24.1	29.8
Mean Minimum Temp (°C)		14.4	18.4	21.6	24.5	24.6	22.1	14.9	7.9	6.2	2.8	6.6	9.6
Average Wind Velocity (km/hr)		1.7	1.8	1.0	0.5	0.5	0.5	0.4	0.3	0.5	0.7	0.9	1.3
Average Daily bright sunshine (hrs)		6.8	7.0	5.4	2.6	2.4	4.5	6.7	4.3	4.4	4.4	5.6	7.1
Average Daily Evaporation (mm)		5.3	6.2	4.1	2.5	2.2	2.7	2.7	1.5	1.1	1.1	1.6	3.3
Av. relative humidity (%)	(0719 hrs.)	80.0	71.8	83.5	93.8	94.2	93.6	89.7	88.1	89.6	90.4	90.4	90.3
	(1419 hrs.)	26.6	33.8	57.0	77.3	79.3	70.1	48.2	44.9	46.7	39.6	39.9	27.9
Agra													
Rainfall (mm)		0.0	34.4	78.9	82.5	82.4	26.4	0.0	0.0	2.4	2.0	0.0	0.0
Number of rainy days		0	3	7	7	7	1	0	0	0	0	0	0
Mean Maximum Temp (°C)		40.7	41.2	39.7	35.0	35.8	35.8	36.9	29.1	24.4	21.7	27.5	34.9
Mean Minimum Temp (°C)		21.1	24.8	26.7	26.5	26.5	25.0	18.8	11.4	8.2	5.1	10.1	14.4
Average Wind Velocity (km/hr)		3.6	3.9	4.0	4.1	3.3	2.3	1.5	1.5	1.6	1.7	3.0	3.5
Average Daily bright sunshine (hrs)		9.1	8.5	6.6	5.0	4.6	6.7	7.7	6.6	6.5	6.3	7.4	8.7
Average Daily Evaporation (mm)		8.7	7.3	6.8	4.2	3.6	4.0	4.0	2.0	1.5	1.0	2.8	5.0
Av. relative humidity (%)	(0719 hrs.)	71	76	82	95	92	87	85	88	89	91	90	91
	(1419 hrs.)	39	51	59	80	70	67	33	37	47	50	51	57
Ballary													
Rainfall (mm)		0.0	24.6	217.8	20.4	161.1	239.0	221.9	7.3	0.0	0.0	0.0	0.6
Number of rainy days		00	02	02	02	10	08	07	02	00	00	00	00
Mean Maximum Temp (°C)		40.3	39.3	35.1	34.2	33.2	31.9	30.8	30.3	29.0	30.5	32.7	36.6
Mean Minimum Temp (°C)		26.2	26.1	24.6	24.0	23.3	23.0	21.9	19.3	14.9	16.2	17.7	21.2
Average Wind Velocity (km/hr)		7.3	9.1	10.6	11.9	8.1	5.9	3.5	3.5	3.1	3.5	7.4	--
Average Daily bright sunshine (hrs)		9.5	8.6	5.6	5.1	4.7	5.3	5.9	7.8	8.6	9.1	9.4	7.9
Average Daily Evaporation (mm)		10.7	10.2	7.9	7.1	5.9	6.1	5.8	5.5	5.0	5.4	6.8	8.9
Av. relative humidity (%)	(0723 hrs.)	61	66	64	77	87	87	92	89	87	80	75	70
	(1423 hrs.)	19	28	37	44	52	56	61	47	36	33	25	21
Chandigarh													
Rainfall (mm)		14.4	8.8	152.4	179.3	379.2	160.8	0.0	0.0	36.0	10.8	45.4	2.8
Number of rainy days		05	03	09	11	19	05	00	00	01	01	03	03
Mean Maximum Temp (°C)		35.0	37.7	34.3	33.4	31.6	32.2	32.7	26.3	22.6	20.4	24.9	30.3
Mean Minimum Temp (°C)		17.9	22.5	22.1	24.6	24.2	21.8	17.3	10.2	7.7	3.9	7.5	11.8
Average Wind Velocity (km/hr)		3.6	3.7	2.7	2.5	1.7	1.1	1.3	1.4	1.4	1.6	2.2	2.5
Average Daily bright sunshine (hrs)		8.8	7.7	5.6	4.5	4.3	6.7	7.6	4.2	5.6	6.1	7.4	8.0
Average Daily Evaporation (mm)		6.1	7.3	5.7	4.0	3.1	3.4	3.4	2.0	1.4	1.4	2.3	3.9
Av. relative humidity (%)	(0723 hrs.)	47	47	66	85	91	89	72	84	87	89	86	73
	(1423 hrs.)	26	25	47	65	73	64	44	45	51	48	38	30
Datia													
Rainfall (mm)		0.0	4.2	60.4	138.2	118.6	164.6	0.0	0.0	0.4	0.0	0.6	0
Number of rainy days		0	0	6	10	9	4	0	0	0	0	0	0
Mean Maximum Temp (°C)		41.0	43.2	40.8	33.1	33.9	35.1	36.4	30	25.6	24.8	28.6	35.5
Mean Minimum Temp (°C)		23.0	27.4	27.4	26	26.0	25.1	20.5	11.6	8.1	5.3	9.7	14.1
Average Wind Velocity (km/hr)		3.9	4.6	4.8	4.4	4.5	2.6	1.6	1.4	1.3	1.5	2.7	2.6
Average Daily bright sunshine (hrs)		10.5	8.9	8.4	3.6	4.6	7.5	9.5	7.8	6	8.4	8.3	10.3
Average Daily Evaporation (mm)		10.0	13.9	9.1	3.2	3.5	4.4	5.0	3.0	2.0	2.4	3.3	6.2
