DEPARTMENT OF GEOLOGY
KURUKSHETRA UNIVERSITY
KURUKSHETRA-136119, HARYANA (INDIA)

E-mail: chairperson.geology@kuk.ac.in
Fax: 238277, 238035
Mob. +91 98969-55777
Date: .....
No. Geol/22/_____

To,

DR. SHASHI BHUSHAN SHUKLA, GEOLOGY HEAD

ZAWAR GROUP OF MINES, TEH. SARADA (UDAIPUR)
PIN: 313901

Subject: Request for permission to **visit the Mines and Geological Division, Labs etc.**

Dear Sir,

M.Tech. Applied Geology (5-Year Integrated Course) 5th and 7th semester students of our Department are required to undergo Geological Field Training in the different types of terrains as part of the curriculum. Exposure in **'Geology Based Industries'** like; Mines, Dams, and other relevant sites is also a part of their field training. They are going for above said training from 21st February to 28th February 2023 to Udaipur, Jaipur, Khetri (Rajasthan) and Narnaul (Haryana) and surrounding regions. The **total 16 students** of these classes would like to visit ZAWAR GROUP OF MINES **for one day** (between 21st February to 28th February 2023). These students will be accompanied by teacher In-Charges of the Training Mr. Yashpaul, Mr. Paryant Ashwani and Ms. Sarita Mann (Lady Escort).

The Department shall remain grateful if you kindly accord permission for the purpose and depute concerned Geologist / official during their scheduled program.

Thanking you

20/2/23

CHAIRPERSON
Chairman
Department of Geology,
Kurukshetra University,
Kurukshetra-136119.

Request for permission of Only One Day Visit with my students in Zawar Mines

External Inbox

Yashpaul . 20/2/2023

to Shashi.shukla

Dear Sir, Greetings of the Day!

I am Yashpaul, Assistant Professor in the Department of Geology, Kurukshetra University, Kurukshetra (Haryana). Sir as mentioned in the subject above, I am requesting you for the permission of Only One Day Visit of Zawar Mines along with my colleagues and students of M.Tech Applied Geology. Sir our students are really very keen to learn about operations in Mines.
I am sending details and request letter from Chairperson, Department of Geology, Kurukshetra University Kurukshetra.
Kindly Consider this request.
We will be obliged the favour.

Regards
Yashpaul
Assistant Professor
Department of Geology
Kurukshetra University, Kurukshetra

Yashpaul . 24/2/2023

to Shashi, Vivek, Debanshu

Dear Sir Good Evening!
We are coming on 26.02.2023.
Details of the students and Training In-charges including me are as follows:

Class M.Tech Applied Geology (VIII semester)
Teacher Incharge

Mr.Yashpaul	Male	08
Mr. Paryant	Male	07
Ms. Sarita Mann	Female	05

Students

Name	Gender	Shoes no.
Tanu Devi	Female	05
Muskan	Female	06
Yukta	Female	06
Aarti	Female	05
Madhu rani	Female	06
Aman	Male	07
Aman	Male	07
Harsh	Male	08

Class M.Tech Applied Geology (VI semester)

Name	Gender	Shoes no.
Surbhi	Female	06
Konark	Male	07
Dishant	Male	09
Prashant	Male	07
Shivam	Male	09
Gyan Babu	Male	08

Gmail

chairperson geology <chairperson.geology@kuk.ac.in>

Regarding training/ field work with GSI, Chandigarh

3 messages

Director TCSU PHHP <dir.suphhp@gsi.gov.in>
To: "chairperson.geology@kuk.ac.in" <chairperson.geology@kuk.ac.in>, "yp_geo@kuk.ac.in" <yp_geo@kuk.ac.in>
Thu, Jul 7, 2022 at 5:29 PM

महोदय,

With reference to the meeting held with the students of Kuruskhetra University, it is to convey that as per the request received from Ms. Diksha Thakur and Ms Anshika, MSc. Applied Geology, the competent authority has approved to impart the field based training programme.

However, it is to mention, that no logistic or financial aid shall be provided by GSI during the training/ field work period. The details of the interested students may kindly be forwarded to this office. The date of the initiation of of the training shall be intimated to your office once finalized.

भवदीय / Yours faithfully,

निदेशक तकनीकी समन्वय / Director TC

भा.भू.स., चंडीगढ़/ GSI, Chandigarh

chairperson geology <chairperson.geology@kuk.ac.in>
To: 1998dikshathakur@gmail.com, anshikarana5678@gmail.com
Mon, Jul 11, 2022 at 9:43 AM

[Quoted text hidden]

Diksha Thakur <1998dikshathakur@gmail.com>
To: chairperson geology <chairperson.geology@kuk.ac.in>
Mon, Jul 11, 2022 at 12:18 PM

[Quoted text hidden]

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RESEARCH ARTICLE

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Standardized precipitation index based dry and wet conditions over a dryland ecosystem of northwestern India

Divya Saini[a], Omvir Singh[a] and Pankaj Bhardwaj[b]

[a]Department of Geography, Kurukshetra University, Kurukshetra, India; [b]Department of Geography, Government College, Bahu, India

ABSTRACT

Droughts are extreme meteorological and hydrological events having severe impacts on the natural environment and socioeconomic conditions of the affected region especially over a dryland ecosystem like Rajasthan state in northwestern India. Therefore, in this paper an attempt has been made to investigate the dry and wet conditions over the state based on standardized precipitation index (SPI). For this study, diurnal rainfall data of 33 stations have been procured and used for the period 1961–2017. The analysis has been carried out at different time scales i.e. early, mid, late, whole *rabi* season and annually. To examine the trends in rainfall and SPI, Mann-Kendall test has been applied. Spatial plotting of rainfall and SPI has been done by means of inverse distance weighting interpolation technique. The analysis has shown an increasing trend in annual SPI over majority of stations (23 stations), with significant increasing trend at 5 stations (significant at 95% confidence level). Seasonally, incremental drying conditions have been witnessed during mid- and late *rabi* seasons, which are opposite to early *rabi* season when about 70% of the stations have witnessed wetting conditions. Almost all the stations have evidenced severely dry years except Banswara, Barmer, Nagaur and Sirohi stations. Overall, the northwestern, southeastern and northeastern parts have suffered from high drought severity, whereas central regions have relatively low severity of droughts. Finally, the results of this study may be beneficial for decision makers in formulating water management policies to mitigate the impact of dryness and wetness.

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Received 11 May 2020
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KEYWORDS
Drought severity; rainfall; season; spatial distribution; trend analysis; Rajasthan

1. Introduction

Drought events and their related impacts on society and environment are expected to increase due to changing climate (Bates et al., 2008; Dai, 2011; Romm, 2011). Over the years, several drought indices such as Palmer Drought Severity Index (PDSI) (Palmer, 1965), Rainfall Anomaly Index (RAI) (Van Rooy, 1965), Surface Water Supply Index (SWSI) (Shafer & Dezman, 1982), Palfai Aridity Index (PAI) (Palfai, 1990), Standardized Precipitation Index (SPI) (Mckee et al., 1993), Vegetation Condition Index (VCI) (Kogan, 1995), Effective Drought Index (EDI) (Byun & Wilhite, 1999), Reconnaissance Drought Index (RDI) (Tsakiris et al., 2007), Perpendicular Drought Index (PDI) (Ghulam et al., 2007), Standardized Runoff Index (SRI) (Shukla & Wood, 2008) and Standardized Precipitation Evaporation Index (SPEI) (Vicente-Serrano et al., 2010) have been developed and used by scientists for identification and management of drought around the world. Mishra and Singh (2011) have comprehensively reviewed the merits and demerits of these indices under diverse conditions. Of the above indices, SPI suggested by Mckee et al. (1993) have distinct merits consisting of simplicity to calculate, broader applicability, tailored for multiple time scale, incorporates only rainfall as input data and least affected by geographical and topographical differences (Bazrafshan et al., 2014). Of late, SPI has been extensively used in estimation, monitoring, watching and forecasting of droughts universally (Spinoni et al., 2014) as well as in several realms namely, Africa (Dhurmea et al., 2019; Dutra et al., 2013), Europe (Barker et al., 2016; Karabulut, 2015), North America (Ford & Labosier, 2014), South America (Seiler et al., 2002), West Asia (Awchi & Kalyana, 2017; Mossad & Alazba, 2018; Mustafa & Rahman, 2018; Zakhem & Kattaa, 2016) and South-East Asia (Bong & Richard, 2019; Du & Shi, 2013; Kundu et al., 2020; Rahman et al., 2018; Zin et al., 2013). Apart from this, SPI has been modelled using geostatistical techniques to generate spatial maps (Bhuiyanet al., 2006; Sharafati et al., 2020).

India has a history of droughts, facing 22 major droughts between 1871 and 2002. Likewise, about 16% of its total geographical area is drought prone, annually affecting approximately 50 million people (Prabhakar & Shaw, 2008). Droughts are of major concern in Rajasthan state of India because much of the state is highly drought prone experiencing drought very frequently (Dutta et al., 2015). The state has witnessed recurring and prolonged droughts of about 3–4 years in a cycle of 5 years with water scarcity almost every year, resulting a disruption in the socio-economic development. Pingale et al. (2014) have reported a significant increasing trend in temperature

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ORIGINAL PAPER

Geoinformatics and analytic hierarchy process based drought vulnerability assessment over a dryland ecosystem of north-western India

Divya Saini[1] · Omvir Singh[1] · Tejpal Sharma[2] · Pankaj Bhardwaj[3]

Received: 4 November 2020 / Accepted: 23 May 2022 / Published online: 14 June 2022

Abstract

Drought vulnerability is the extent to which an area is susceptible to damage as well as causing a threat to human society. Drought frequently occurs in the Indian state of Rajasthan, and so far, very little attention has been paid towards its vulnerability assessment. Therefore, the present study focuses on a spatial multi-criteria integrated technique for an all-out drought vulnerability assessment and mapping consisting of geographic information systems (GIS) and analytic hierarchy process (AHP) techniques. The data have been acquired from various secondary sources pertaining to a total of 16 indicators under meteorological (rainfall, temperature and evapotranspiration), hydrological (hydrogeology, elevation, groundwater level, groundwater development and surface water bodies), agricultural (available water holding capacity of soils, land use and slope) and socio-economic (density of population, female-to-male ratio, irrigated land, agriculture-dependent population and deep tube wells) drought categories. Further, spatial layers for each category have been developed by various GIS operations followed by the calculation of weights for each drought category and type employing pair-wise comparison matrices by means of AHP criterion. Afterwards, individual drought category and comprehensive drought vulnerability maps have been prepared by employing the weighted overlay technique. The generated maps have effectively displayed the areal spreads and levels of drought vulnerability with respect to normal, mild, moderate, severe and extreme category of droughts. The findings from this study have demonstrated a proneness of severe to extreme drought vulnerability in 25% area of the state. Distinctively, the eastern, western, central and small pockets of south-western parts of the state have witnessed severe to extreme drought vulnerability, while the remaining areas have demonstrated normal to moderate drought vulnerability. The results of the overall drought vulnerability have been validated by employing normalized difference vegetation index and past occurrence of drought disasters, which revealed an accuracy of 81%. The obtained results prove the effectiveness of geoinformatics and AHP techniques in comprehensive drought vulnerability assessment and mapping. Finally, the findings of the present study may be easily applied for designing suitable drought mitigation strategies of the vulnerable areas.

Keywords Drought severity · Meteorological · Hydrological · Agricultural · Socio-economic · Rajasthan

Extended author information available on the last page of the article

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Mapping main risk areas of lightning fatalities between 2000 and 2020 over Odisha state (India): A diagnostic approach to reduce lightning fatalities using statistical and spatiotemporal analyses

Manoranjan Mishra [a,f], Tamoghna Acharyya [b], Celso Augusto Guimarães Santos [c,*], Richarde Marques da Silva [d], Pritam Chand [e], Debdeep Bhattacharyya [f], Sanjay Srivastava [g], Omvir Singh [h]

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ARTICLE INFO

Keywords:
Lightning death
Lightning Imaging Sensor (LIS)
Lightning strike
Natural hazards
Sen estimator
Trend analysis

ABSTRACT

This study analyzes the spatiotemporal variation of lightning flashes and lightning strike deaths from 2001 to 2020 among all 30 districts of Odisha State, India. Lightning flash data for the study area were acquired from Lightning Imaging Sensor (LIS) installed aboard the Tropical Rainfall Measuring Mission (TRMM) for the 2001–2014 period and from International Space Station for the 2017–2020 period. Deaths by lightning flashes were acquired from the annual report of natural calamities for the 2001–2020 period from the Revenue and Disaster Management Department, Government of Odisha. In this study, the spatial pattern of lightning flashes based on LIS data and resultant deaths were assessed using spatiotemporal statistical analysis, including the interpolation method and Sen's slope estimator. The geospatial heat maps of lightning strikes and deaths highlight the spatiotemporal heterogeneity of lightning strikes and induced deaths in Odisha State. Furthermore, statistical analyses demonstrate an apparent increase in lightning strikes in the state as a whole, with particular attention to the Mayurbhanj, Sundargarh, and Keonjhar districts, which had the highest incidence of lightning. Odisha State was hit by more than 10,000 lightning strikes every year between 2000 and 2020, excluding 2001, 2017, and 2018. The results show a moderate correlation (R = 0.61) between lightning strikes and lightning deaths in Odisha State during the analyzed period, which further needs to be investigated with respect to the seasonality of lightning, the locational vulnerability, and temporal risk.

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ORIGINAL PAPER

Recent rainfall variability over Rajasthan, India

Divya Saini[1] · Pankaj Bhardwaj[2] · Omvir Singh[1]

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Abstract
In this study, an attempt has been made to examine the recent rainfall variability by means of daily rainfall data of 33 well-spread stations over dryland ecosystem of Rajasthan in north western India during 1961–2017. For trend analysis, Mann–Kendall, Sen's slope estimator, and simple linear regression test have been used (at 95% confidence level). The results have shown a high interannual variability in rainfall occurrence varying from 277 mm (in year 2002) to 839 mm (in year 1975) with mean of 583 mm over this dryland ecosystem. Most of the rainfall deficit years have occurred with El-Nino years. The mean annual rainfall has shown a marginal non-significant upward trend over the ecosystem. The station-wise mean annual rainfall has revealed a significant rising trend over Barmer, Churu, Ganganagar, Jaisalmer, and Pratapgarh stations. Interestingly, 3-year running average has shown a cyclic pattern of rainfall over dryland ecosystem under the changing climatic conditions. The spatial pattern has exhibited that the mean annual rainfall decreases from east and south east (more than 850 mm) to west and north west (less than 400 mm), which is mainly associated with the presence of Aravalli Mountains spreading north east to south west in central Rajasthan. Remarkably, majority of stations positioned in western parts of dryland ecosystem have shown increasing rainfall trends, whereas some stations located in eastern parts have recorded a non-significant declining trend. The magnitude of significant rising trend has varied from 5.34 mm/year (Pratapgarh station) to 2.17 mm/year (Jaisalmer station). Also, the frequency of heavy rainfall events has shown a positive trend with significant increasing trends over Bharatpur, Jaisalmer, and Pratapgarh stations, whereas Bundi station has shown significant decreasing trend.

1 Introduction

Rainfall and temperature are vital climatic parameters, which have been frequently used to identify the alterations in global climatic conditions (Mayowa et al. 2015; Sa'adi et al. 2019). Global ocean's and land surface temperature trend has revealed a warming of 0.85 °C (ranging between 0.65 and 1.06 °C) during 1880–2012 (IPCC 2014). This rise in the surface temperature could result in changing rainfall patterns globally (Wang et al. 2016). For instance, Trenberth et al. (2007) have observed a rising trend in rainfall over Asia, Australia, northern Europe, North and South America, whereas decreasing trend over the Mediterranean area, southern Asia, Sahel, western and southern Africa. Likewise, Longobardi and Villani (2010) and Altava-Ortiz et al. (2011) have shown a decreasing trend in average annual precipitation over Mediterranean basin and nearby regions. More recently, Adler et al. (2017) have not detected any significant trend in the global mean precipitation; however, a rising trend over tropical oceans and a declining trend over certain mid-latitudes areas has been detected. Nicholson et al. (2018) and Caloiero et al. (2018) have detected a significant downward trend in annual rainfall over West Africa, North Africa, and eastern Mediterranean. Besides, several other attempts have been made to examine the possible influences of changing climate on spatial and temporal rainfall trends (Loo et al. 2015; Mayowa et al. 2015; Xiao et al. 2016; Hu et al. 2017; Sein et al. 2018; Biasutti 2019; Haag et al. 2019; Sa'adi et al. 2019; Gebrechorkos et al. 2019).

Additionally, it has been well-recognized that the warming environment has enhanced the intensity of extreme precipitation more rapidly than mean precipitation (Kharin et al. 2013; Boucher et al. 2013; Berg et al. 2013; Fischer and Knutti 2016; Myhre et al. 2019). Hartmann et al. (2013) have observed that the occurrence of extreme precipitation events has increased over larger land areas than it has decreased in the second half of twentieth century. Therefore,

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Applied Water Science (2022) 12:44
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ORIGINAL ARTICLE

Understanding energy and groundwater irrigation nexus for sustainability over a highly irrigated ecosystem of north western India

Omvir Singh[1] · Amrita Kasana[1] · Pankaj Bhardwaj[2]

Received: 11 August 2021 / Accepted: 15 November 2021

Abstract
This paper examines various features of energy and groundwater irrigation nexus in a highly irrigated ecosystem of north western India. The study is based both on primary and secondary sources of data. Electric tube-wells account for about 72 percent of the total tube-wells population and consume about 40 percent of the total electricity consumption. Power subsidies account approximately 46 percent of the total subsidies disbursed which stimulate the groundwater development. The area irrigated by means of tube-wells has enlarged from 22 to 58 percent. Rice and sugarcane crops are the key consumers of energy both in terms of average energy consumption as well as per hectare of cultivated land. The average use factor of tube-wells is about 7.5 times high during *kharif* than in *rabi* season. Farmers have yielded high economic productivity under all crops with the exception of rice than other states such as Uttar Pradesh, Bihar and Gujarat.

Keywords Energy · Groundwater · Irrigation · Productivity · Farmers · Perception · India

Introduction

Of late, groundwater irrigation has prospered as a key resource for assured supply of water to farmers. Its smoothness and flexibility in relation to other sources of irrigation has resulted in an increasing groundwater withdrawal (Srinivasan and Kulkarni 2014). About 75 percent of rural population and more than 50 percent of the total population in India, directly or indirectly depend on groundwater for their livelihoods (Sharma et al. 2004). Groundwater irrigation infrastructure contributes over 10 percent of India's gross domestic product and 60 percent of irrigation requirements (Shah 2007; Scott and Sharma 2009). It accounts for about 70–80 percent of the farm value output, which is 1.2–3.0 times higher than those of canal irrigation (Dhawan 1995; Sharma et al. 2004). Surprisingly, only 58 percent of the identified groundwater resources have been developed till now, reflecting much scope for their development in India (Shankar et al. 2011). Groundwater development is modest in eastern region (less than 50 percent), whereas its development is more than 150 percent in the major food grains producing states of Punjab, Haryana and Uttar Pradesh. Currently, 972 out of 6881 blocks (groundwater observation units) in India are overexploited (CGWB 2017). In the north western states, which have been an epicenter of the Green Revolution like Haryana and Punjab, groundwater use exceeds natural recharge by 49 percent and 35 percent, respectively (CGWB 2017). In the state of Haryana, Singh and Kasana (2017) have used the data of 893 monitoring wells and observed a decreasing trend in groundwater level with decline of about 32 cm annuum^{-1}. India's groundwater consumption dramatically increased from 50 in 1970 to 250 km^3 in 2010 (Shah 2014). Of 250 km^3, more than 90 percent is used for irrigation alone. Overall, the groundwater irrigated area increased from 12 million ha to 40 million ha in between 1970 and 2010 (MoSPI 2015). Due to the rapid growth in groundwater irrigated area, there has been a sharp growth in the electricity use in the agriculture sector, especially since the 1980s. The abstraction of groundwater for irrigation is closely coupled with access to subsidized or free electricity in the country (Rajan and Ghosh 2019; Sarkar 2020). Supply of free electricity has led to the

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Published online: 11 February 2022

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Omvir Singh

Understanding energy and groundwater irrigation nexus for sustainability over a highly irrigated ecosystem of north western India

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Authors	Omvir Singh, Amrita Kasana, Omvir Bhardwaj
Publication date	2021
Journal	Applied Water Science
Publisher	Springer
Description	This paper examines various features of energy and groundwater irrigation nexus in a highly irrigated ecosystem of north western India. The study is based both on primary and secondary sources of data. Electric tube-wells account for about 72 percent of the total tube-wells population and consume about 40 percent of the total electricity consumption. Power subsidies account approximately 46 percent of the total subsidies disbursed which stimulate the groundwater development. The area irrigated by means of tube-wells has enlarged from 22 to 58 percent. Rice and sugarcane crops are the key consumers of energy both in terms of average energy consumption as well as per hectare of cultivated land. The average use factor of tube-wells is about 7.5 times high during *kharif* than in *rabi* season. Farmers have yielded high economic productivity under all crops with the exception of rice than other states such as …
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Research Article

Standardized precipitation index based dry and wet conditions over a dryland ecosystem of northwestern India

Divya Saini, **Omvir Singh** & Pankaj Bhardwaj

Pages 252-264 | Received 11 May 2020, Accepted 04 Oct 2020, Published online: 07 Dec 2020

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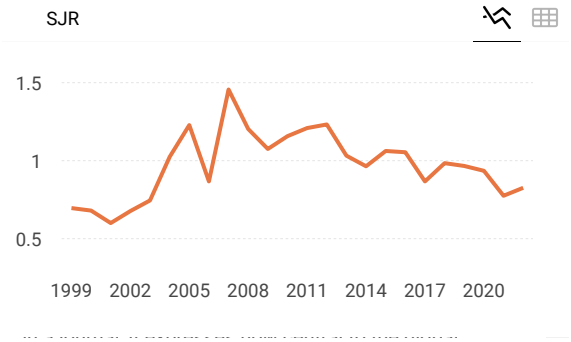
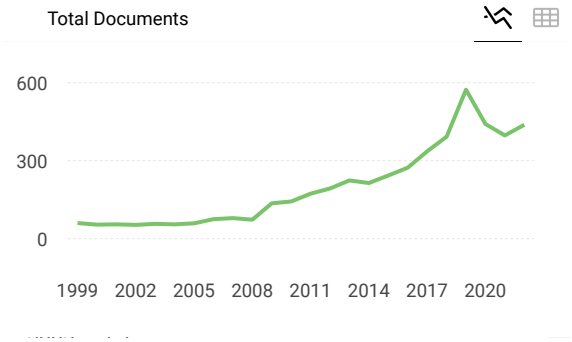
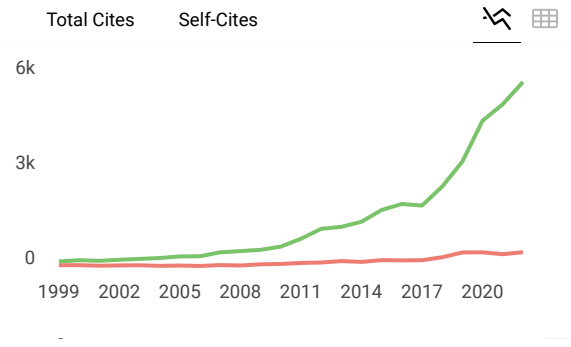
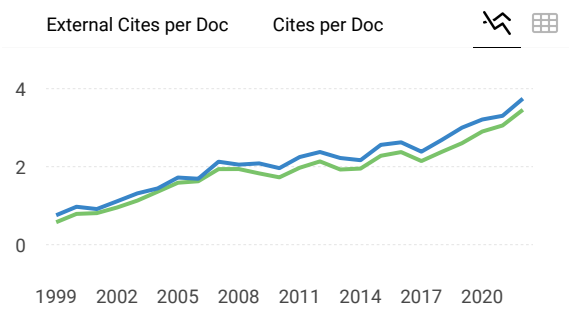
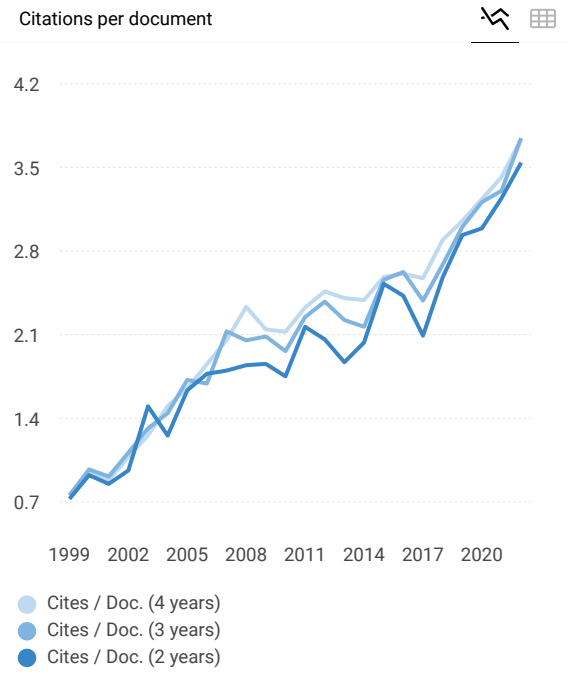


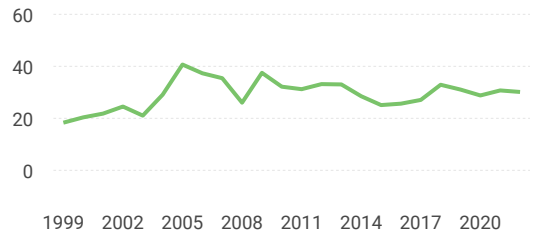








% International Collaboration



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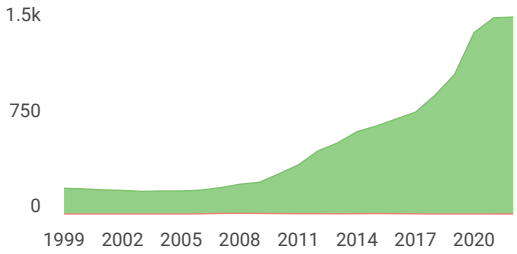

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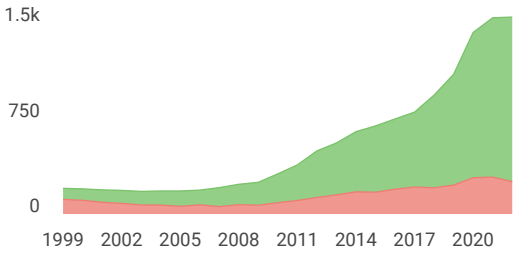

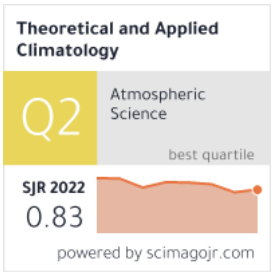

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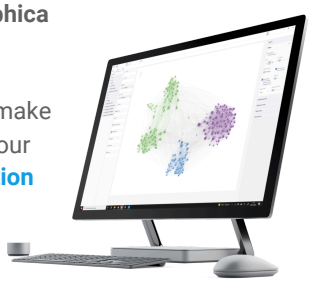

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Omvir Singh

Recent Rainfall Variability Over Rajasthan, India

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Full View

Authors	Divya Saini, Pankaj Bhardwaj, Omvir Singh
Publication date	2021/12
Journal	Theortical and Applied Climatology
Publisher	Springer
Description	In this study, an attempt has been made to examine the recent rainfall variability by means of daily rainfall data of 33 well-spread stations over dryland ecosystem of Rajasthan in north western India during 1961–2017. For trend analysis, Mann–Kendall, Sen's slope estimator, and simple linear regression test have been used (at 95% confidence level). The results have shown a high interannual variability in rainfall occurrence varying from 277 mm (in year 2002) to 839 mm (in year 1975) with mean of 583 mm over this dryland ecosystem. Most of the rainfall deficit years have occurred with El-Nino years. The mean annual rainfall has shown a marginal non-significant upward trend over the ecosystem. The station-wise mean annual rainfall has revealed a significant rising trend over Barmer, Churu, Ganganagar, Jaisalmer, and Pratapgarh stations. Interestingly, 3-year running average has shown a cyclic pattern of …
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Recent rainfall variability over Rajasthan, India
D Saini, P Bhardwaj, O Singh - Theoretical and Applied Climatology, 2022
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Recent Rainfall Variability Over a Dryland Ecosystem of North Western India *
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Omvir Singh

Geoinformatics and analytic hierarchy process based drought vulnerability assessment over a dryland ecosystem of north-western India

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Authors	Divya Saini, Omvir Singh, Tejpal Sharma, Pankaj Bhardwaj
Publication date	2022/6
Journal	Natural Hazards
Publisher	Springer
Description	Drought vulnerability is the extent to which an area is susceptible to damage as well as causing a threat to human society. Drought frequently occurs in the Indian state of Rajasthan, and so far, very little attention has been paid towards its vulnerability assessment. Therefore, the present study focuses on a spatial multi-criteria integrated technique for an all-out drought vulnerability assessment and mapping consisting of geographic information systems (GIS) and analytic hierarchy process (AHP) techniques. The data have been acquired from various secondary sources pertaining to a total of 16 indicators under meteorological (rainfall, temperature and evapotranspiration), hydrological (hydrogeology, elevation, groundwater level, groundwater development and surface water bodies), agricultural (available water holding capacity of soils, land use and slope) and socio-economic (density of population, female-to-male …
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Omvir Singh

Mapping main risk areas of lightning fatalities between 2000 and 2020 over Odisha state (India): A diagnostic approach to reduce lightning fatalities using statistical and …

Authors	Manoranjan Mishra, Tamoghna Acharyya, Celso Augusto Guimarães Santos, Richarde Marques Da Silva, Pritam Chand, Debdeep Bhattacharyya, Sanjay Srivastava, Omvir Singh
Publication date	2022/9/1
Journal	International Journal of Disaster Risk Reduction
Volume	79
Pages	103145
Publisher	Elsevier
Description	This study analyzes the spatiotemporal variation of lightning flashes and lightning strike deaths from 2001 to 2020 among all 30 districts of Odisha State, India. Lightning flash data for the study area were acquired from Lightning Imaging Sensor (LIS) installed aboard the Tropical Rainfall Measuring Mission (TRMM) for the 2001–2014 period and from International Space Station for the 2017–2020 period. Deaths by lightning flashes were acquired from the annual report of natural calamities for the 2001–2020 period from the Revenue and Disaster Management Department, Government of Odisha. In this study, the spatial pattern of lightning flashes based on LIS data and resultant deaths were assessed using spatiotemporal statistical analysis, including the interpolation method and Sen's slope estimator. The geospatial heat maps of lightning strikes and deaths highlight the spatiotemporal heterogeneity of lightning …
Total citations	Cited by 6

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Mapping main risk areas of lightning fatalities between 2000 and 2020 over Odisha state (India): A diagnostic approach to reduce lightning fatalities using statistical and spatiotemporal analyses
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To,

Ref: 4/4/23-SM/KUK-034

4th April-2023

Dr. SP Kaushik
Head of the Department, Geography,
Kurukshetra University, Kurukshetra, Haryana

Respected Sir,

SUB: Proposal for conducting Workshop/seminar on Modern mapping trends and technology for Geographers.

Greetings from NIGMT Foundation!!!
NETRA Institute of Geoinformatics Management and Technologies Foundation (NIGMT Foundation)

Greetings from NETRA Institute of Geo-Informatics !!!

Netra foundation is planning to conduct **workshop/** ***Seminar*** in your prestigious institution. We interact with students on Geo-Informatics Tools and Technology & how it can be helpful for their career prospects.
Who can attend this seminar: This seminar/workshop is helpful for Geographers, Environmentalist, Disaster management and urban planners?
Will cover topic during seminar:

1. Geoinformatics tools and technology
2. Modern mapping trends and their applications
3. Case studies of Govt. policies
4. Career prospects for Students
5. Training and Placements

We NETRA Institute of Geo-Informatics Management & Technologies Foundation, a team of professional having more than 15 years of rich industrial experience across the functions like GIS, Remote Sensing, Lidar Technology, Digital Photogrammetry, UAV/Drone Technologies, Management Solutions (HR, IT, Finance, Banking etc.).

Netra Offers Live Projects Training & 100% Placements Assistance.
Above mentioned programs will be mostly helpful for following domain students:
1.Research Scholars
2.M.A. Geography

NIGMT Foundation
Head of the Department
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Netra Institute of Geoinformatics management & Technologies Foundation, New Delhi, INDIA

Applied Water Science

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
Germany Universities and research institutions in Germany Media Ranking in Germany	Environmental Science Water Science and Technology	Springer Science and Business Media Deutschland GmbH	68

PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION
Journals	21905495, 21905487	2011-2022	Homepage How to publish in this journal e.drioli@itm.cnr.it

SCOPE

Applied Water Science is an open access journal that explores water scarcity solutions from a holistic system oriented viewpoint. It focuses on the sustainable management of natural water resources to the development of the technologies and infrastructure for the production of clean fresh water from natural and waste water. It accepts innovative and sound theoretical research on different water issues, exploring potential alternative water sources via recycling and reuse of wastewater with a focus on arid and semiarid environments and the following topics; water desalination, drinking water treatment, wastewater treatment, water resources planning, investigation and management.

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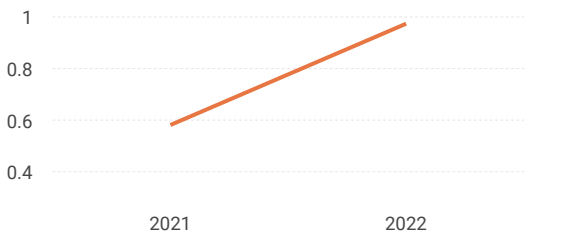

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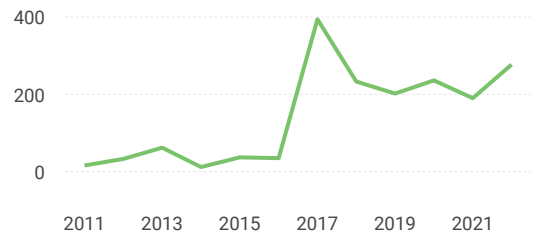

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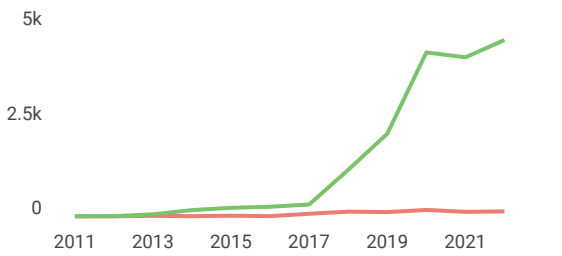

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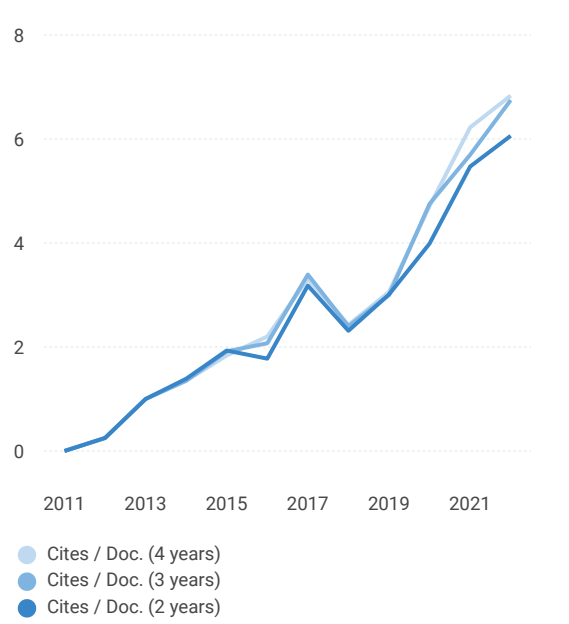

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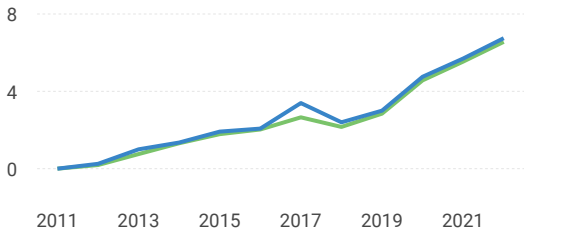

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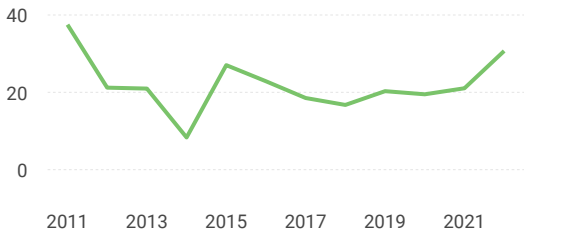

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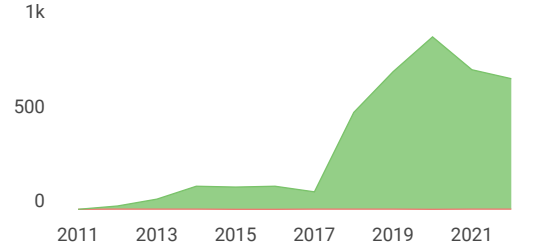

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Geology, Ecology, and Landscapes

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
United Kingdom Universities and research institutions in United Kingdom Media Ranking in United Kingdom	Earth and Planetary Sciences Geology Environmental Science Ecology Nature and Landscape Conservation	Taylor and Francis Ltd.	20

PUBLICATION TYPE	ISSN	COVERAGE	INFORMA
Journals	24749508	2017-2022	Homepa How to publish i this jour gel@inw on.org.r

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Geology, Ecology and Landscapes is a peer-reviewed open access journal publishing research on geology and related ecological chang forming within the tropical regions. Geology, Ecology and Landscapes is the official journal of International Water, Air and Soil Conserva Society (INWASCON). The journal aims to share high-quality research that maps, tracks, and assesses the different drivers of ecosyste conservation to speed up the dissemination of research work and promote discussion between global researchers and practitioners. Geology, Ecology, and Landscapes accepts research articles, review articles, editorial papers and short communications. The Journal operates a double-blind peer review policy. All articles will be made freely and permanently available online through gold open access publication.

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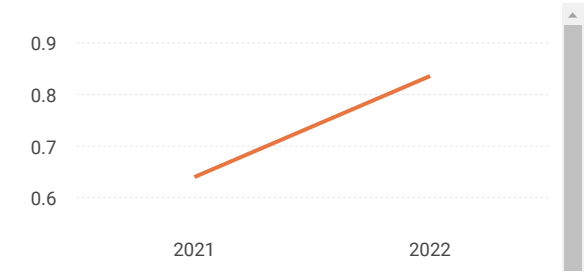

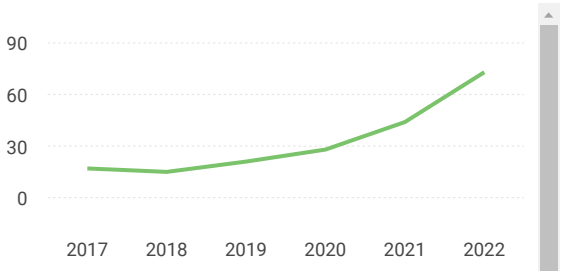

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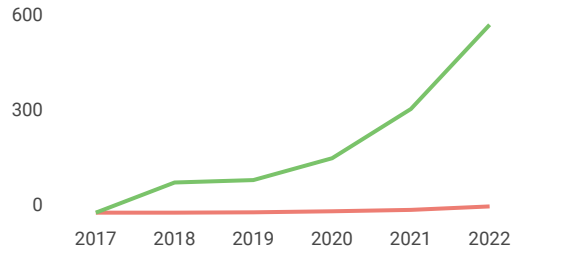

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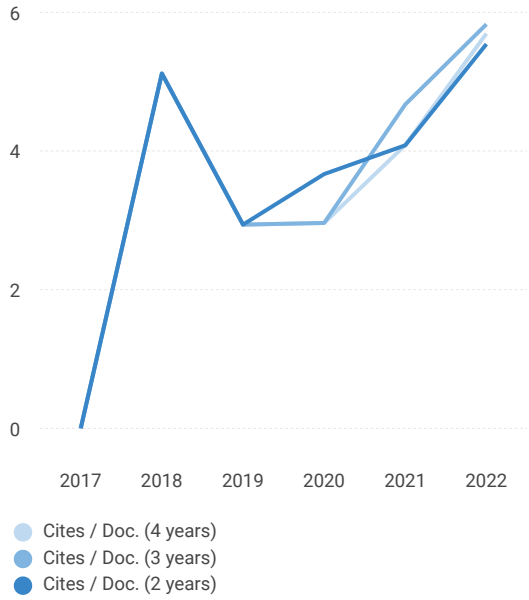

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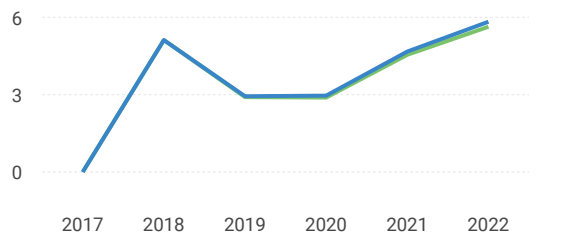

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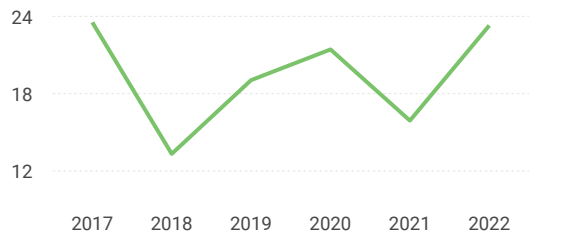

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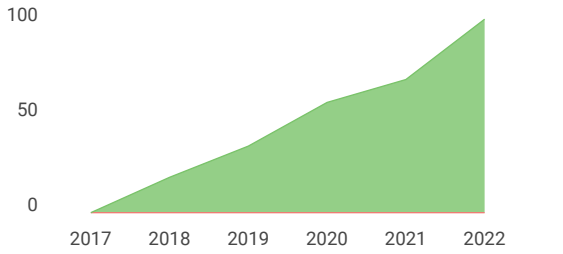

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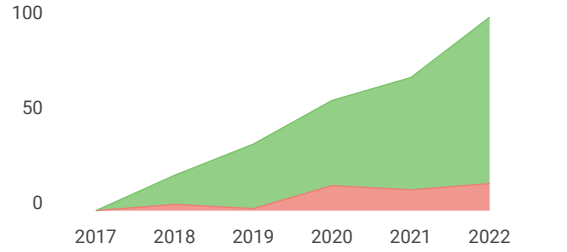

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International Journal of Disaster Risk Reduction

COUNTRY

United Kingdom

Universities and research institutions in United Kingdom

Media Ranking in United Kingdom

SUBJECT AREA AND CATEGORY

Earth and Planetary Sciences
- Geology
- Geotechnical Engineering and Engineering Geology

Social Sciences
- Safety Research

PUBLISHER

Elsevier Ltd.