Av. relative humidity (%)	(0716 hrs.)	50	41	60	86	90	89	82	88	90	92	83	72
	(1416 hrs.)	13.9	17	34	68	63	52	28	27	34	38	40	27

Koraput													
Rainfall (mm)		12.8	104	16	368.9	342.4	272.6	232.7	23.4	0	0	0	0.1
Number of rainy days		1	6	167.4	17	16	13	13	2	0	0	0	0
Mean Maximum Temp (^{o}C)		36.4	35.72	28.7	26.14	26.9	28.79	28.53	26.91	27.15	26.29	29.74	33.33
Mean Minimum Temp (^{o}C)		18.22	19.66	19.8	20.36	20.72	20.27	17.83	12.54	7.13	6.39	9.84	15.30
Average Wind Velocity (km/hr)		2.39	1.17	2.2	2.97	0.82	0.51	0.26	0.18	0.22	0.57	0.56	0.86
Average Daily bright sunshine (hrs)		9.37	8.22	2.1	1.44	2.57	3.74	4.8	6.97	8.05	8.47	8.01	7.52
Average Daily Evaporation (mm)		6.34	5.35	2.7	2.13	2.22	2.07	2.38	1.89	2.05	2.63	3.61	4.67
Av. relative humidity (%)	(0659 hrs.)	89.73	89.26	93.8	95.26	96.29	96.13	96.55	97.7	96.61	97.06	97.14	92.97
	(1359 hrs.)	38.93	53.74	84.7	83.94	87.94	81.4	87.81	76.87	76.81	54.23	56.11	42.55
Kota													
Rainfall (mm)		0	3.4	117.2	86.2	239.6	20.0	0	0	7.6	0		
Number of rainy days		0	2	5	15	10	4	0	0	2	0		
Mean Maximum Temp (^{o}C)		39.8	42.1	39.6	33.1	32.1	33.4	36.3	29.7	24.6	24.5		
Mean Minimum Temp (^{o}C)		21.6	26.4	29.1	26.5	25.7	24.2	17.5	11.4	8.9	6.5		
Average Wind Velocity (km/hr)		4.2	4.6	5.8	5.4	3.5	2.7	1.3	0.9	1.0	1.2		
Average Daily bright sunshine (hrs)		10.4	10.0	9.3	4.2	4.2	7.2	8.8	6.8	6.0	8.2		
Average Daily Evaporation (mm)		8.9	10.1	9.5	5.2	3.9	4.5	4.7	2.7	2.0	2.1		
Av. relative humidity (%)	(0727 hrs.)	46.0	44.5	61.8	83.1	23.3	83.4	78.1	88.9	84.5	88.3		
	(1427 hrs.)	15.0	17.2	35.8	64.6	24.1	51.3	22.8	29.3	38.7	35.8		
Udhagamandalam													
Rainfall (mm)		40.6	169.4	98.3	74.3	154.9	343.0	99.5	57.8	92.8	1.9	32.0	83.0
Number of rainy days		5	13	9	8	16	16	9	5	3	0.0	2.0	5.0
Mean Maximum Temp (^{o}C)		23.4	23.0	20.3	19.2	19.3	19.0	20.1	19.7	20.5	20.2	22.7	22.1
Mean Minimum Temp (^{o}C)		12.9	12.5	12.3	11.9	12.6	12.7	11.4	10.6	7.7	6.6	7.4	10.7
Average Wind Velocity (km/hr)		3.3	2.5	5.7	7.2	4.9	3.8	1.9	2.4	4.6	2.9	3.1	4.7
Average Daily bright sunshine (hrs)		7.2	4.7	2.9	3.1	1.8	1.4	2.6	4.6	7.0	7.4	8.7	7.6
Average Daily Evaporation (mm)		4.4	2.7	2.1	2.2	1.4	1.3	2.1	2.6	3.3	3.4	4.2	4.4
Av. relative humidity (%)	(0723 hrs.)	77.1	89.2	90.8	92.3	92.7	93.9	92.2	89.1	79.9	74.0	78.0	80.0
	(1423 hrs.)	56.7	66.8	74.8	76.2	76.3	78.1	77.0	74.0	60.4	52.0	51.0	59.0
Vasad													
Rainfall (mm)		0.0	11.2	119.5	329.7	123.8	70.4	0.0	0.0	4.6	0.0	0.0	0.0
Number of rainy days		0.0	1	7	18	7	6	0.0	0.0	0.0	0.0	0.0	0.0
Mean Maximum Temp (^{o}C)		39.0	40.5	37.4	31.4	32.1	32.8	35.6	32.2	28.1	29.4	32.5	37.0
Mean Minimum Temp (^{o}C)		19.8	25.0	26.5	24.5	24.6	24.3	19.1	13.6	13.3	10.4	12.5	15.7
Average Wind Velocity (km/hr)		5.32	5.89	6.82	5.38	4.21	2.96	2.13	2.19	3.83	2.76	2.81	3.18
Average Daily bright sunshine (hrs)		10.4	10.6	7.6	2.7	3.5	5.1	8.5	8.3	5.9	8.3	8.3	9.0
Average Daily Evaporation (mm)		7.4	8.2	6.6	2.5	2.8	3.1	4.2	3.2	2.5	3.0	4.0	6.0
Av. relative humidity (%)	(0716 hrs.)	72.4	69.2	79.9	93.7	91.1	90.5	91.8	84.2	80.5	87.1	81.1	79.8
	(1416 hrs.)	39.2	31.6	56.6	80.8	72.3	71.4	49.0	42.3	51	34.6	31.0	51.0

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