H-INDEX

70

PUBLICATION TYPE

Journals

ISSN

22124209

COVERAGE

2012-2022

INFORMATION

Homepage

How to publish in this journal

SCOPE

The International Journal of Disaster Risk Reduction (IJDRR) is the journal for researchers, policymakers and practitioners across diverse disciplines: earth sciences and their implications; environmental sciences; engineering; urban studies; geography; and the social sciences. IJDRR publishes fundamental and applied research, critical reviews, policy papers and case studies with a particular focus on multi-disciplinary research that aims to reduce the impact of natural, technological, social and intentional disasters. IJDRR stimulates exchange of ideas and knowledge transfer on disaster research, mitigation, adaptation, prevention and risk reduction at all geographical scales: local, national and international. Key topics:- -multifaceted disaster and cascading disasters -the development of disaster risk reduction strategies and techniques -discussion and development of effective warning and educational systems for risk management at all levels -disasters associated with climate change -vulnerability analysis and vulnerability trends -emerging risks -resilience against disasters. The journal particularly encourages papers that approach risk from a multi-disciplinary perspective.

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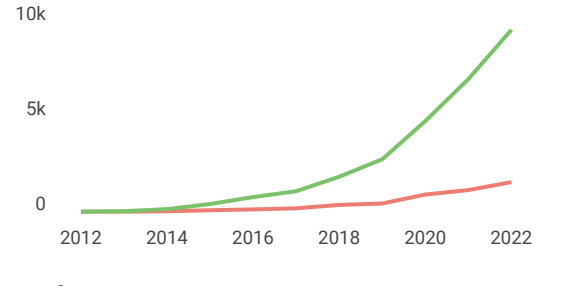

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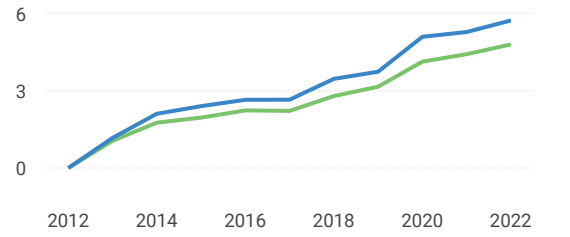

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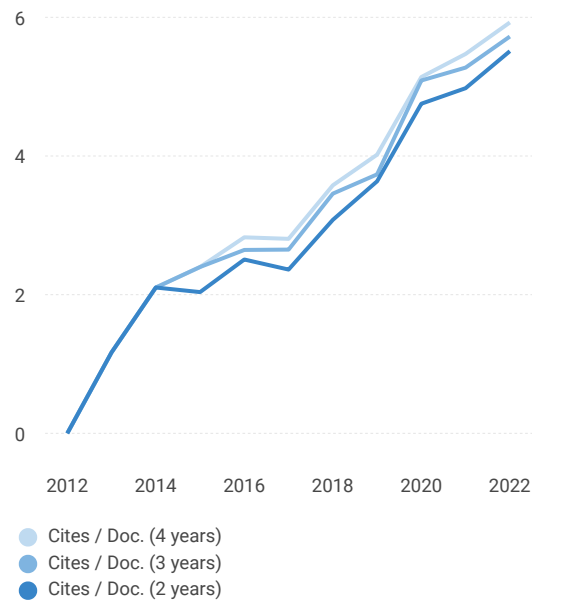

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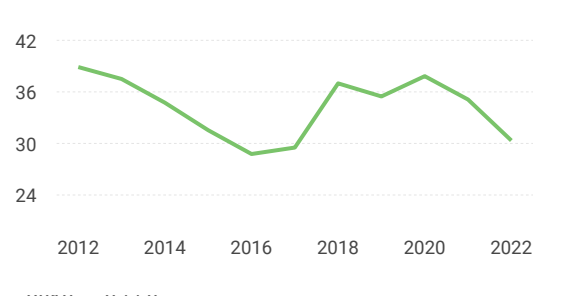

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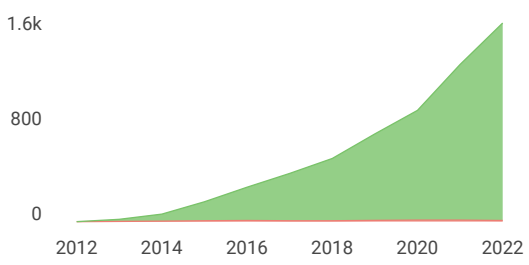

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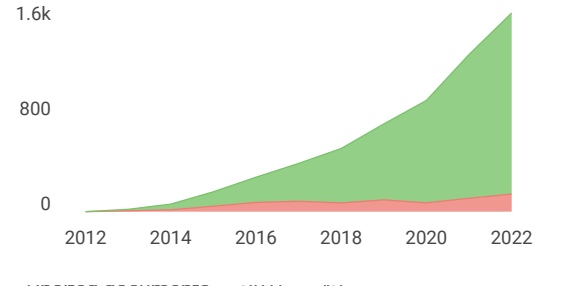

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Natural Hazards

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
Netherlands Universities and research institutions in Netherlands Media Ranking in Netherlands	Earth and Planetary Sciences Atmospheric Science Earth and Planetary Sciences (miscellaneous) Environmental Science Water Science and Technology	Springer Netherlands	127

PUBLICATION TYPE	ISSN	COVERAGE	INFORMA
Journals	15730840, 0921030X	1988-2022	Homepa How to publish i this jour

SCOPE

Natural Hazards is devoted to original research work on all aspects of natural hazards, the forecasting of catastrophic events, their risk management, and the nature of precursors of natural and/or technological hazards. Although the origin of hazards can be different sou and systems (atmospheric, hydrologic, oceanographic, volcanologic, seismic, neotectonic), the environmental impacts are equally catastrophic. This circumstance warrants a tight interaction between the different scientific and operational disciplines, which should enhance the mitigation of hazards. Hazards of interest to the journal are included in the following sections: general, atmospheric, climatological, oceanographic, storm surges, tsunamis, floods, snow, avalanches, landslides, erosion, earthquakes, volcanoes, man-ma technological, and risk assessment. The interactions between these hazards and society are also addressed in the journal and include governance, disaster response and preventive actions such as spatial planning and remedial measures.

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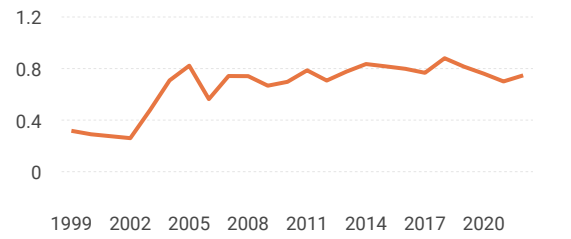

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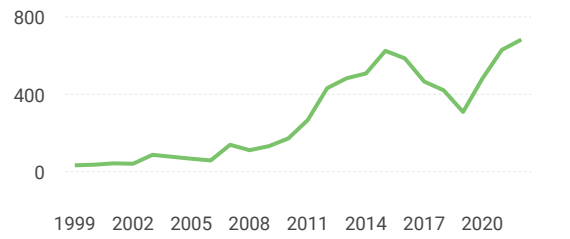

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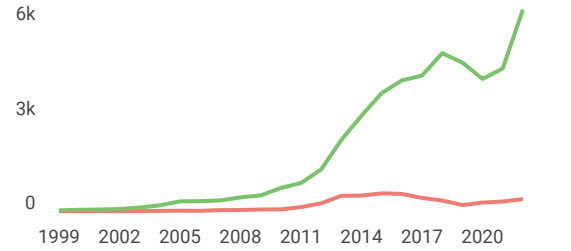

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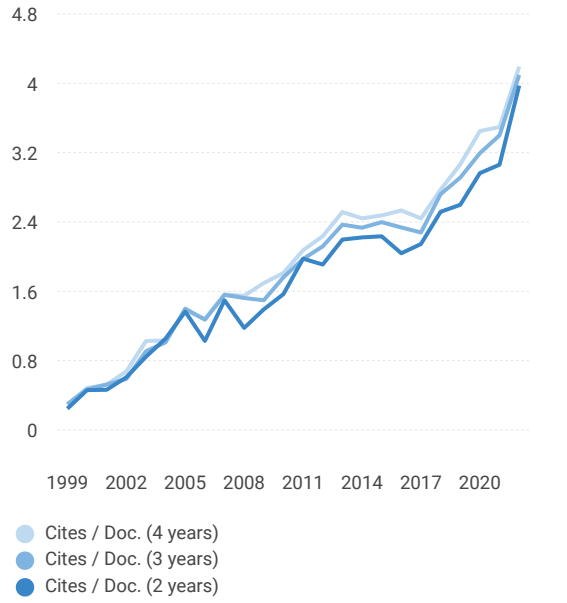

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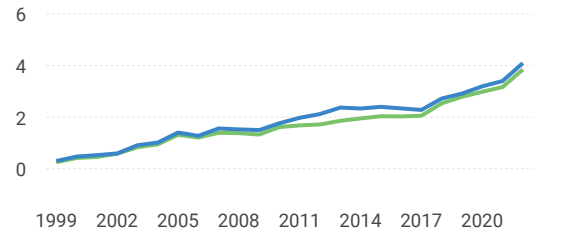

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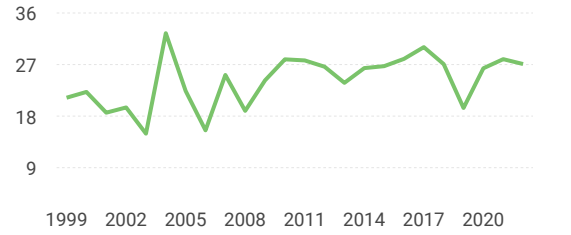

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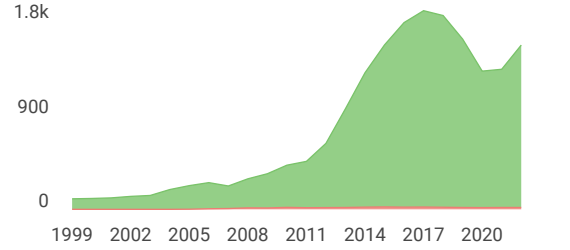

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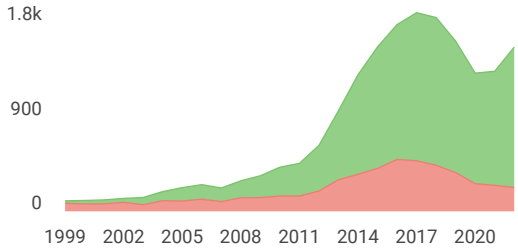

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Subject: Consent for working as Co-supervisor for the PhD work entitled "Climate change vulnerability assessment of rainfed agriculture systems of Haryana using process-based model"

Madam,

With reference to the above cited subject, it gives me immense pleasure to confirm my association with you to work as co-supervisor for guiding the PhD work "Climate change vulnerability assessment of rainfed agriculture systems of Haryana using process-based model" proposed by Mr. Hemant Kamboj. The proposed topic is close to my professional experience and I will be happy to extend guidance to implement remote sensing and GIS related inputs along with testing and running of process-based vegetation models to achieve the objectives of the proposed PhD.

19/06/2021

(Manoj Kumar)

To
Prof. Dr. Smita Chaudhary
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Chapter 5
Soil Carbon Pools Under Different Farming Practices

Hement Kumar, Pooja Arora, Ganpat Louhar, Vipin Kumar, and Smita Chaudhry

Abstract Soil organic carbon (SOC) stocks constitute a major portion of the global C stocks in tropical regions. It is an important component to contribute towards soil structure, soil fertility, crop productivity, and soil sustainability. A field experiment was conducted in 2016–17 to study the effect of different farming systems on various organic carbon pools in the soil. Surface (0–15 cm) and subsurface (15–30 cm) soil samples were taken from organic (O_F) as well as conventional fields (C_F) of wheat, sugarcane, mustard, and barseem from two districts of Haryana state. Results revealed that organic fields had higher very labile carbon pool, active pool, and microbial biomass carbon as compared to conventional fields. Surface soils were observed to be repositories of higher organic carbon pools as compared to subsurface soils in all fields. The organic fields of mustard showed the highest very labile SOC pool and microbial biomass carbon. Sugarcane was observed to have the highest active carbon pool as compared to other crop fields. Soil microbial biomass carbon increased from traditional to organic farming, which explains the high microbial activity of the soil in organic farming practices.

Keywords Organic farming · Carbon pools · Microbial biomass carbon · Haryana

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1 Introduction

The global concentrations of atmospheric CO_2 have passed 410 ppm and will continue to rise (NASA 2020). This increase in atmospheric concentrations of greenhouse gas (GHG) is a clear indication of anthropogenic impact on the climate (IPCC 2014). Agriculturally induced methane and nitrous oxide contribute toward climate change, but soil carbon sequestration is a crucial step in agriculture to reduce these emissions (UNFCCC 2008). Soil carbon sequestration can be described as the process of storing carbon dioxide (CO_2) from the atmosphere into the soil. It is achieved through the addition of residues of various crops and various organic solids in the soil. The sequestration occurs in a form which is not instantly and easily re-emitted back to the atmosphere. This storage or "sequestration" of carbon helps in offsetting emissions which accrue from combustion of fossil fuels and other such activities which are responsible for carbon emissions. This process simultaneously enhances soil quality and long-term productivity. Soil carbon sequestration can be efficiently accomplished and improved by applying management systems that incorporate high levels of biomass to soil, create minimal soil disturbance, preserve soil and water, strengthen soil structure, and promote soil microbial activity (Syswerda et al. 2011). Soil organic carbon (SOC) is an important measurable component of soil organic matter (SOM). It contributes significantly to soil structure, soil fertility, crop production, and soil sustainability (Gelaw et al. 2014). Different studies have reported varied amounts of organic carbon stocks in the soils of India (Table 5.1). These stocks constitute about 3% of the global C stocks of the tropical regions (Velayutham et al. 2000). A small increase in soil organic carbon in large areas under agricultural and pastoral can significantly reduce atmospheric carbon dioxide. For this reduction to be more efficient and long-lasting, soil organic matter has to be more stable or resistant to degradation.

Most of soil organic matter and hence the amount of SOC are found near the soil surface. Storage of organic carbon content in the topsoil is determined by the interactions among topography, climate, soil type, and other aspects of crop management which further includes crop rotation, fertilization, tillage (Peigne et al. 2007), irrigation, mulching, and manuring. Also, sustainability of agricultural production systems depends on soil quality which gets affected by the characteristics and

Table 5.1 Estimated Organic carbon stocks in soils of World and India

Depth	SOC density/stock/pool (Pg)	Region	References
0–30 cm	684–724	World	Batjes (1996)
0–150 cm	2376–2456	World	Batjes (1996)
44–186 cm	24.3	India	Gupta and Rao (1994)
0–30 cm	9.55	India	Bhattacharyya et al. (2000)
0–150 cm	29.92	India	Bhattacharyya et al. (2000)
0–30 cm	21	India	Velayutham et al. (2000)
0–150 cm	63	India	Velayutham et al. (2000)
1 m to 1 km	6.8	India	

features of the farming system encompassing strategies such as cultivation with a single crop for a prolonged period, tillage, and removal of the crop residues. These factors are also responsible to accelerate the rate of decomposition of SOM which accounts for 20–67% of soil C loss (Yang et al. 2019). It further leads to soil degradation such as diminished or degraded physicochemical and biological properties of the soil (Lal 2014).

Change in land use pattern has also been reported as one of the major causes of soil degradation and loss of soil organic carbon as carbon dioxide. Guo and Gifford (2002) have reported 42% of SOC loss due to change from forest land to crop and 59% loss of SOC due to changes from pasture to crop land through meta-analysis of data on stocks of soil carbon and land use land cover changes. Therefore, it is necessary to increase the storage of soil carbon either by enhancing the carbon pools or by reducing the emissions through the decomposition of organic matter to achieve the goals of sustainable agricultural production and better management of the environment.

The potential of C sequestration in cropland is reported to be about twice than that in managed pastureland; however, the global surface area under cropland is less than half. Gazdar (2020) reported that 0.4%improvement in soil organic carbon could sequester ≈1 gigatonne (GT) carbon per year over a period of the next three decades, which is equivalent to 10% of global anthropogenic emissions. Several management practices have been suggested to enhance SOC contents in agricultural lands which include organic amendments, manures, cover crops, crop rotations in diversified form, application of biochar and biofertilizers, reduced use of chemical pesticides and insecticides, no tillage, crop residue management, integrated pest and nutrient management, agroforestry, organic farming, and conservation agriculture. Conservation agriculture is in practice in about 180 mha (million hectares) all over the world (Kassam et al. 2017) of which Indian contribution accounts for 1.5 mha (Jat et al. 2012). Conservation agriculture is a farming system which emphasizes minimum soil disturbance through no-till farming, maintaining permanent soil cover in the fields by adding crop residues or retaining live mulch intact and diversifying the plant species through crop rotation or intercropping. The benefits of conservation agriculture include enhanced biodiversity, efficient above- and belowground biological processes, gradual increase in SOM, increased water retention, infiltration and use efficiency, appropriate soil moisture conditions, better nutrient management and their utilization by soil biota, suppression of weed species, and prevention of erosion of topsoil. It also reduces the cost factor associated with the use of mechanical instruments, fuel, labor, and time required to till the fields. Hence, conservation agriculture ultimately leads to sustainable crop production system or sustainable intensification.

SOC content has been reported to persist in organic farming systems under diversified crop rotations, intercropping, and organic fertilizers' application. However, it decreases under systems of conventional farming (C_F) with the application of inorganic or chemical fertilizers. Under organic farming systems, the basic concept is rotation of components in the field, which are built on three main key elements: (1) the avoidance of synthetic fertilizers and pesticides; (2) the use of farmyard manure

to attain high soil fertility; and (3) the reduction of high-energy-consuming feedstuffs (Fließbach et al. 2007). Agricultural practices in organic farming (O_F) systems are said to benefit various components of agroecosystems such as soil, surface and groundwater, biodiversity, and air (FAO 2003). Crop productivity in O_F is dependent on soil nutrient transformation mechanisms. Thus, soil quality is a crucial issue in O_F, and SOC is a key component of this system.

SOC was shown to be stable in an O_F system that included ley-based crop rotations and organic fertilizer application, whereas it declined in C_F with mineral fertilization (Gadermaier et al. 2011). Fließbach et al. (2007) and Munro et al. (2002) also observed organically managed top soils to have a higher percent amount of organic matter as compared to conventional management. The reason may be the addition of higher quantity of organic matter in O_F. It further leads to an additional accumulation of SOC (Drinkwater et al. 1998).

Based on the length of residence, soil organic carbon can be classified into five pools: less labile, labile, highly labile, active pool, and passive pool (Parton and Rasmussen 1994). Under soil organic pools, the active pools include labile elements that provide available meal for microorganisms and are altered by fresh residue inputs, making them an ideal indication of soil quality (Joshi et al. 2017). The SOC fraction with the fastest turnover rates is the labile C pool. Despite the fact that this pool of SOC is critical for crop productivity, its oxidation quickly adds CO_2 to the atmosphere, contributing to the process of global warming (Majumder et al. 2008). The very recalcitrant or passive pool is transformed quite slow by microbes and thus cannot be regarded a good indication of soil quality and production (Weiler and Naef 2003; Sherrod et al. 2005; Majumder et al. 2008).

Soil microorganisms play a significant role in regulating soil organic matter trends and nutrient availability (Six et al. 2006). Microbial biomass in soil and their interactions are indeed the markers of biological soil fertility, which OF greatly improves (Fließbach et al. 2007). Excessive use of chemicals such as herbicides and pesticides in C_F practices can severely alter the structure and function of microbial communities residing in soil, modify the terrestrial ecosystems along with substantial changes in soil quality and fertility (Pampulha and Oliveira 2006). Moreover, some organic additions have the potential to boost soil microbial activity and improve biodiversity (García-Orenes et al. 2010). This research was designed to compare various soil carbon pools under conventional and organic farming systems in various crops.

2 Materials and Methods

2.1 Study Sites and Farming Practices

Four different farmer's fields, in villages Matak Majri, Nanhera, and Pathera in Karnal and village Mehra in Kurukshetra districts of Haryana, India were selected for this study. Out of four farmers, three farmers have been practising organic

Table 5.2 Farming systems under study

S. no.	Farming system	No. of years	Crop
1	Organic (O_F1)	3	Wheat
2	Organic (O_F2)	3	Berseem
3	Organic (O_F3)	3	Mustard
4	Organic (O_F4)	8	Sugarcane
5	Conventional (C_F1)	–	Wheat
6	Conventional (C_F2)	–	Berseem
7	Conventional (C_F3)	–	Mustard
8	Conventional (C_F4)	–	Sugarcane

farming for the last 3 years, while for the fourth farmer, this span was 8 years (Table 5.2). Along with organic farming, all the farmers were also practicing conventional farming on the remaining field. Soils of the fields were alluvial with clay loam texture. Wheat, berseem, mustard, and sugarcane were grown by farmers hailing from the villages of Matak Majri, Nanhera, Pathera, and Mehra, respectively, under both organic and conventional systems.

All four organic and conventional fields were tilled as per the recommended package practice every year before cropping. In all organic fields, 12 t ha^{-1} dried cow manure was applied prior to seeding Kharif season crops, while prescribed fertilizer doses were applied in conventional fields. All the fields were irrigated with ground water. The crops were grown using organic agricultural practices, with no herbicides used. Mechanical weeding was done three times during the stages of emergence and leaf development. Inorganic fertilizers and insecticides are used in conventional systems.

2.2 Soil Sampling and Analyses

Soil samples were taken in bulk in March 2017, after 6 months of farmyard manure application. These samples were collected from all the eight fields. Samples were taken from two different depths 0–15 cm and 15–30 cm. They were then air-dried at a constant room temperature (25°C). After drying, the samples were then sieved (2 mm) to eliminate coarser soil particles. In order to limit experimental error, four replicates for every sample were analyzed in the laboratory. Soil bulk density was determined with the core cylinder method (Blake and Hartge 1986). In a soil suspension with deionized water (1:2.5, w/v), the pH (Guitián and Carballas 1976) and 1:1 suspension in water EC (Smith and Doran 1996) of dried samples at 60°C for 24 h was determined. The modified Walkley–Black method reported by Chan et al. (2001) was used to separate total SOC into various C pools 6.0, 9.0, and 12.0 M H_2SO_4 (Ghosh et al. 2010). It entailed varying the quantities of 1/6 M dichromate solution and H_2SO_4. The soil was kept at room temperature for 1/2 h to react with the dichromate-acid mixture. Total SOC was thus allowed to divide into four pools

based on their stability Chan et al. (2001). SOC fraction oxidized by 6.0 M H_2SO_4 is considered as very labile pool, the difference between SOC fraction which is oxidizable by 9.0 M H_2SO_4 and that by 6.0 M H_2SO_4 estimates the labile pool, and the difference between SOC fraction which is oxidized by 12.0 M H_2SO_4 and that oxidized by 9.0 M H_2SO_4 estimates the less labile pool (Chan et al. 2001). The active pool was generated from the highly labile and labile pools. Estimation of soil microbial biomass C was done with fresh moist soil samples by chloroform-fumigation-extraction according to Vance et al. (1987). Stocks of organic carbon (Mg ha^{-1}) in each extracted SOM fraction of each sampling layer (0–15 cm and 15–30 cm depth) were calculated using the below equation (Wang and Dalal 2006):

$$\text{Carbon stock} = \frac{\text{SOC} \times \text{BD} \times d \times \left(1 - 2\,\text{mm}\ \%\right)}{10}$$

where:

SOC: content of soil organic carbon (gkg^{-1}),
d: thickness (cm) of the soil layer
2 mm: fractional percentage (%) of soil mineral particles >2 mm in size,
BD: soil bulk density (Mgm^{-3}).

Statistical analyses were done using Microsoft excel.

3 Results and Discussion

3.1 EC, pH, and Bulk Density

Soil sample analysis for physicochemical properties was done for all the soil samples. In all the agro-system, EC significantly decreased with increasing depth (Table 5.3). The same trend was recorded by Ozlu and Kumar (2018). All the conventional farming systems recorded higher EC than O_F. Among the organic fields, the highest EC was recorded under wheat field (194 μS). Higher EC values in C_F are most likely connected with high salt deposition from inorganic fertilizer use (Velmourougane 2016). Inorganic fertilizers contain a higher concentration of accessible nutrients. These nutrients get dissolved into various types of ions in the soil, resulting in a higher electrical conductivity (Sihi et al. 2017). Under different agro-system, pH significantly increased with increase in soil depth. pH was less under O_F fields as compared with C_F of the same systems except for berseem fields with the lowest pH (7.3). Reeves and Liebig (2016) also observed the increase in the pH as depth increases because acidification is most pronounced near the soil surface. Bulk density of the soil gets affected by field management practices and integration of green manure. However, no variation in bulk density under varying soil depths was found in all the farming

Table 5.3 Depth-wise changes in different soil properties under different farming systems

Crop	Farming system	Depth (cm)	EC (μS)	pH	BD (gm cm^{-3})
Wheat	Organic	0–15	188.2 ± 5.74	7.6 ± 0.40	1.22 ± 0.01
		15–30	169.3 ± 3.95	7.64 ± 0.11	1.2 ± 0.004
	Conventional	0–15	194.0±4.21	7.9±0.15	1.24±0.02
		15–30	183.8±4.50	7.92±0.17	1.23±0.02
Barseem	Organic	0–15	162.8±7.81	8.2±0.17	1.2±0.02
		15–30	153.8±3.78	8.3±0.26	1.21±0.01
	Conventional	0–15	163.7 ± 23.2	7.3 ± 0.26	1.23 ± 0.01
		15–30	152.0 ± 16.3	7.9 ± 081	1.23 ± 0.01
Mustard	Organic	0–15	187.5 ± 1.73	8.1 ± 0.55	1.19 ± 0.009
		15–30	169.6 ± 11.6	8.3 ± 0.40	1.21 ± 0.008
	Conventional	0–15	190.1 ± 12.0	8.4 ± 0.23	1.28 ± 0.02
		15–30	185.2 ± 3.95	8.4 ± 0.35	1.26 ± 0.02
Sugarcane	Organic	0–15	132.9 ± 26.6	8.4 ± 0.1	1.21 ± 0.02
		15–30	109.8 ± 9.46	8.7 ± 0.1	1.23 ± 0.028
	Conventional	0–15	153.5 ± 11.3	8.5 ± 0.1	1.22 ± 0.01
		15–30	138.1 ± 15.0	8.7 ± 0.1	1.22 ± 0.02

systems. In all of the conventional fields, bulk density was reported to be higher than that in organic fields. According to a number of studies (Khaleel et al. 1981; Pagliai 1988; Novara et al. 2019), it has been suggested that organic matter is responsible to decrease the bulk density due to a drop in denser mineral component, as well as an increase in aggregation and soil pores. Hence, it is the improvement and enhancement in soil structure by appropriate organic manures addition which is responsible for decreasing bulk density in the organic fields. Sheeba and Kumarswamy (2001) also observed a similar trend of decreasing bulk density with the increasing addition of organic matter. On the other hand, the reason for increment in bulk density under fields of conventional farming can be attributed to soil structure deterioration with the application of chemical or synthetic fertilizers. The deterioration of soil structure may also be due to the less retention of crop residues into the soil. The trend of increasing bulk density with the application of inorganic fertilizers has also been reported by Tadesse et al. (2013).

3.2 Different SOC Pools

In all farming systems, different pools of SOC were observed to be decreasing significantly with depth increment (Table 5.4). Santos et al. (2012) also observed higher soil organic carbon at 0–15 cm soil depth than 15–30 cm under organic farming. The same trend was also recorded by Jacinthe et al. (2011). These findings contradicted previous studies (Leifeld and Fuhrer 2010; Marriott and Wander

Table 5.4 Depth-wise distribution of different pools of SOC (mg kg^{-1}) under different farming systems

Crop	Farming system	C_{LL}		C_L		C_{VL}	
		0–15 cm	15–30 cm	0–15 cm	15–30 cm	0–15 cm	15–30 cm
Wheat	Organic	3.3 ± 0.1	0.7 ± 0.02	4.0 ± 0.22	3.3 ± 0.13	6.6 ± 0.45	6.3 ± 0.56
	Conventional	9.2 ± 0.89	8.4 ± 0.77	4.0 ± 0.31	3.4 ± 0.26	3.5 ± 0.29	2.3 ± 0.33
Barseem	Organic	6.1 ± 0.35	2.3 ± 0.17	6.6 ± 0.23	6.5 ± 0.29	2.7 ± 0.12	1.5 ± 0.089
	Conventional	5.3 ± 0.68	5.2 ± 0.87	11.5 ± 1.2	9.4 ± 1.5	12.7 ± 2.3	2.9 ± 0.98
Mustard	Organic	3.0 ± 0.97	0.9 ± 0.06	3.4 ± 0.75	2.6 ± 0.83	12.3 ± 3.2	6.9 ± 1.1
	Conventional	18.9 ± 3.5	18 ± 2.6	11.6 ± 1.8	10.9 ± 1.5	3.5 ± 0.91	2.8 ± 0.81
Sugarcane	Organic	15.9 ± 3.5	10.5 ± 1.5	3.9 ± 0.99	1.9 ± 0.84	13.4 ± 2.5	10.0 ± 1.9
	Conventional	16.5 ± 4.6	13.4 ± 2.6	4.0 ± 1.7	1.4 ± 0.87	1.1 ± 0.09	0.8 ± 0.1

SOC soil organic carbon, C_{LL} less labile carbon, C_L labile carbon, C_{VL} very labile carbon

2006) that found significant increase in organic carbon content of the soil with organic farming. However, in study sites with equivalent crop rotation, Leifeld and Fuhrer (2010) discovered that there is no consistent difference in soil organic carbon between different farming systems and cautioned against drawing hasty conclusions about the effects of organic farming on SOC stock restoration. Variations in research time and soil depth tested could potentially contribute to these contradictory findings. Organic fields of different farming systems recorded low less labile carbon rather than C_F fields of the same systems. The highest labile carbon was recorded under conventional mustard from 0 to 15 cm depth (11.6 mg kg^{-1}) which is 241% higher than O_F system of that crop. Organic fields of wheat and sugarcane didn't show significant change in labile carbon content compared to conventional of the same. According to Herencia et al. (2008), plots adopting organic treatments had a numerical improvement in SOC at the conclusion of the conversion phase; however, it is only after four to five crop cycles that the SOC rise became significant. All O_F fields of different farming systems recorded higher very labile carbon rather than C_F fields of the same systems except berseem which is 370% lower than the organic field of that system because higher biomass increases higher microbial activity which further helps in increase in higher labile organic carbon (Xavier et al. 2006). The difference in less labile carbon was significant between organic and conventional farming systems ($p < 0.05$).

3.3 Microbial Biomass Carbon (MBC)

In all fields, microbial biomass carbon significantly decreased with increasing soil depth (Table 5.5). Jacinthe et al. (2011) also reported the trend of decrease in MBC as increase in depth. These investigations (Castellazzi et al. 2004; Potthoff et al. 2006; Babujia et al. 2010) show a decrease in soil microbial biomass as depth increases. Under sugarcane and mustard organic fields, from 0 to 15 cm depth, higher MBC was recorded than their conventional counterpart. The differences in microbial biomass carbon were however not significant between organic and conventional farming systems ($p>0.05$) of barseem and wheat. In wheat, higher MBC was recorded in the conventional field than that of organic (0.24 μgC gm^{-1}). Considerable changes in soil microbial markers can be observed in 2–3 years of organic farming (Jacinthe et al. 2011). O_F of mustard had the highest MBC, i.e., 55% more than sugarcane and 53% more than wheat as well as berseem. For O_F, the persistent input of organic residues may favor the increase of the soil microbial biomass (Xavier et al. 2006). Organic fertilizer treatment significantly enhanced soil microbial biomass C on sampling day. Despite the fact that similar amounts of organic C were provided, this rise was much higher in the manure treatments than in the compost treatments in the majority of cases (Jannoura et al. 2014).

Table 5.5 Depth-wise changes in MBC (μgC gm^{-1}), C stock (Mg ha^{-1}) and active carbon pool under different farming systems

Crop	Farming system	MBC (μg C gm^{-1})		C stock (Mg ha^{-1})		Active pool (mg kg^{-1})	
		0–15 cm	15–30 cm	0–15 cm	15–30 cm	0–15 cm	15–30 cm
Wheat	Organic	0.21 ± 0.07	0.16 ± 0.03	6.0 ± 0.99	1.3 ± 0.05	10.6 ± 1.1	10.6 ± 1.2
	Conventional	0.24 ± 0.08	0.18 ± 0.02	17.1 ± 0.13	15.5 ± 1.1	7.5 ± 0.98	5.7 ± 0.55
Barseem	Organic	0.21 ± 0.02	0.13 ± 0.09	11.0 ± 0.52	4.2 ± 0.21	9.3 ± 0.99	8.2 ± 0.56
	Conventional	0.21 ± 0.05	015 ± 0.05	9.8 ± 0.54	9.6 ± 0.39	24.2 ± 2.1	12.3 ± 1.5
Mustard	Organic	0.45 ± 0.10	0.10 ± 0.04	5.4 ± 0.24	1.6 ± 0.15	15.7 ± 1.9	9.5 ± 0.89
	Conventional	0.26 ± 0.04	0.23 ± 0.08	36.3 ± 1.4	34.0 ± 1.1	15.1 ± 1.1	4.8 ± 0.56
Sugarcane	Organic	0.20 ± 0.04	0.11 ± 0.08	29.3 ± 1.2	19.1 ± 1.69	15.3 ± 1.4	13.9 ± 1.56
	Conventional	0.10 ± 0.05	0.02 ± 0.01	30.2 ± 1.2	24.5 ± 1.9	5.1 ± 0.69	2.2 ± 0.87

MBC microbial biomass

3.4 Carbon Stock

C stock significantly following the patterns of labile carbon pools decreased with depth increment (Table 5.5). SOC is regulated by soil depth in addition to treatments (Joshi et al. 2017), and decreased SOC with increasing soil depth has been found by numerous researchers (Venkatesh et al. 2013; Yang et al. 2014). Bhattacharyya et al. (2011) revealed that fertilization impacted SOC up to a depth of 30 cm, but had no effect in the 30–45 cm soil layer. It could be associated with lesser rhizobium activities, lower rhizode position, and less biomass return to subsurface layers. Under O_F at 0–15 cm soil depth sugarcane recorded the highest C stock (29.3 mg ha^{-1}) followed by berseem (11.0 mg ha^{-1}), (wheat 6.0 mg ha^{-1}), and mustard (5.4 mg ha^{-1}). The reduced C stock in lower layers is due to low downward movement of crop residue and compacted soil layers (Liangang et al. 2020). Litter, crop residues, organic or green manures, and spontaneous vegetation over the soil surface provided additional C to the first layer, resulting in a significant rise in SOC content. During the first 5 years after converting to organic farming, the rate of rise in SOC was slower. This indicates that pruning crop residues and other organic inputs in the form of weed biomass that were not absorbed into the soil will take around 5 years to become part of the soil. The SOC exhibited a logarithmic growth in the surface soil layer after the first 5 years, but not in the deeper layer (Novara et al. 2019). Under O_F systems lower C stock was recorded than C_F practices. This may be attributed to the lesser duration of O_F being in practice, tillage practices, higher microbial activity with input of organic fertilizer, and other climatic conditions (Hábová et al. 2019). Also, the difference in carbon stocks of soil in O_F and C_F systems was observed to be significant ($p < 0.05$).

3.5 Active Pool of Carbon

In all the studied fields active pool significantly decreased with increasing depth following the patterns of very labile carbon pool (Table 5.5). The application of easily decomposable crop residues increased the active SOC pools in the topsoil (Parihar et al. 2018). As effective root systems are mostly found in the plow layer (0–15 cm), and litter breakdown of residues and stubble material occurs in the topsoil, our findings imply that the 0–15 cm soil depths have higher SOC content than the 15–30 cm soil depths. Some researchers have found higher SOC levels in the top soil layer in agricultural land (Chivenge et al. 2007; Singh et al. 2015). All O_F in different farming systems have high active pool value than the C_F of same crop except berseem. Among O_F systems active C pool was highest in mustard (15.7 mg kg^{-1}) followed by sugarcane (13.9 mg kg^{-1}), wheat (10.6 mg kg^{-1}), and berseem (9.3 mg kg^{-1}). Active pool contains the easily degradable organic carbon (labile, very labile), as transitional practices from C_F

to O_F clearly impact the size of the soil microbial biomass which leads to the higher active pool under O_F (Santos et al. 2012). However, the differences in active pools of carbon between O_F and C_F systems in the present study were not significant ($p > 0.05$).

4 Conclusion

Current status and changes in soil properties and organic carbon pools as response to agronomic practices are extremely important today. The stocks of soil organic carbon along with agricultural practices, soil structure and texture, soil depth, organic and chemical fertilizers input, and climatic conditions determine the status of soil as a sink or source of carbon. The problems associated with conventional farming are attracting the concerns of farmers, researchers, and policymakers towards organic farming. SOC serves as a significant component for maintaining soil quality and productivity. The various strategies of conservational and organic farming such as conservation tillage, persistent cover crops, mulching, efficient nutrient cycling, composting, manuring, and sustainable soil and water management practices can enhance soil quality and potentially increase soil carbon sequestration.

The present study also concluded that the very labile carbon pool was higher in O_F soil as compared to C_F soil because in organic farming the micro flora and fauna are not disturbed much, but in conventional farming, the microbial activity is altered. Higher the number of years of organic practice, higher will be the microbial activity which would further increase the sequestration of carbon in the soil. Also, organic manures and compost applications or the strategies of organic farming have reported to increase more of the SOC content as compared to the similar amount of inorganic or synthetic fertilizer applications (Chai et al. 2015; Gregorich et al. 2001).

In the present scenario, where we are struggling with the problem of climate change and where agriculture is becoming a source rather than a sink of greenhouse gases, we have to put more efforts in the agricultural sector. This sector can be a promising field as a mitigation strategy of climate change. Even organic farming can provide us with financial gains and prestigious status in agribusiness. It can offer many benefits such as sequestering more of soil carbon, mitigating climate change, enhancing soil quality and prolonged productivity, and improving the economic status of a country in global agribusiness. The percentage of SOC content has come down to 0.3–0.4% in India whereas it should be between 1 and 1.5% (Jaisankar 2014). The main reasons for the degradation can be attributed to ever-increasing atmospheric temperatures, soil degradation, and conventional farming practices such as extensive soil tillage, poor land and crop management, and inappropriate use of fertilizer. These factors also accelerate soil erosion and loss of soil fertility and productivity. There needs to be a massive reduction in dependency on chemical fertilizers and

pesticides and more use of biopesticides and organic fertilizers. Conservation agriculture over conventional agriculture should thus be implied to get these benefits at minimal costs. It should be part of any policy or development strategy for its effective implementation.

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Corporate Identity Number. U45207HR1997SGC033517
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Ref. No. 29

IN PLANT TRAINING CERTIFICATE

This is certified that Mr. **VISHAL** bearing Roll No. **2021072041** a student of **INSTITUTE OF ENVIRONMENT STUDIES, KURUKSHETRA UNIVERSITY, KURUKSHETRA** has undergone vocational/industrial training in "Civil Maintenance Division" at Panipat Thermal Power Station, Panipat from **August 01, 2022** to **September 15, 2022**. During this period his performance is found good.

Executive Engineer
Training Division
P.T.P.S. H.P.G.C.L, Panipat

Place:- PTPS, Panipat
Date:- September 15, 2022

Regional Office
M.P. Pollution Control Board, Bhopal
Paryawaran Parisar, E-5, Arera Colony, Bhopal
Telephone:- 0755-2466392 Email:- romppcb_bpl@rediffmail.com

No. 3093 **RO/MPPCB/BPL/2022** **Bhopal, Dated** 26/10/2022

Ref:- Letter of Institute of Enviormental Studies Kurukshetra University Kurukshetra No.1935 Dated 08/08/2022.

TO WHOM IT MAY CONCERN

This is to certify that **Mr. Faisal Sidiqi** student of **M.Sc.** (Environmental Studies) from **Institute of Environmental Studies Kurukshetra University Kurukshetra** for his summer internship studies and compiled The Environmental data available on web portal of MPPCB and also visited Continues Ambient Air Quality Monitoring Station (CAAQMS), water & noise monitoring station of Bhopal city. He has presented the data in report form and submitted in a systematic manner. We wish him good luck.

Regional Officer

HARYANA POWER GENERATION CORPORATION LIMITED
Regd. Office :- C-7, Urja Bhawan, Sector-6, Panchkula
Corporate Identity Number: U45207HR1997SGC033517
Website: www.hpgcl.org.in E-mail: [illegible]

Ref. No. 27

IN PLANT TRAINING CERTIFICATE

This is certified that Mr. **KAMALJEET** bearing Roll No. **2021072007** a student of **INSTITUTE OF ENVIRONMENT STUDIES, KURUKSHETRA UNIVERSITY, KURUKSHETRA** has undergone vocational/industrial training in "Civil Maintenance Division" at Panipat Thermal Power Station, Panipat from **August 01, 2022** to **September 15, 2022**. During this period his performance is found good.

Executive Engineer
Training Division
P.T.P.S. H.P.G.C.L. Panip.

Place:- PTPS, Panipat
Date:- September 15, 2022

भारत सरकार
GOVERNMENT OF INDIA
भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

संख्या सी एच टी – 49 /
दिनांक: 30.09.2022

ई-मेल : chandimet@yahoo.com
दूरभाष : 0172 – 2629984; 2920224
फैक्स : 0172 – 2629984

निदेशक का कार्यालय,
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मौसम केन्द्र,
Meteorological Centre
सैक्टर 39 - सी, चंडीगढ़ - 160036
Sector 39 - C, Chandigarh - 160036

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Ms. Meenakshi** student of M.Sc. (Environmental Science) from the Institute of Environmental Studies, Kurukshetra University, Kurukshetra has successfully completed her internship from August 01, 2022 to September 30, 2022 with Meteorological centre Chandigarh, India Meteorological Department (under Ministry of Earth Science , Government of India).

In her capacity as an intern she has successfully completed her summer project on '**Analysis of damage due to the hailstorm in Haryana, Punjab & Chandigarh**' under the guidance of **Sh. Shivinder Singh, Scientist 'C', Meteorological Center Chandigarh**. Her performance as an intern was excellent.

I wish her all the best for her future endeavors.

(मनमोहन सिंह) / (Manmohan Sing

वैज्ञानिक 'एफ' व प्रमुख / Scientist 'F' & He

मौसम केन्द्र चंडीगढ़ / Meteorological Centre Chandig

(मनमोहन सिंह)
(MANMOHAN SINGH)
प्रमुख / निदेशक
Head/Director
मौसम केन्द्र, चण्डी
Meteorological Centre, Chand

IPL Centre for Rural Outreach

NATIONAL PRODUCTIVITY COUNCIL

ICRO/6/2022/ 20220700001

CERTIFICATE OF COMPLETION

This certificate is awarded to

Ms. Jyoti Yadav

Student of Kurukshetra University

For completing the

ICRO AMRIT INTERNSHIP PROGRAMME

Sponsored by

IPL Centre for Rural Outreach

NPC Building, 3rd Floor, Utpadakta Bhawan, 5-6 Institutional Area, Lodhi Road, New Delhi-110003

in

National Productivity Council, New Delhi

From 27.07.2022 to 26.09.2022

Ms. Kritika Shukla
Deputy Director,
National Productivity Council (Nodal Officer)

Dr. Rajeev Ranjan
Director,
IPL Centre for Rural Outreach

DEFENCE LABORATORY, JODHPUR
(DRDO)

CERTIFICATE

This is to certify that Ms. Rekha Yadav, Student of M.Sc. (Environmental Science), 2nd Year, from Kurukshetra University, Haryana, has undergone practical training on "Effect of Sodium Silicate & Polyacrylamide on growth of vegetation " from 8th August 2022 to 23rd September 2022 at this Laboratory.

DLJ/HRD/R/2044/XI/2022/174

Date: 31 October 2022

(Lalit Awwal, Sc-E)
Training Guide

(Dr. Prashant Vasistha, Sc-G)
Group Director, HRD

Government of India

Phone: 0172-2619501
Email: rdnwr-cgwb@nic.in

Central Ground Water Board
North Western Region
Bhujal Bhawan, Plot No. 3B,
Sector 27A, Madhya Marg
Chandigarh-160019
Dated: 02.09.2022

File No.: CGWB/NWR/Chem Lab/sanctions/2022-23- 773

TO WHOM IT MAY CONCERN

This is to certify that **Ms. Shivani D/o Gurmej Singh** has participated in the Skill Development Initiative (Training Programme) of CGWB, NWR, Chandiagarh from 25.08.2022 to 02.09.2022 under the supervision of Mrs. Balinder P. Singh, Sc-D. She carried out analysis of groundwater samples following standard operating procedures using conventional and modern instruments. Skills were developed in various hydrochemical aspects of groundwater, including data generation in compliance with validation protocols.

Balinder P Singh

(Balinder. P. Singh)
Sc-D & HOO

To,
Ms. Shivani
D/o Gurmej Singh
Village-Shergarh Khalsa, PO-Garhi Birbal,
Distt-Karnal-132054,
Haryana

IPL Centre
for Rural Outreach

NATIONAL PRODUCTIVITY COUNCIL

ICRO/6/2022/ 20220700002

CERTIFICATE OF COMPLETION

This certificate is awarded to

Ms. Isha

Student of Kurukshetra University

For completing the

ICRO AMRIT INTERNSHIP PROGRAMME

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NPC Building, 3rd Floor, Utpadakta Bhawan, 5-6 Institutional Area,
Lodhi Road, New Delhi-110003

in

National Productivity Council, New Delhi

From 27.07.2022 to 26.09.2022

Ms. Kritika Shukla
Deputy Director,
National Productivity
Council (Nodal Officer)

Dr. Rajeev Ranjan
Director,
IPL Centre for Rural
Outreach

WECOI22-23HR0007

WARRANIUM ENERGY

Certificate of Internship

This certificate is awarded to

Nirmala Choudhary

In appreciation of your outstanding accomplishments in the company as intern at Warranium Energy's Water and Environment Analyst from July 25, 2022 to October 01, 2022.

Given this 3rd day of October 2022 at Munirka, New Delhi 110067.

Suresh Kumar
DIRECTOR

Mohit Kumar
MANAGER (O&M)

IPL Centre
for Rural Outreach

ICRO/6/2022/ 20220600068

CERTIFICATE OF COMPLETION

This certificate is awarded to

Ms. Apurva Chaudhary

Student of Kurukshetra University

For completing the

ICRO AMRIT INTERNSHIP PROGRAMME

Sponsored by

IPL Centre for Rural Outreach

NPC Building, 3rd Floor, Utpadakta Bhawan, 5-6 Institutional Area,
Lodhi Road, New Delhi-110003

in

National Productivity Council, New Delhi

From 27.07.2022 to 26.09.2022

Ms. Kritika Shukla
Deputy Director,
National Productivity
Council (Nodal Officer)

Dr. Rajeev Ranjan
Director,
IPL Centre for Rural
Outreach

Together...Shaping the Future of Elec ricity

CVS Power Project Private Limited

Sh. 9, 1st floor, Opp. Dalal Bhawan, Gohana Road, Rohtak – 124001 (Haryana)
Office Contact: 9992098953
Email: info@cvspowers.com
CIN: U40200HR2017PTC067878

Ref. No.TAR/103/22020920

Date:19/09/2022

TO WHOM IT MAY CONCERN

This is to certify that **Miss Poonam Mor**, Msc (Environmental sciences) student at **IES Kurukshetra University**, has completed summer internship at CVS POWER.She worked under the guidance of Mr. Chetan Bhardwaj from 2nd Aug 2022 to 15th Sep 2022.

Miss Poonam worked on ' Solar Power Plant' as a part of the project , she understood the working of so PV power simulation and designing.

She is a self-motivated, hard worker that is always looking to learn new skills. **Poonam** has done mo than his role's responsibilities. We wish her all the best in all her future endeavors.

For CVS Power.

Signature

Mr. Chetan Bhardwaj
(Manager-Projects)

Government of India

Phone: 0172-2619501
Email: rdnwr-cgwb@nic.in

Central Ground Water Board
North Western Region
Bhujal Bhawan, Plot No. 3B,
Sector 27A, Madhya Marg
Chandigarh-160019
Dated: 02.09.2022

File No.: CGWB/NWR/Chem Lab/sanctions/2022-23/ [illegible]

TO WHOM IT MAY CONCERN

This is to certify that **Ms. Shailja D/o Aksh Pal** has participated in the Skill Development Initiative (Training Programme) of CGWB, NWR, Chandiagarh from 25.08.2022 to 02.09.2022 under the supervision of Mrs. Balinder P. Singh, Sc-D. She carried out analysis of groundwater samples following standard operating procedures using conventional and modern instruments. Skills were developed in various hydrochemical aspects of groundwater, including data generation in compliance with validation protocols.

Balinder P Singh

(Balinder. P. Singh)
Sc-D & HoO
केंद्रीय भूमि जल बोर्ड
उत्तर पश्चिमी क्षेत्र
चंडीगढ़।

To,
Ms. Shailja
D/o Aksh Pal
VPO- Kheri Matarwa, Kaul,
Distt-Kaithal-136021,
Haryana

केन्द्रीय प्रदूषण नियंत्रण बोर्ड

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MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE

पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय भारत सरकार

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Dated: 08.09.2022

TO WHOM IT MAY CONCERN

This is to certify that Miss. Navkiran DIO Sh. Satwant Singh student of M.Sc. Environmental Science 3rd Semester at Kurukshetra University, Kurukshetra has undertaken Summer Training work on "Report on Physico Chemical Characteristics of Soil samples collected from various sites" at Water Laboratory (Soil and Solid Waste Laboratory) of Central Pollution Control Board, Delhi from 25th July to 09th September 2022.

During the training she has also learnt Environmental Samples analysis for Soil and Solid waste & worked on Laboratory instruments like pH Meter, Conductivity meter, Flame photometer, Moisture analyser, AAS Spectrophotometer, ICP-MS etc. She has completed the training satisfactorily. During this period she proved herself to be hard working, sincere and I found her very enthusiastic, attentive and regular in her training work.

I wish her all the success for her bright future.

(Dr. K. Ranganathan)

Add. Director & Divisional Head

Water & Instrumentation Laboratory

Chandigarh Pollution Control Committee
Paryavaran Bhawan, Madhaya Marg, Sector 19-B,Chandigarh- 160019

CPCC/Lab/21/Trng./2022 /2933 Dated: 16/09/2022

TO WHOMSOEVER IT MAY CONCERN

It is certified that **Ms. Rhythm Sharma,** student of M.Sc. Environment Sciences, Institute of Environmental Studies, **Kurukshetra University, Kurukshetra**, Haryana has successfully undergone training from **01.08.2022 to 15.09.2022** at Chandigarh Pollution Control Committee on **Air & Water Sampling and Analysis**.

During the training period, she was punctual, hardworking and her conduct was good. She bears a good moral character.

I wish her all success in the future.

(Arulrajan P., IFS)
Member Secretary

केन्द्रीय प्रदूषण नियंत्रण बोर्ड
CENTRAL POLLUTION CONTROL BOARD
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय भारत सरकार
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE, GOVT. OF INDIA

No. C-11012/5/Misc/2011/Water Lab

Dated: 08.09.2022

TO WHOM IT MAY CONCERN

This is to certify that **Miss. Sarika D/o Sh. Vinod Kumar** student of M.Sc. Environmental Science 3rd Semester at Kurukshetra University, Kurukshetra has undertaken Summer Training work on **"Study on influence of Rainfall on the Physico-Chemical parameters of Shahdara drain in Delhi"** at Water Laboratory (Waste Water Laboratory) of Central Pollution Control Board, Delhi from 25th July to 09th September 2022.

During the training she has also learnt Environmental Samples analysis for Waste Water & worked on Laboratory instruments like pH Meter, Conductivity meter, Flame photometer, UV-Visible Spectrophotometer, ICP-MS etc. She has completed the training satisfactorily. During this period she proved herself to be hard working, sincere and I found her very enthusiastic, attentive and regular in her training work.

I wish her all the success for her bright future.

K. Ranganathan 8/9/22

(Dr. K. Ranganathan)
Add. Director & Divisional Head
Water & Instrumentation Laboratory

'परिवेश भवन' पूर्वी अर्जुन नगर, दिल्ली-110032
Parivesh Bhawan, East Arjun Nagar, Delhi-110032
दूरभाष/Tel : 43102030, 22305792, वेबसाईट/Website : www.cpcb.nic.in

PHED
Haryana

जन स्वास्थ्य अभियांत्रिकी विभाग, हरियाणा
Public Health Engineering Department, Haryana

Memo No. 13116 **Dated** 27/09/2022

TO WHOM IT MAY CONCERN

Certified that Miss Mahak Rani D/o Sh. Parvesh Kumar participated in the Skill Development Initiative (Training Programme) of Sewerage Treatment Plant of Public Health Department from 27/08/2022 to 04/09/2022 under the Supervision of Sh. Gautam Sharma Junior Engineer. She Carried out Characteristic of Biochemical Oxygen Demand (BODS), Chemical oxygen Demand (COD), Total Suspended Solids (TSS),/pH, Total Nitrogen (TN), Fecal Coliform etc. Skills were developed in various reuse of treated water of Sewerage Treatment Plant.

Executive Engineer,
Public Health Engineering Division No.2,
Yamuna Nagar.

IPL Centre
for Rural Outreach

ICRO/6/2022/20220700031

CERTIFICATE OF COMPLETION

This certificate is awarded to

Mr. Robin Khan

Student of Kurukshetra University

For completing the

ICRO AMRIT INTERNSHIP PROGRAMME

Sponsored by

IPL Centre for Rural Outreach

NPC Building, 3rd Floor, Utpadakta Bhawan, 5-6 Institutional Area,
Lodhi Road, New Delhi-110003

in

National Productivity Council, New Delhi

From 05.08.2022 to 05.09.2022

Ms. Kritika Shukla
Deputy Director,
National Productivity
Council (Nodal Officer)

Dr. Rajeev Ranjan
Director,
IPL Centre for Rural
Outreach

Ref. No: -HEECPL/27092022 Date: - 27/09/2022

TO WHOMSOEVER IT MAY CONCERN

It is certified that **Ms. Simran Prajapati**, student of M.Sc. Environment Science, Institute Environmental studies, **Kurukshetra University, Kurukshetra**, Haryana has successfully undergone training from **01.08.2022 to 15.09.2022** at Hitech Enviro Engineers & Consultants Pvt. Ltd (D-11/47, Surajpur Industrial Area, Site 5, Kasna Greater Noida, U.P. 201306) on **Sewage Treatment Plant based on MBBR Technology**.

During the training period, she was punctual, hardworking and conduct was good. She bears a good moral character.

I wish her all success in future.

For Hitech Enviro Engineers & Consultants Pvt. Ltd.

Auth. Sign

Sr. Project Manager

भारत सरकार
GOVERNMENT OF INDIA
भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

संख्या मौ एच टी - 49 /
दिनांक 30 09 2022

ई-मेल : chandimet@yahoo.com
दूरभाष : 0172 – 2629984, 2920224
फैक्स : 0172 – 2629984

निदेशक का कार्यालय,
Office of the Director
मौसम केन्द्र,
Meteorological Centre
सैक्टर 39 - सी, चंडीगढ़ - 160036
Sector 39 - C, Chandigarh - 160036

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Ms. Shivani Saini**, student of M.Sc. (Environmental Science) from Institute of Environmental Studies, Kurukshetra University, Kurukshetra has successfully completed her internship from August 01, 2022 to September 30, 2022 with Meteorological Centre Chandigarh, India Meteorological Department (under Ministry of Earth Sciences, Government of India).

In her capacity as an intern she has successfully completed her summer project on "**Analysis of damage due to Thunderstorm & High Wind Speed in Haryana, Punjab & Chandigarh**" under the guidance of **Sh. Shivinder Singh**, Scientist 'C', Meteorological Centre Chandigarh. Her performance as an intern was excellent.

I wish her all the best for her future endeavors.

(मनमोहन सिंह) (Manmohan Singh)
वैज्ञानिक 'एफ' व प्रमुख Scientist 'F' & Head
मौसम केन्द्र चंडीगढ़ Meteorological Centre Chandigarh

(मनमोहन सिंह)
(MANMOHAN SINGH)
प्रमुख / निदेशक
Head/Director
मौसम कें-द्र चण्डीगढ़
Meteorological Centre, Chandigarh

THE HISAR-JIND CO-OPERATIVE MILK PRODUCERS UNION LTD
MILK PLANT, JIND

Ref. No.MUHJ/Admn/2022/ 9638

Dated 20/9/22

TO WHOM IT MAY CONCERN

This is to certify that Ms. Annu, Roll no. 2021072001 a student of M.Sc. Environmental Science from Kurukshetra University, Kurukshetra has undergone practical training w.e.f 4.08.2022 to 17.09.2022 in Engineering Section at Milk Plant, Jind. During this period her work and conduct has been found Satisfactory.

She has completed her training successfully.

Chief Executive Officer
Milk Union Hisar-Jind.

(AN ISO 9001: 2015 & ISO 22000:2018 CERTIFIED UNIT)
PHONE: 01681-225776, 225772, 9896476401 TELE-FAX = 226266
E-mail: vitajind@gmail.com

Government of India

Phone: 0172-2619501
Email: rdnwr-cgwb@nic.in

Central Ground Water Board
North Western Region
Bhujal Bhawan, Plot No. 3B,
Sector 27A, Madhya Marg
Chandigarh-160019
Dated: 02.09.2022

File No.: CGWB/NWR/Chem Lab/sanctions/2022-23- 776

TO WHOM IT MAY CONCERN

This is to certify that **Ms. Rupal W/o Sahil** has participated in the Skill Development Initiative (Training Programme) of CGWB, NWR, Chandiagarh from 25.08.2022 to 02.09.2022 under the supervision of Mrs. Balinder P. Singh, Sc-D. She carried out analysis of groundwater samples following standard operating procedures using conventional and modern instruments. Skills were developed in various hydrochemical aspects of groundwater, including data generation in compliance with validation protocols.

Balinder P Singh

(Balinder. P. Singh)
Sc-D & HOO
कार्यालय प्रमुख
केंद्रीय भूमि जल बोर्ड
उत्तर पश्चिमी क्षेत्र
चंडीगढ़।

To,
Ms. Rupal
W/o Sahil
H. No. 1197, Near Mittal Mega Mall, Sector-25
Part-2, HUDA, Panipat-132103
Haryana

Government of India

Phone: 0172-2619501
Email: rdnwr-cgwb@nic.in

Central Ground Water Board
North Western Region
Bhujal Bhawan, Plot No. 3B,
Sector 27A, Madhya Marg
Chandigarh-160019
Dated: 02.09.2022

File No.: CGWB/NWR/Chem Lab/sanctions/2022-23- 771

TO WHOM IT MAY CONCERN

This is to certify that **Ms. Preeti D/o Minar Singh** has participated in the Skill Development Initiative (Training Programme) of CGWB, NWR, Chandiagarh from 25.08.2022 to 02.09.2022 under the supervision of Mrs. Balinder P. Singh, Sc-D. She carried out analysis of groundwater samples following standard operating procedures using conventional and modern instruments. Skills were developed in various hydrochemical aspects of groundwater, including data generation in compliance with validation protocols.

Balinder P Singh

(Balinder. P. Singh)
Sc-D & HOO
कार्यालय प्रमुख
केंद्रीय भूमि जल बोर्ड
उत्तर पश्चिमी क्षेत्र
चंडीगढ़।

To,
Ms. Preeti
D/o Minar Singh
Ward No. 27, Shanti Nagar, Gali no. 2
Kurukshetra-136118,
Haryana

JS Infrastructure Consultants Pvt. Ltd.
Regd. Office: Unit No. 602, Tower A, Unitech Business Zone, Nirvana Country, Golf Course Extension Road, Sector 50, Gurugram, Haryana-122001
Ph : 0124-4067460 **E-mail :** jsicplindia@gmail.com, info@jsicpl.com
Web: www.jsicpl.com, **CIN:** U93000HR2012PTC093760

JS Infrastructure CONSULTANTS PVT. LTD.

INTERNSHIP CERTIFICATE

This is to certify that **Ms. Sheetal Dhariwal,** a student of **Kurukshetra University, University** Market Rd, Thanesar, Haryana, PIN-136119 bearing the registration no. **21-UD-430** has duly completed **internship** from 26th July 2022 to 8th Sep 2022 as a Intern in Environmental division at **M/s JS Infrastructure Consultants Pvt Ltd**, Sector-50, Gurgaon, Haryana, PIN-122001 under ***Vikas* Kumar Yadav- Manager Project Management.**

During this period, we find **Ms. Sheetal Dhariwal** demonstrated good design skills with a self-motivated attitude to learn new things. Her performance exceeded the expectations and was able to complete the assigned tasks within time Frame.

We wish her all the best for the future endeavors.

Warm regards

For M/s JS Infrastructure Consultants Pvt. Ltd.

Kumari Shreya
Manager-HR
Date:- 15.09.2022

JS INFRASTRUCTURE CONSULTANTS PVT. LTD.

Vita

The Kurukshetra-Karnal Co-operative Milk Producers' Union Limited

No. : MUK/Admn./22/5828 Dated : 15/09/2022

TO WHOM IT MAY CONCERN

It is certified that Miss. Rajni, student of M.Sc. Environment Science Course at Institute of Environmental Studies, Kurukshetra University has undergone the training on Environmental aspects and industrial procedures from this organization from 30.08.2022 to 15.09.2022 successfully. During the training period, she showed a great interest on learning.

We wish her success in life.

Chief Executive Officer
The Kurukshetra-Karnal Cooperative
Milk Producers' Union Ltd. Kurukshetra

Vita Milk Plant, G.T. Road, Near Sanwala, P.Box No. 41, Kurukshetra-136118
Ph. : 01744-275544, E-mail : milkunitkkr1@rabee.co.in GST : 06AACAT4387N1ZC

Regional Office
M.P. Pollution Control Board, Bhopal
Parywaran Parisar, E-5, Arera Colony, Bhopal
Telephone:- 0755-2466392 E-mail:- romppcb_bpl@rediffmail.com

No. 3091 RO/MPPCB/BPL/2022 Bhopal, Dated 31/8/2022

Ref:- Letter of Institute of Enviormental Studies Kurukshetra University Kurukshetra No 1937 Dated 08/08/2022.

TO WHOM IT MAY CONCERN

This is to certify that **Mr. Aminullah** student of **M.Sc.** (Environmental Studies) from **Institute of Environmental Studies Kurukshetra University Kurukshetra** for his summer internship studies and compiled The Environmental data available on web portal of MPPCB and also visited Continues Ambient Air Quality Monitoring Station (CAAQMS), water & noise monitoring station of Bhopal city. He has presented the data in report form and submitted in a systematic manner. We wish him good luck.

Regional Officer

Regional Officer
M.P. Pollution Control Board
BHOPAL

HONDA

Honda Motorcycle and Scooter India Pvt. Ltd.

Ref: GA2F/HR/09KS/21

Date: 16 September 2022

To whomsoever it may Concern

This is to certify that **Ms. Kavita Yadav** has successfully completed her industrial training from **06 Aug 2022** to **16 Sep 2022**. During her project training she has worked on the project of "**ZLD System (Zero Liquid Discharge)**" & shared her inputs for the same with her project Guide.

During her tenure we found her sincere & committed to her project. We wish her all the best for all her future endeavor.

For Honda Motorcycle & Scooters India Private Limited

(Karandeep Singh)

Chief Manager - HR

IPL Centre for Rural Outreach

NATIONAL PRODUCTIVITY COUNCIL

ICRO/6/2022/ 20220600105

CERTIFICATE OF COMPLETION

This certificate is awarded to

Ms. Shabnam

Student of Kurukshetra University

For completing the

ICRO AMRIT INTERNSHIP PROGRAMME

Sponsored by

IPL Centre for Rural Outreach

NPC Building, 3rd Floor, Utpadakta Bhawan, 5-6 Institutional Area, Lodhi Road, New Delhi-110003

in

National Productivity Council, New Delhi

From 27.07.2022 to 26.09.2022

Ms. Kritika Shukla
Deputy Director,
National Productivity Council (Nodal Officer)

Dr. Rajeev Ranjan
Director,
IPL Centre for Rural Outreach

राष्ट्रीय प्रौद्योगिकी संस्थान, कुरुक्षेत्र
NATIONAL INSTITUTE OF TECHNOLOGY
KURUKSHETRA-136 119 (HARYANA) INDIA
PBX No. 01744-233100, 233200
Gram: NITKU FAX: 01744-238050

Ref No ____

Dated 30/9/2021

TO WHOM IT MAY CONCERN

This is to certify that Mr. **Fazal Omar** a student of MSc. (Environmental Science) has successfully completed his 45 days Summer Internship-Research Program in the GIS lab of National Institute of Technology Kurukshetra under my supervision.

His internship activities encapsulated learning to work with ArcGIS and QGIS software. During the entire period of his internship-research program, Mr. **Fazal Omar** had been exposed to work extensively on both GIS softwares. I found him to have a consistent high standard of academic temperament.

I wish him all the best in his future endeavors.

(Mahesh Pal)
Professor, Department of Civil Engineering
National Institute of Technology Kurukshetra
Email: Mahesh.pal@nitkkr.ac.in
Phone (office) : 01744233356

राष्ट्रीय प्रौद्योगिकी संस्थान, कुरुक्षेत्र
NATIONAL INSTITUTE OF TECHNOLOGY
KURUKSHETRA-136 119 (HARYANA) INDIA
PBX No 01744-233100, 233200
Gram NITKU FAX 01744-238050

Ref. No _____

Dated 30/9/2022

TO WHOM IT MAY CONCERN

This is to certify that Mr. **Hewad** a student of MSc. (Environmental Science) has successfully completed his 45 days Summer Internship-Research Program in the GIS lab of National Institute of Technology Kurukshetra under my supervision.

His internship activities encapsulated learning to work with ArcGIS and QGIS software.

During the entire period of his internship-research program, Mr. **Hewad** had been exposed to work extensively on both GIS softwares. I found him to have a consistent high standard of academic temperament.

I wish him all the best in his future endeavors.

Mahesh Pal

(Mahesh Pal)
Professor, Department of Civil Engineering
National Institute of Technology Kurukshetra
Email: Mahesh.pal@nitkkr.ac.in
Phone (office): 01744233356

CVS Power Project Private Limited

Sh. 9, 1st floor, Opp. Dalal Bhawan, Gohana Road, Rohtak – 124001 (Haryana)
Office Contact: 9992098953
Email: info@cvspowers.com
CIN: U40200HR2017PTC067878

Ref. No.TAR/103/22020920

Date:19/09/2022

TO WHOM IT MAY CONCERN

This is to certify that Miss Preeti, Msc (Environmental sciences) student at **IES Kurukshetra Jniversity**, has completed summer internship at CVS POWER.She worked under the guidance of Mr. Chetan Bhardwaj from 2nd Aug 2022 to 15th Sep 2022.

Miss Preeti worked on ' Solar Power Plant' as a part of the project , she understood the working of sola PV power simulation and designing.

he is a self-motivated, hard worker that is always looking to learn new skills.Miss Preeti has done more han his role's responsibilities. We wish her all the best in all her future endeavors.

For CVS Power.

Signature

Mr. Chetan Bhardwaj
Manager-Projects)

CVS Power Project Private Limited

Together...Shaping the Future of Electricity

Sh. 9, 1st floor, Opp. Dalal Bhawan, Gohana Road, Rohtak – 124001 (Haryana)
Office Contact: 9992098953
Email: info@cvspowers.com
CIN: U40200HR2017PTC067878

Ref. No. TAR/103/22020919

Date: 19/09/2022

TO WHOM IT MAY CONCERN

This is to certify that **Mr. Arun Kumar**, Msc (Environmental sciences) student at **IES Kurukshetra University**, has completed summer internship at CVS POWER. He worked under the guidance of Mr. Chetan Bhardwaj from 2nd Aug 2022 to 15th Sep 2022.

Mr. Arun worked on '**carbon credits and trading**'. As a part of the project, he understood how the "**Carbon Trading & Credit System** "works. Mr. Arun also covered Impact of carbon footprint of worldwide Growth & Earth Temperature rise.

He is a self-motivated, hard worker that is always looking to learn new skills. Mr. Arun has done more than his role's responsibilities. We wish him all the best in all her future endeavors.

For CVS Power.

Signature

Mr. Chetan Bhardwaj
(Manager-Projects)

Forest Department, Haryana
O/O : Deputy Conservator of Forests, Kaithal, Forest Division, Kaithal
Opp. Fire Brigade, Near Pehowa Chowk, Kaithal-136027, Phone 01746-228095 E-mail – dfo.ktl-hry@nic.in

No. :- 3804 **Dated :-** 03/10/22

TO WHOM IT MAY CONCERN

It is certified that Miss. Ritu D/o Sh. Jaipal student of M.Sc Environment Science Course at Institute of Environment Studies, Kurukshetra University has undergone the Training/Project Work in Environmental aspects and industrial procedures from this organization from 03/08/2022 to 03/10/2022 successfully. During the training period, she shown a keen interest in learning.

We wish her success in life.

Ritu
3/10/22

Deputy Conservator of Forests,
Kaithal Forest Division,
Kaithal.
3/10/22

Certificate

Date : 10.09.2022

To whom Soever it may concern

This is certified that Ms. Monika student of M Sc Environment Science, Institute of Environment Studies Kurukshetra University Kurukshetra, is completed her summer training of 45 Days w e f 25th July 2022 in our company in Environment Health & Safety Department

For NIHON PARKERIZING (INDIA) PVT LTD

AUTHORISED SIGNATORY

NIHON PARKERIZING INDIA PVT LTD

PERFACT GROUP

16th September, 2022

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Ms. Nancy Dutt,** a student of **Institute of Environmental Studies, Kurukshetra University, Kurukshetra; Msc- EVS , Roll Number 06 ,** has successfully completed her 45-day mandatory internship with **Perfact Group, Gurgaon office** from **1st August, 2022- 15th September, 2022.**

Her department of working was **Environmental Impact Assessment (E.I.A.)**

The title of her project was **"Post EC work – Creating a database of the ECs obtained in the last 3 years and performing meaningful data analysis on the same."**

During the entire period of her internship, we found her to be a focused, honest and a dedicated professional who handled the work assigned to her with zeal.

We wish her all the very best in all her future endeavors.

Regards

26/09/2022

[illegible] Floor, NN Mall, Sector [illegible]
Rohini, New Delhi - 110085 | +91-11-49281300 | [illegible]

CERTIFICATE

This is to certify that the Project titled **"A Theoretical Study of Toxic Emissions Released Due to Military Activities"** has been carried out by **Sourabh Yadav,** a student of M.Sc. Environmental Science, Kurukshetra University, Kurukshetra, Haryana, under the supervision of Dr. Pritam Sangwan, Scientist - 'E', CFEES, DRDO. It is certified that the report is authentic and genuine. They had been hard working and dedicated throughout their training. To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

Sangwan 22/09/2022

Dr. Pritam Sangwan

Scientist - 'E' & Joint Director

HARYANA POWER GENERATION CORPORATION LIMITED
Regd. Office----- C- 7, Urja Bhawan, Sector-6, Panchkula
Corporate Identity Number, U45207HR1997SGC033517
Website : www.hpgcl.org.in E-mail : trainingcellptps@gmail.com

Ref. No. 28

IN PLANT TRAINING CERTIFICATE

This is certified that Mr. **VINEET KUMAR** bearing Roll No. **2021072040** a student of **INSTITUTE OF ENVIRONMENT STUDIES, KURUKSHETRA UNIVERSITY, KURUKSHETRA** has undergone vocational/industrial training in "Civil Maintenance Division" at Panipat Thermal Power Station, Panipat from **August 01, 2022** to **September 15, 2022.** During this period his performance is found good.

Executive Engineer
Training Division
P.T.P.S. H.P.G.C.L, Panipat

Place:- PTPS, Panipat
Date:- September 15, 2022

Vita

The Kurukshetra-Karnal Co-operative Milk Producers' Union Limited

No. : MUK/Admn./22/5827 Dated : 15/09/2022

TO WHOM IT MAY CONCERN

It is certified that Miss. Simran, student of M.Sc. Environment Science Course at Institute of Environmental Studies, Kurukshetra University has undergone the Training in Environmental aspects and industrial procedures from this organization from 30.07.2022 to15.09.2022 successfully. During the training period, she shown a keen interest in learning.

We wish her success in life.

Chief Executive Officer
The Kurukshetra-Karnal Cooperative
Milk Producers' Union Ltd.Kurukshetra

Vita Milk Plant, G.T. Road, Near Sanwala, P.Box No. 41, Kurukshetra-136118
Ph. : 01744-275544, E-mail : milkunionkkr1@yahoo.co.in GST : 06AACAT4307N1ZC

GST No. : 06AAGCE0937P1ZB

ESPERTO FOODS PVT. LTD.

TO WHOM IT MAY CONCERN

This is to certify that Mr. Manoj Pawar s/o Sh. Shyam Lal r/o VPO Bara Gaon, Karnal, student of M.Tech Energy and Environmental Management, Kurukshetra University has undergone dissertation work on " Physicochemical analysis of effluent discharge from a food processing industry – A case study" in M/s. Esperto Foods Pvt. Ltd., VPo Bara Gaon, Distt. Karnal from 22/01/2023 to 30/07/2023.

Place : Karnal

Date : 05/08/2023

For Esperto Foods Pvt. Ltd.

(Plant Manager)

CIN : -U15400HR2020PTC089405

9896800008 VPO BARAGAON, GHEER ROAD NEAR BALAJI MANDIR, KARNAL, HARYANA

info@espertofoods.com

GOODRICH

ADDING VALUE TO FOOD

GCL/2023 Date-26.09.2023

To Whom It May Concern

It is certified that Ms. Parneet Kaur , Student of M.Tech in Energy and Environmental Management Institute of Engineering and Technology (Kurukshetra University Kurukshetra) completed her Six months training of **A Study on Performance of a Effluent Treatment Plant of Food Industry** in Goodrich Carbohydrates Ltd. Village-Nagla, Meerut Road, Karnal -132001 (Haryana) for the period of from 17.01.2023 to 16.07.2023.

During her training period it was noticed that her work and conduct was satisfactory.

We wish her all success in her future endeavors.

For Goodrich Carbohydrates Ltd.

Goodrich Carbohydrates Ltd. Auth. Sign

Authorized Signatory

Reference: 08/23/1 Date: 03.08.2023

CERTIFICATE

This is to certify that the work reported in the dissertation entitled, **"Determination of metal content in waste Li-ion battery by ICP-OES"** is an original piece of work, carried out by Ms. **Sumit** from **January 17, 2023** to **July17, 2023** under guidance and supervision of the Head (R&D) **Dr. Parveen Kumar** in partial fulfilment of the requirements for the degree of **Master ofTechnology in Energy & Environmental Management, Kurukshetra University, Kurukshetra.**

We Wish all success in her career and professional achievement.

Parveen Kumar

Parveen Kumar, PhD.
Head
Research and Development

Exigo Recycling Pvt. Ltd
E-mail: parveenkumar@exigorecycling.com| Ph: 9416371023 | W: www.exigorecycling.com
Toll Free No: 1800 102 5018

Works 1
Barsat-Panipat Road, Barsat, Karnal, Haryana 132114

Works 2
Unit 2- Opposite Kirpal Ashram Barsat Road, Panipat, Haryana - 132103

Reg. Office
F-36, 1st Floor, East of Kailash, New Delhi 110065

Corporate Office
B-19,1st & 2nd Floor Sec-63 Noida-201 309, Uttar Pradesh

HARYANA SPACE APPLICATIONS CENTRE (HARSAC)

(Citizen Resources Information Department, Haryana)

CCS HAU Campus, Hisar – 125004

Phone: 01662-232632, 231045, 231047, FAX: 225958

Website: www.harsac.org, E-mail: Contact@harsac.org

HARSAC/GGM/2023/1.3 07-09-2023

CERTIFICATE

This is to certify that Mr. **Vijay Kumar**, a student of Master of Technology in Energy & Environment Management, Institute of Environmental Studies, Kurukshetra University, Kurukshetra session (2021-2023) has satisfactorily completed his dissertation work of 6 months on the topic entitled **"Development of a conceptual IoT-enabled drinking water supply system in Gurugram (Haryana)"** under the joint guidance and supervision of **Dr. Dharmendra Singh** (Senior Scientist), HARSAC (Haryana Space Application Centre), Node, Gurugram, **Dr. Priti Attri** (Senior Scientific Assistant), HARSAC (Haryana space application Centre).

The dissertation work being submitted fulfills the basic ordinance governing partial fulfillment of requirements for the award of the degree of Master of Technology.

During his tenure, we found him active and competent in executing all assigned tasks were found to be satisfactory.

We wish him great success in all of his future endeavors.

Dr. Dharmendra Singh
Senior Scientist HARSAC

Dr. Priti Attri
Sr.Scientific Assistant
HARSAC

Date: 07-09-2023

जनस्वास्थ्य अभियात्रिकी विभाग, हरियाणा
PUBLIC HEALTH ENGINEERING DEPARTMENT, HARYANA
O/O THE SUB DIVISIONAL ENGINEER PUBLIC HEALTH ENGINEERING SUBDIVISION NO.3
REWARI
Garhi Bolni Road, Near Nala Rewari - 123401
Ph. No. : 01274-260635, E-mail : sdephesdno.3rewari@gmail.com
SNK Toll Free No. : 1800-180-5678

CERTIFICATE

This is to certified that Yash Gupta bearing Roll No:- (2021073008) pursuing **MTech. Energy and Environmental Management** course from Institute of Environmental Studies, Kurukshetra University, Kurukshetra has undergone six months "Dissertation Thesis Work" dated from 06 February 2023 to 07 August 2023 from Public Health Engineering Department, Rewari (Haryana).

He was sincere, self-managed and bears good moral character during the work.

We wish a bright future for him.

Place: REWARI (Haryana)
Date of issuing: 21 August, 2023

SANJAY CHANDOLIA
...ter Engineer
...PHED No.3, Rewari

CHANDIGARH

Chandigarh Pollution Control Committee

Paryavaran Bhawan, Madhya Marg, Sector 19-B,Chandigarh-160019

CPCC/Lab/21/Trng./2023/2386

Dated: 21/08/2023

TO WHOMSOEVER IT MAY CONCERN

It is certified that **Mr. Parveen Bura,** student of M.Tech. (Energy and Environmental Management), Institute of Environmental Studies, Kurukshetra University, Kurukshetra, Haryana has successfully undergone the training from **February 2023 to August 2023** at Chandigarh Pollution Control Committee on the topic *"A Study on Pollutant Removal Efficiency of Different Sewage Treatment Plants in Chandigarh City"*.

During the training period, he was punctual, hardworking and his conduct was good. He bears a good moral character.

I wish him all success in the future.

(Arulrajan P., IFS)
Member Secretary

EPABX : 0172-2700311, E - mail : cpcc-chd@nic.in

ICAR-INDIAN INSTITUTE OF WHEAT & BARLEY RESEARCH
KARNAL - 132001

May 22, 2021

The following applications were received by email for allotment as Co-major or Co-supervisor in the Advisory Committee of the PG Scholars enrolled at different R&D institutions.

1. email from Dr. Surender S Yadav (surender.ento@gmail.com) dated 20.05.2021 seeking Dr. Poonam Jasrotia
2. email from Dr Sandeep Gupta (drsandeep.gupta@kuk.ac.in) dated 21.05.2021 seeking Dr Sudheer Kumar

Accordingly, the following allotment as Co-major or Co-supervisor in the Advisory Committee has been proposed by the Committee on Academic Trainings. The suggested list is put forth for your kind perusal and approval.

S.No.	Student Name and Degree Pursued	Institution	Name of the Allotted Scientist in the Advisory Committee
1.	Sunny Manju Admn. No. 2020A46M M.Sc. (Entomology)	CCSHAU, Hisar	Dr. Poonam Jasrotia (Co-major)
2.	Shant Kumar Ph.D	Kurukshetra University	Dr. Sudheer Kumar (Co-supervisor)

All the guidelines laid out by ICAR on dissertation / research has to be followed

Ratan Tiwari 22/5/21
(Chairman)

Arun Gupta
(Member)

Dinesh Kumar
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R. Sendhil
(Member Secretary)

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(Director, ICAR-IIWBR)

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NATIONAL COMMISSION FOR WOMEN
PLOT NO. 21, JASOLA INSTITUTIONAL AREA
NEW DELHI-110 025
Website : www.ncw.nic.in

File No. 13(10)/2022-23/NCW/(RS) **Date:30/12/2022**

To,

Dr. Anita Rani Dua (PI)
Director
Women's Studies Research Centre
Kurukshetra University, Haryana

Subject: Research Study on **"An Appraisal of 'Beti Bachao Beti Padhao' Scheme in Haryana"**

Sir/Madam,

Please refer to the proposal for Research Study on the above mentioned subject submitted by **Kurukshetra University, Haryana** to the National Commission for Women. This letter will serve as an acceptance and approval for the **Kurukshetra University, Haryana** research team comprising of **Dr. Vanita Dhingra** (Co-PI) and **Dr. Vandana Dave** (Co-PI) to carry out the research project with a financial assistance of **Rs.12,98,000/- (Rupees Twelve Lakh Ninety Eight Thousand Only)** titled **"An Appraisal of 'Beti Bachao Beti Padhao' Scheme in Haryana"**.

2. In order to enable the Commission to process the matter further to release First Installment, the following documents/information are required to be made available to the Commission as per prescribed formats, at the earliest of the issuance of this letter which has also been e-mailed to you:

i. Acceptance Letter
ii. Agreement and Undertaking duly endorsed, signed and stamped (in original) by Registrar or Vice-Chancellor
iii. Bank Mandate Form
iv. The organization will have to register itself on PFMS (Public Finance management System) portal and link itself with NCW PFMS account (Scheme Code 1187). If already registered, the organization will have to link with NCW and send its proof to the NCW.

3. The financial assistance of **Rs.12,98,000/- (Rupees Twelve Lakh Ninety Eight Thousand Only)** will be released in two installments as under:

i. 50% in advance after receipt of documents mentioned in para 2 above (subject to availability of funds).

ii. 50% on receipt of the following (subject to availability of funds):

   a. Soft copies of Filled Questionnaire
   b. Final Research Study Report (both hard and soft copy)
   c. Executive Summary of Final Research Study Report
   d. Utilization Certificate as per GFR 12-A format
   e. Expenditure Statement
   f. Original/Certified Bills and Vouchers

4. It may be noted that the First Installment of the sanctioned amount will be released only after receipt of the above mentioned documents/information.

5. It may also be noted that this letter should not be treated as sanction letter.

6. It may further be noted that no further extension for commencement of the study will be given. In rare case, where the **Grantee Organisation** seeks for extension of time period, **2 months prior permission** will be required from the Commission

Yours faithfully,

30/12/22

(Ashutosh Pande)
Sr. Research Officer

Director(T).: 91-184-2290501
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भा.कृ.अ.प.-केन्द्रीय मृदा लवणता अनुसंधान संस्थान, करनाल
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India

F.No.4(14)/Estt.Sci./2021/1877
Dated: ~~22~~.07.2021
24

Dr. Neeraj Kumar, Ph.D.
Chairman
Department of Microbiology,
Kurukshetra University
Kurukshetra-136 119 (India).

Sub: Ph.D. registration of Ms. Kirti Yadav- regarding.

Sir,

In continuation to this office letter dated 22.07.2021 on the above cited subject. In this connection, it is to inform that the Director, ICAR-CSSRI, Karnal is pleased to permit Dr. Awtar Singh, Scientist (Soil Science) to collaborate in the broad area of research of **"Microbiological degradation of soils under long term irrigation with alkali and partially neutralized water through amendments",** ICAR-CSSRI, Karnal for Ph.D. registration of Ms. Kirti Yadav. As per ICAR norms, the fee of Rs.30000/- Per semester will be charged from Ms. Kirti Yadav for Ph.D. Programe.

This issues with the approval of the Director, ICAR-CSSRI, Karnal.

Yours faithfully,

23/07/2021

(Tarun Kumar)
Asstt. Admn. Officer

CC: Dr. Awtar Singh, Scientist through HSCM for information please.

26.07.2021

Director(T).: 91-184-2290501
Res. : 2291801
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भा.कृ.अ.प.-केन्द्रीय मृदा लवणता अनुसंधान संस्थान, करनाल
ICAR-Central Soil Salinity Research Institute
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India

F.No.4(14)/Estt.Sci./2021/1877
Dated: ~~22~~.07.2021
24

Dr. Neeraj Kumar, Ph.D.
Chairman
Department of Microbiology,
Kurukshetra University
Kurukshetra-136 119 (India).

Sub: Ph.D. registration of Ms. Kirti Yadav- regarding.

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This issues with the approval of the Director, ICAR-CSSRI, Karnal.

Yours faithfully,

23/07/2021

(Tarun Kumar)
Asstt. Admn. Officer

CC: Dr. Awtar Singh, Scientist through HSCM for information please.

26.07.2021

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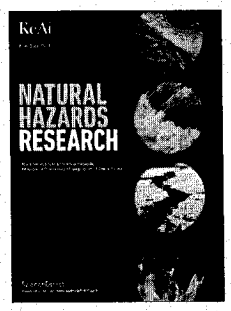

Estimation of source parameters and scaling relations using small to moderate earthquakes occurred in Delhi and surrounding region of India

Abhishek, Manisha Sandhu, Babita Sharma, Dinesh Kumar, R.B.S. Yadav, S.S. Teotia

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Chairman,
Department of Geophysics
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Physics and Chemistry of the Earth 127 (2022) 103158

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Seismicity and magnitude recurrence hazard assessment in Eastern Nepal, Northeast India and Tibet Himalaya

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ARTICLE INFO

Keywords:
Gumbel III distribution
Northeast India
Earthquake hazard parameters
Magnitude recurrence maps
Return periods

ABSTRACT

The regions of eastern Nepal, northeast India and Tibet Himalaya (26°-30°N, 85°-97°E) are one of the most earthquake hazardous areas in the Indian subcontinent. The seismicity of this region is analyzed using Gumbel's third asymptotic distribution (*GIII*) method of extreme values to assess the earthquake hazard. A uniform and complete seismic data covering the time span of 120 years (i.e. 1900-2019) is used for the appraisal of earthquake magnitude recurrence in different return periods. The expected largest earthquake magnitudes during the next 20 (M_{20}), 50 (M_{50}) and 100 (M_{100}) years with their 90% probability of not being exceeded (PNBE) are spatially mapped to create a brief atlas of short- and long-term regional earthquake magnitude recurrence hazard maps. The obtained results of maximum magnitude during 20, 50 and 100-years are expected to exceed the values of Mw 7.1, 7.7 and 8.2, respectively in two prominent blocks of eastern Nepal and Arunachal Himalaya in the examined region. These blocks are also more prominent for the results of 20, 50 and 100 years earthquake magnitudes with 90% PNBE i.e. return periods of 190 (M_{190}), 475 (M_{475}) and 950 (M_{950}) years along with two additional blocks in the Eastern Himalayan Syntaxis (EHS) and Yadong-Gulu rift near Lhasa in the Tibet Plateau. These earthquake magnitudes are expected to exceed Mw 8.5, 8.6 and 8.9 during the next 190, 475 and 950 years, respectively in these blocks. The spatial distribution of earthquake hazards in the region reveals the complex seismotectonic setup and high crustal heterogeneity.

1. Introduction

The quantification of seismicity rates in different seismotectonic settings is always a topic of interest and worth, and probing into differences in subduction zones, extensional regimes and conservative strike-slip boundaries, is fascinating. The Himalaya provides a different perspective, a massive example of a continent-continent collision, in which great earthquakes have occasionally occurred. Various stochastic and probabilistic methods have been introduced in the past to estimate the earthquake hazard and return periods of different earthquake magnitudes. These methods comprise the assessment of the recurrence of a future earthquake of a particular size within a fixed interval of time in a region. The most common parameter in such studies is the earthquake magnitude recurrence. In terms of nomenclature, the phrase "earthquake hazard" is an expression of the severity of seismicity and is quite different from the commonly encountered phrase "seismic hazard", which describes the exceedance probability of strong ground shaking consequent to the earthquake occurrences.

Among many statistical approaches used, asymptotic extreme value statistics has the benefit that it does not necessitate an investigation of the whole process of all earthquake occurrences, whereas, for example, the method of Gutenberg and Richter (1944) requires the whole process and all earthquake occurrences. Gumbel's (1935, 1954, 1958) extreme value statistics consider the sequence of seismic events assembled from the biggest earthquake magnitudes from a group of prearranged intervals of time. It directly addresses the part process of the larger and rarer earthquakes in the tail of the distribution. This theory has been implemented in various areas by many scientists who usually adopted Gumbel's third asymptotic method (*GIII*) when dealing with seismicity and earthquake magnitude occurrence (for example Epstein and Lomnitz, 1966; Burton, 1977; Makropoulos, 1978; Burton et al., 1984; Al-Abbasi and Fahmi, 1985; Makropoulos and Burton, 1985; Tsapanos and Burton, 1991; Tsapanos 1998; Shanker et al., 2007; Yadav et al., 2012; Burton and Bayliss, 2013; Yadav et al., 2013; Tsapanos et al.,

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Spatial variability of earthquake hazard parameters, return periods and probabilities of earthquake occurrences in the eastern Himalayan seismic belt

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ARTICLE INFO

Keywords:
Earthquake hazard
Eastern Himalayan seismic belt
Maximum likelihood method
Regional maximum magnitude
Return periods
Probabilities of occurrences

ABSTRACT

We present a brief atlas of the geographical distribution of earthquake hazard parameters, return periods and probabilities of exceedance of medium to large earthquakes in a hazardous region of the eastern Himalayan seismic belt. A maximum likelihood procedure is applied for the purpose that allows earthquake data during 1500–2019 containing the mixed files of both the historical as well as instrumental era. The results reveal a high activity rate (λ) in eastern Nepal and Arunachal Himalaya, and a low value in the Bhutan-middle Arunachal-Assam Himalaya. A high b-value (or β-value) associated with eastern Nepal and its vicinity, Shillong Plateau and eastern Arunachal Himalaya reveals low crustal stress, while a low b-value associated with Bhutan, middle Arunachal, western Assam and east of the Lhasa reveals high differential crustal stress. The high values of M_{max} (Mw > 8.0) are perceived in eastern Nepal, eastern Arunachal Himalaya, Shillong Plateau and south of Lhasa in Tibet. The return periods and probability of exceedance for magnitude Mw 6.0, 6.5 and 7.0 during the next 10-, 20- and 50-years are calculated and correlated with the prevailing tectonics and seismicity of the area. The low return periods (10–20 years) and high probabilities (>0.8) for magnitudes Mw 6.0–6.5 are associated with eastern Nepal, Shillong-Kopli Fault-Arunachal Himalaya, Eastern Himalayan Syntaxis and Yadong-Gulu rift in Tibet revealing potential regions for future earthquake hazard. These hazard maps are highly useful to prepare earthquake hazard mitigation plan in high hazard regions.

1. Introduction

The territory of the eastern Himalayan seismic belt including eastern Nepal, Sikkim, Bhutan, Assam, Arunachal Himalaya and southern Tibet (Fig. 1) bounded by coordinates 26°–30° N and 85°–97° E is a highly seismic hazardous region in the Indian subcontinent, wherein the Indian and Eurasian plates converged and developed the world's highest mountain Himalaya (Kayal, 2010; Dasgupta et al., 2021). The region has a rich seismic history of the occurrences of great earthquakes, viz. June 12, 1897 (Mw 8.1) Shillong Plateau, January 15, 1934 (Mw 8.2) Bihar-Nepal and August 15, 1950 (Mw 8.6) Assam earthquakes. The Bureau of Indian Standard (BIS, 2002) reconsidered the seismic design code for the entire Indian continent, according to which the study region falls in the seismic zones V and IV that can generate earthquakes of magnitude 8 and 7, respectively in the future. According to the NDMA (2011) report, the region exhibits 0.35–0.55g of peak ground acceleration (PGA) for a 10% and 2% probability of exceedance in 50 years (i.e. 475 and 2475 years of return periods, respectively). However, Nath and Thingbaijam (2012) obtained high PGA values of 0.93g and 1.93g for a 10% and 2% probability of exceedance in 50 years, respectively. Keeping in view of the high earthquake potentiality and seismic hazard scenario of the region, it is urgently required to study the present-day scenario of earthquake hazard for future seismic hazard mitigation using the most updated catalogue and sophisticated technique.

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Mio-Pliocene tectonic activity along the Main Boundary Thrust and exhumation of the Amritpur Granite Body, Kumaun region, northwestern Himalaya

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Abstract: The Main Boundary Thrust (MBT) is studied along the Baliya-Amritpur-Jamrani road section of the Baliya Nala-Gola River valley including an isolated granite body, associated with MBT hanging wall in the Kumaun region of the NW-Himalaya. In this study, we have reviewed available Fission-Track Thermochronological ages and seismicity data in combination with the new field evidence and geomorphological data to understand the mechanism for the exhumation of the Amritpur Granite Body (AGB) and the tectonic movement history along the MBT. Furthermore, the timing of the tectonic activity along the MBT and its role in the exhumation of the AGB are explored. The study focused on two different locations, where the Amritpur Granite is in direct contact with the Siwalik rocks along the MBT. The available apatite and zircon Fission-Track (AFT/ZFT) ages are range between 11.3 Ma to 14.7 Ma with a mean of 13.4 Ma and 12.4 Ma to 15.4 Ma with a mean of 13.9 Ma respectively. Mean AFT and ZFT ages of the AGB have similar age trends from the MBT to the Salari Thrust, which indicates that the AGB was rapidly uplifted and exhumed along the MBT from the basement at a depth of ca. 8-10 km during the middle Miocene (ca. 14-13 Ma). Similarly, the AFT ages of the sandstone samples from the contact zone of AGB and middle Siwalik (MBT's footwall side) are completely reset and age ranges between 4.4 Ma to 5.5 Ma with a mean of ~5.0 Ma reveal the tectonic reactivation of the MBT during Pliocene-Quaternary period. The morphometric trends suggest that the AGB has a lower erosion susceptibility than the rocks available on the northern side of AGB. Furthermore, an aggregated map and morphometric index revealed that the AGB has aligned along the regional faults (i.e., MBT and Salari Thrust), which also indicate the demarcation of the dendritic drainage pattern of the watershed with low susceptibility to erosion. The scattered pattern of seismicity also indicates the tectonic activity along the MBT almost ceased after the Pliocene-Quaternary period. Based on the morphometry, field evidences and available FT thermochronological age data, we envisage that the AGB was exhumed to the surface from the basement as 'Tectonic Slivers' during the development and reactivation of the MBT between Miocene to Pliocene period.

Keywords: Main Boundary Thrust, Amritpur Granite Body, outer LHMS zone, Kumaun region, Northwest Himalaya.

INTRODUCTION

The Himalayan Mountain belt was formed through continental collision between Indian and Eurasian plates, which was began ca. 58 Ma (Yin 2006; Jain 2014; Jain *et al.* 2005; Singh *et al.* 2021 and references therein). From north to south, the first order litho-tectonic units are the Tethys Himalayan Sequence (THS), Higher Himalayan Crystallines Sequence (HHCS), Lesser Himalayan Sequence (LHS) and Sub-Himalaya, separated by north dipping thrust/faults such as South Tibetan Detachment System (STDS), Main Central Thrust (MCT) and Main Boundary Thrust (MBT) respectively (Yin 2006; Singh *et al.* 2022a,b; Webb *et al.* 2007, 2011) (Fig. 1). The various kinematics models explained the evolution of the Himalaya (Jain, 2022) and suggested that the Himalayan Mountain belts were undergone through three kinematic phases, which are characterized as: first phase was began ca. 58 Ma ago, when the collision between the Indian-Eurasian plates took place and the THS thrusted over the Indian continental lithosphere along the Indus Tsangpo Suture Zone (Jain 2014; Webb *et al.* 2011 and reference therein). The second phase initiated during the late-Oligocene-to-Miocene, when the crystalline rocks of the HHCS were transported over the LHS along the MCT (Catlos *et al.* 2004; Kellett *et al.* 2009, 2010; Patel *et al.* 2011a,b, 2015; Robinson & McQuarrie 2012; Singh & Patel 2017; Singh *et al.* 2012; Valdiya 1980). In the third phase: the transported crystalline rocks were compressed and folded, which resulted in the formation of anticlinal, synclinal and development of Lesser Himalayan Duplex (LHD) structures in the footwall of the MCT during the middle-late Miocene (Patel *et al.* 2015; Robinson & Martin 2014; Robinson *et al.* 2006; Srivastava & Mitra 1994; Singh & Patel 2017) and initiated the formation of MBT (Singh & Patel 2022).

In the northwestern Himalaya, several studies have been carried-out on exhumation and suggested that the coeval-thrusting and crustal thickening along the MCT accommodated at least 80-90 km shortening, it caused the rapid exhumation of the HHCS rocks during early-Miocene (~23 Ma) (Catlos *et al.* 2004; Godard *et al.* 2009, 2014; Jain 2022; Martin 2017; Patel *et al.* 2007, 2011a, 2015; Puniya *et al.* 2018; Robert *et al.* 2009, 2011; Singh *et al.* 2012; Tobgay *et al.* 2012), subsequently, development of the MBT and the Himalayan Frontal Thrust during the late Miocene-Pleistocene (DeCelles *et al.* 2001; Singh & Patel 2022). Whilst, Apatite Fission Track (AFT) and Zircon U/He thermochronological studies suggest that the tectonic activity along the MBT was started prior to 10 to 8 Ma in the NW-Himalaya (Adlakha *et al.* 2013; Meigs *et al.* 1995; Brozovic & Burbank 2000; Thiede *et al.* 2017). Recently, single zircon U/He thermochronological age of ~7 Ma in the proximity of the MBT, interpreted as cooling of the outer LHMS zone due to more recent exhumation along the MBT during late Mio-

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https://doi.org/10.1007/s10950-021-10016-1

ORIGINAL ARTICLE

Joint inversion for stress and fault orientations using focal mechanisms of earthquakes in the Saurashtra horst, a part of stable continental region of India, and source parameter estimation

Charu Kamra · Sumer Chopra · R.B.S. Yadav

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Abstract The Saurashtra horst in the Gujarat state is an intraplate region located in the westernmost part of India, bounded by three failed rifts, namely Kachchh, Cambay, and Narmada. The region is prone to swarm type of seismic activity, mostly occurring after an intense summer monsoon. In this study, the focal mechanism of earthquakes occurring in the Saurashtra region has been investigated. The earthquakes are clustered in two groups, one in the northern part near the Jamnagar region and the other in the southern part near the Talala region. The focal mechanism of 29 earthquakes were determined with 16 in the Jamnagar region and 13 in the Talala region. The magnitude range of these earthquakes is 3.1–5.1. It is found that the Jamnagar region located in the northern part is characterized by reverse faulting and the Talala region located in the southern part is characterized by strike-slip faulting. The focal mechanisms obtained are inverted to find out the present-day stress field in the Saurashtra horst. It is observed that the Jamnagar and the Talala regions are dominated by radial compression and transtension regimes, respectively. The source parameters of some of these earthquakes from the strong motion data are also estimated. It is found that the stress drop of earthquakes in this region is in the range 9–69 bars, lower than the adjacent Kachchh rift. The average stress drop of the strike-slip earthquakes is found to be more than the reverse mechanism earthquakes, which agrees with the observation in the adjacent Kachchh rift. It is also observed from the data set that the stress drop of the earthquakes in the Saurashtra is dependent on the earthquake size and independent of the focal depth.

Keywords Stress inversion · Moment tensor solution · Source parameters · Saurashtra

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1 Introduction

The Saurashtra region located in the westernmost part of India is a part of the Indian stable continental region and was tectonically stable during Quaternary (Gupta and Amin 1974; Patel 1991). The southern Saurashtra basin separated from the northern Kachchh basin by the Saurashtra Arch trending ENE–WSW and it extends to a considerable distance from the land beyond the shelf, sinking into deep waters. The arch has gone through a process of evolution in three stages, with the volcanic stage during the Late Cretaceous, collapse and rifting stage during early Paleocene, and tilting stage during Lower to Middle Miocene (Sriram et al. 2006). Presently, the study area has a semi-arid climate with 600 to 750 mm of annual rainfall (Prizomwala 2018). Historical seismicity reveals that for the past 200 years, earthquake tremors have occurred mostly in the southern Saurashtra region. The northern part of the Saurashtra

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Seismicity and magnitude recurrence hazard assessment in Eastern Nepal, Northeast India and Tibet Himalaya

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ARTICLE INFO

Keywords:
Gumbel III distribution
Northeast India
Earthquake hazard parameters
Magnitude recurrence maps
Return periods

ABSTRACT

The regions of eastern Nepal, northeast India and Tibet Himalaya (26°-30°N, 85°-97°E) are one of the most earthquake hazardous areas in the Indian subcontinent. The seismicity of this region is analyzed using Gumbel's third asymptotic distribution (*GIII*) method of extreme values to assess the earthquake hazard. A uniform and complete seismic data covering the time span of 120 years (i.e. 1900-2019) is used for the appraisal of earthquake magnitude recurrence in different return periods. The expected largest earthquake magnitudes during the next 20 (M_{20}), 50 (M_{50}) and 100 (M_{100}) years with their 90% probability of not being exceeded (PNBE) are spatially mapped to create a brief atlas of short- and long-term regional earthquake magnitude recurrence hazard maps. The obtained results of maximum magnitude during 20, 50 and 100-years are expected to exceed the values of Mw 7.1, 7.7 and 8.2, respectively in two prominent blocks of eastern Nepal and Arunachal Himalaya in the examined region. These blocks are also more prominent for the results of 20, 50 and 100 years earthquake magnitudes with 90% PNBE i.e. return periods of 190 (M_{190}), 475 (M_{475}) and 950 (M_{950}) years along with two additional blocks in the Eastern Himalayan Syntaxis (EHS) and Yadong-Gulu rift near Lhasa in the Tibet Plateau. These earthquake magnitudes are expected to exceed Mw 8.5, 8.6 and 8.9 during the next 190, 475 and 950 years, respectively in these blocks. The spatial distribution of earthquake hazards in the region reveals the complex seismotectonic setup and high crustal heterogeneity.

1. Introduction

The quantification of seismicity rates in different seismotectonic settings is always a topic of interest and worth, and probing into differences in subduction zones, extensional regimes and conservative strike-slip boundaries, is fascinating. The Himalaya provides a different perspective, a massive example of a continent-continent collision, in which great earthquakes have occasionally occurred. Various stochastic and probabilistic methods have been introduced in the past to estimate the earthquake hazard and return periods of different earthquake magnitudes. These methods comprise the assessment of the recurrence of a future earthquake of a particular size within a fixed interval of time in a region. The most common parameter in such studies is the earthquake magnitude recurrence. In terms of nomenclature, the phrase "earthquake hazard" is an expression of the severity of seismicity and is quite different from the commonly encountered phrase "seismic hazard", which describes the exceedance probability of strong ground shaking consequent to the earthquake occurrences.

Among many statistical approaches used, asymptotic extreme value statistics has the benefit that it does not necessitate an investigation of the whole process of all earthquake occurrences, whereas, for example, the method of Gutenberg and Richter (1944) requires the whole process and all earthquake occurrences. Gumbel's (1935, 1954, 1958) extreme value statistics consider the sequence of seismic events assembled from the biggest earthquake magnitudes from a group of prearranged intervals of time. It directly addresses the part process of the larger and rarer earthquakes in the tail of the distribution. This theory has been implemented in various areas by many scientists who usually adopted Gumbel's third asymptotic method (*GIII*) when dealing with seismicity and earthquake magnitude occurrence (for example Epstein and Lomnitz, 1966; Burton, 1977; Makropoulos, 1978; Burton et al., 1984; Al-Abbasi and Fahmi, 1985; Makropoulos and Burton, 1985; Tsapanos and Burton, 1991; Tsapanos 1998; Shanker et al., 2007; Yadav et al., 2012; Burton and Bayliss, 2013; Yadav et al., 2013; Tsapanos et al.,

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Spatial variability of earthquake hazard parameters, return periods and probabilities of earthquake occurrences in the eastern Himalayan seismic belt

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ARTICLE INFO

Keywords:
Earthquake hazard
Eastern Himalayan seismic belt
Maximum likelihood method
Regional maximum magnitude
Return periods
Probabilities of occurrences

ABSTRACT

We present a brief atlas of the geographical distribution of earthquake hazard parameters, return periods and probabilities of exceedance of medium to large earthquakes in a hazardous region of the eastern Himalayan seismic belt. A maximum likelihood procedure is applied for the purpose that allows earthquake data during 1500–2019 containing the mixed files of both the historical as well as instrumental era. The results reveal a high activity rate (λ) in eastern Nepal and Arunachal Himalaya, and a low value in the Bhutan-middle Arunachal-Assam Himalaya. A high b-value (or β-value) associated with eastern Nepal and its vicinity, Shillong Plateau and eastern Arunachal Himalaya reveals low crustal stress, while a low b-value associated with Bhutan, middle Arunachal, western Assam and east of the Lhasa reveals high differential crustal stress. The high values of M_{max} (Mw > 8.0) are perceived in eastern Nepal, eastern Arunachal Himalaya, Shillong Plateau and south of Lhasa in Tibet. The return periods and probability of exceedance for magnitude Mw 6.0, 6.5 and 7.0 during the next 10-, 20- and 50-years are calculated and correlated with the prevailing tectonics and seismicity of the area. The low return periods (10–20 years) and high probabilities (>0.8) for magnitudes Mw 6.0–6.5 are associated with eastern Nepal, Shillong-Kopli Fault-Arunachal Himalaya, Eastern Himalayan Syntaxis and Yadong-Gulu rift in Tibet revealing potential regions for future earthquake hazard. These hazard maps are highly useful to prepare earthquake hazard mitigation plan in high hazard regions.

1. Introduction

The territory of the eastern Himalayan seismic belt including eastern Nepal, Sikkim, Bhutan, Assam, Arunachal Himalaya and southern Tibet (Fig. 1) bounded by coordinates 26°–30° N and 85°–97° E is a highly seismic hazardous region in the Indian subcontinent, wherein the Indian and Eurasian plates converged and developed the world's highest mountain Himalaya (Kayal, 2010; Dasgupta et al., 2021). The region has a rich seismic history of the occurrences of great earthquakes, viz. June 12, 1897 (Mw 8.1) Shillong Plateau, January 15, 1934 (Mw 8.2) Bihar-Nepal and August 15, 1950 (Mw 8.6) Assam earthquakes. The Bureau of Indian Standard (BIS, 2002) reconsidered the seismic design code for the entire Indian continent, according to which the study region falls in the seismic zones V and IV that can generate earthquakes of magnitude 8 and 7, respectively in the future. According to the NDMA (2011) report, the region exhibits 0.35–0.55g of peak ground acceleration (PGA) for a 10% and 2% probability of exceedance in 50 years (i.e. 475 and 2475 years of return periods, respectively). However, Nath and Thingbaijam (2012) obtained high PGA values of 0.93g and 1.93g for a 10% and 2% probability of exceedance in 50 years, respectively. Keeping in view of the high earthquake potentiality and seismic hazard scenario of the region, it is urgently required to study the present-day scenario of earthquake hazard for future seismic hazard mitigation using the most updated catalogue and sophisticated technique.

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ORIGINAL PAPER

Characterization of meteorological parameters over Dokriani Glacier catchment, Central Himalaya: implications for regional perspectives

Jairam S. Yadav[1] · Sameer K. Tiwari[1] · Santosh K. Rai[1] · Rouf A. Shah[1] · R. B. S. Yadav[2] · Rajiv Kumar[2]

Received: 2 March 2021 / Accepted: 8 August 2022

Abstract
The Himalayan meteorology is important for understanding cryospheric-hydrological processes and climate change forecasts. The meteorological observations in the Indian Himalayan region (IHR), notably in glacierized catchments, are scarce. Therefore, the present study aims to demonstrate a comprehensive investigation of meteorological parameters (e.g., temperature, relative humidity, precipitation, wind speed and direction, radiation fluxes, albedo, and pressures) over the Dokriani Glacier catchment (DGC) using time-series data (2011–2016) obtained from a network of three automatic weather stations (AWSs). The study also provides new insights into characteristics of meteorological variables at inter- and intra-seasonal scales (winter: December–February, Pre-monsoon: March–May, Monsoon: June–September, and Post-monsoon: October–November). The results show that the albedo and outflux radiation decreases rapidly with the onset of monsoon season, while there is an increase of relative humidity (RH) and positive degree-days (PDDs). The positive temperature (> 2℃) at higher elevations (> 5500 m) raise serious concerns about the summer accumulation characteristics of the Dokriani glacier. The DGC has an average near-surface temperature lapse rate (NSTLR) of 6.0°C km^{-1}, higher in the pre-monsoon and lower during the monsoon. The wind speed and albedo are more sensitive during winter and pre-monsoon seasons. The air temperature, rainfall, and relative humidity exhibit significant seasonal fluctuation, whereas other meteorological variables have a nearly comparable seasonal pattern. The Indian summer monsoon (ISM) significantly influences all climatic factors. This may be utilized to examine the Dokriani glacier's mass budget and melt rate with other dependent factors, such as glacier hypsometry, orientation, surface velocity, and the extent of debris-cover. Furthermore, the dataset of this study may be correlated with hydro-meteorological observations in various regions of the Himalaya and deciphered using a regional climate dataset; for example, the Kedarnath tragedy-2013 and the most recent flash flood that occurred in Raunthi valley, Tapovan on February 07, 2021.

1 Introduction

The topographic complexity of mountain catchments regulates the cryospheric processes and, hence, controls water resources (Viviroli et al. 2011; Huss et al. 2017). The Himalayan mountain chain has a major impact on South Asia's hydro-meteorology due to its unique geographical position in the mid-latitudes. About 17% of the world's population uses meltwater obtained from snow and glacier fields (Bhutiyani et al. 2007; Immerzeel et al. 2014). Temperature and precipitation are key factors in influencing the differential melting response and accumulation of glaciers because of their strong coupling with energy exchange processes between the atmosphere and earth's surface. Although, it is difficult to retrieve long-term environmental information from these glacierized catchments, yet necessary from various water resource viewpoints.

In mountain catchments, weather conditions fluctuate abruptly in space and time due to the topographic effect (Shea et al. 2015). The spatial and temporal airflow feeds energy into the system through air temperature, humidity, wind speed, and precipitation (Barry and Chorley, 2009). The air travels through varied pathways depending upon the barrier's shape and size. As a result, glaciers within the same region may not be exposed to the same climate

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3.46

Estimation of Site Amplification Factor and Predominant Frequency in and Around Panchkula City, Haryana, India

M. Sandhu, R. B. S. Yadav, D. Kumar, and Abhishek

Abstract In this study, we used the horizontal-to-vertical spectral ratio (HVSR) technique to estimate the site amplification factor and the fundamental/predominant frequency at some of the sites in the Panchkula city of Haryana state of India. This technique gained popularity when Nakamura [1] estimated the site amplification factor by considering the horizontal-to-vertical spectral ratio of microtremor noise data. This method helps in the seismic microzonation of an area with very less seismicity. It has been found that the site amplification factor and the fundamental frequencies at 19 sites in the city vary in the range of 1.9–3.1 and 0.4–1.0 Hz, respectively, depending upon the local geological conditions. The sites associated with the riverside show more site amplifications (> 2.8), while sites away from the river show less amplifications (< 2.1). Similarly, we observed that some sites show higher predominant frequencies (> 0.85), while some sites show less predominant frequencies (< 0.5). It has been also observed that some sites show clear H/V peaks, while some sites show broad peaks due to poor impedance contrast between bedrock and soil. The variation of site amplification factor and predominant frequency in the study region exhibits variable geological conditions and site characteristics. This study is highly useful for civil engineers in designing and constructing high-rise buildings in this region.

Keywords Site amplification · Predominant frequency · Microzonation · Horizontal-to-vertical spectral ratio (HVSR)

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Estimation of Site Amplification Factor and Predominant Frequency in and Around Panchkula City, Haryana, India

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Abstract In this study, we used the horizontal-to-vertical spectral ratio (HVSR) technique to estimate the site amplification factor and the fundamental/predominant frequency at some of the sites in the Panchkula city of Haryana state of India. This technique gained popularity when Nakamura [1] estimated the site amplification factor by considering the horizontal-to-vertical spectral ratio of microtremor noise data. This method helps in the seismic microzonation of an area with very less seismicity. It has been found that the site amplification factor and the fundamental frequencies at 19 sites in the city vary in the range of 1.9–3.1 and 0.4–1.0 Hz, respectively, depending upon the local geological conditions. The sites associated with the riverside show more site amplifications (> 2.8), while sites away from the river show less amplifications (< 2.1). Similarly, we observed that some sites show higher predominant frequencies (> 0.85), while some sites show less predominant frequencies (< 0.5). It has been also observed that some sites show clear H/V peaks, while some sites show broad peaks due to poor impedance contrast between bedrock and soil. The variation of site amplification factor and predominant frequency in the study region exhibits variable geological conditions and site characteristics. This study is highly useful for civil engineers in designing and constructing high-rise buildings in this region.

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Spatial Distribution of the Gutenberg-Richter Parameters and Fractal Dimension and Their Correlations in Northeast India and Its Vicinity

R. B. S. Yadav, P. Chauhan, M. Sandhu, R. Kumar, and V. Singh

Abstract The study aims to estimate the Gutenberg-Richter parameters (*a* and *b*) and fractal dimension (*Dc*) using the maximum likelihood estimation (MLE) method in 18 shallow (≤70 km) and 5 intermediate (>70 km) depth seismic zones in northeast India and its vicinity. Scaling relations have been developed among the estimated hazard parameters. A unified and comprehensive earthquake catalogue spanning the period from 1897 to 2016 is used for the purpose. The regions associated with the low *b*-value and high *Dc* value have been considered the utmost potential regions for the incidence of big events in the examined area. The *b*-values in the examined region vary from 0.59 to 1.31 in shallow zones and from 0.88 to 0.98 in intermediate zones. Similarly, the *Dc* values vary from 1.81 to 2.65 in shallow zones and 2.22 to 2.71 in intermediate zones. The low *b*-values (less than 0.9) and the high *Dc* values (greater than 2.0) are related to shallow zones 3 (Arunachal Himalaya), 6 (Eastern Himalayan syntaxis), 13 (Burmese region), 17 (south of Shillong Plateau) and all intermediate zones in Indo-Burmese regions. This makes these zones the most vulnerable to high earthquake hazards. The associations between D_c and *b*, and D_c and *a/b* illustrate a positive and negative correlation, respectively. The spatial variations of these parameters can be used as important parameters of earthquake hazard levels in the region.

Keywords *b*-value · Fractal dimension · Earthquake hazard · Northeast India

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Spatial Distribution of the Gutenberg-Richter Parameters and Fractal Dimension and Their Correlations in Northeast India and Its Vicinity

R. B. S. Yadav, P. Chauhan, M. Sandhu, R. Kumar, and V. Singh

Abstract The study aims to estimate the Gutenberg-Richter parameters (a and b) and fractal dimension (Dc) using the maximum likelihood estimation (MLE) method in 18 shallow ($\leq$70 km) and 5 intermediate (>70 km) depth seismic zones in northeast India and its vicinity. Scaling relations have been developed among the estimated hazard parameters. A unified and comprehensive earthquake catalogue spanning the period from 1897 to 2016 is used for the purpose. The regions associated with the low b-value and high Dc value have been considered the utmost potential regions for the incidence of big events in the examined area. The b-values in the examined region vary from 0.59 to 1.31 in shallow zones and from 0.88 to 0.98 in intermediate zones. Similarly, the Dc values vary from 1.81 to 2.65 in shallow zones and 2.22 to 2.71 in intermediate zones. The low b-values (less than 0.9) and the high Dc values (greater than 2.0) are related to shallow zones 3 (Arunachal Himalaya), 6 (Eastern Himalayan syntaxis), 13 (Burmese region), 17 (south of Shillong Plateau) and all intermediate zones in Indo-Burmese regions. This makes these zones the most vulnerable to high earthquake hazards. The associations between D_c and b, and D_c and a/b illustrate a positive and negative correlation, respectively. The spatial variations of these parameters can be used as important parameters of earthquake hazard levels in the region.

Keywords b-value · Fractal dimension · Earthquake hazard · Northeast India

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Lecture Notes in Civil Engineering

Manish Shrikhande
Pankaj Agarwal
P. C. Ashwin Kumar *Editors*

Proceedings of 17th Symposium on Earthquake Engineering (Vol. 4)

Springer

Characteristics of Strong Ground Motions for Delhi National Capital Region (NCR) Using Small to Moderate Size Earthquakes

Abhishek, Manisha Sandhu, and Babita Sharma

Abstract The characteristics of strong ground motions such as spectral acceleration and their behaviour on the structural design code are rigorously studied using small to moderate earthquakes occurred in the Delhi NCR region and recorded at local seismic network installed by IIT, Roorkee under the sponsorship of the Ministry of Earth Sciences. Seven earthquakes with magnitude range 3.3 to 4.9 occurred at depths of 5 to 22 km have been used in the present study. Total 159 earthquake waveforms from 27 seismic stations are processed for this purpose. The observed peak ground acceleration (PGA) associated with 5 March 2012 (M 4.9) lies in range of 2.4 to 30.8 cm/s^2 and the peak ground velocity (PGV) lies in between 0.07 and 0.88 cm/s. The maximum PGA (30.8 cm/s^2) is observed at Jaffarpur station and minimum PGA (2.6 cm/s^2) is observed at ridge observatory of New Delhi. The maximum horizontal spectral amplification occurred at 0.054 s in Holocene age formation, 0.109 s in Pleistocene age formation and 0.068 s in Proterozoic age formation. The maximum vertical spectral amplification is at 0.045 s in Holocene age formation, 0.084 s in Pleistocene age formation and 0.060 s in Proterozoic age formation. The normalized acceleration response spectra for Holocene, middle to late Pleistocene and Proterozoic age group is overestimated when compared with that of the Bureau of Indian standard code particularly in short period range, whereas it is underestimated for the longer periods associated with the available data. The present analysis is beneficial for the seismic hazard studies in the Delhi NCR and may be utilized to improve the design code by characterizing the strong motion scenarios in the region.

Keywords Strong ground motion · Amplification · Normalized response spectra

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European Journal of Mechanics - A/Solids

Volume 99, May–June 2023, 104908

Gradation and porosity's effect on Love waves in a composite structure of piezoelectric layers and functionally graded porous piezoelectric material

Anil Kumar Vashishth [a], Umang Bareja [b]

Show more

https://doi.org/10.1016/j.euromechsol.2022.104908

3.7.1 Number of collaborative activities with other institutions/ research establishments/industry for research and academic development of faculty and students per year 2022-23

3.7.1.1: Total number of Collaborative activities with other institutions/ research establishment/industry for research and academic development of faculty and students during the year 2022-23

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Year of collaboration	Duration	Nature of the activity	
	Hkkjrh; i=dkfjrk ,frgkfld ifjis{; ,oe orsekudkfyd lnHk	Haryana Granth Academy, Panchkula	**Media Faculty and Students**	**2022**	**One Day**	**Seminar**	
	Training programme for student journalists	Newshound, India Foundation	**Media Students**	2022	One Day	Training Programme	
	Workshop on Digital Print Graphics	World Print and Communication Forum	Students of Printing & Packaging	2022	One Day	National Workshop	


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29 मार्च, 2022


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राष्ट्रीय संगोष्ठी

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MURTHAL-SONEPAT-131039
HARYANA

Ref. DCRUST/BT/18/180

Dated 11·10·2018

To

The Chairman,
Department of Biochemistry
Kurukshetra University,
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Sub: Consent Letter to be a Co-Supervisor of PhD student

With reference to above mentioned subject, I, **Dr. Krishan Kumar Selwal**, Assistant Professor, Department of Biotechnology, DCRUST, Murthal hereby giving my consent to act as a Co-Supervisor of Mr. Sandeep Kumar who is pursuing his PhD research under the supervision of Dr. Vinita Bhankar, Assistant Professor, Department of Biochemistry, Kurukshetra University, Kurukshetra. I will guide him for entire duration of his research work and will supervise him throughout the research process.

Thanking you.

Keelwal
11/10/18
Dr. Krishan Kumar Selwal
Assistant professor

A copy of the above is forwarded to the following for information

1. PA to V.C. for kind information to Hon'ble Vice Chancellor
2. PA to Registrar for kind information to Registrar
3. Chairperson, Department of Biotechnology for information and record
4. Coordinator Research for information and record

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From:
Sonia Sindhu, Professor & Head,Vety. Physiology & Biochemistry

To,
J.B.Phogat, Dean PGS, Dean CODST,Dean PGS
Sandeep Kumar, Sr. Scientist,Vety. Physiology & Biochemistry

Document No.:- PB1323-140122

Subject: Permission for inclusion of name as Co-Major Advisor/Guide for carrying of PhD degree of Student fromKurukshetra University

Please find the attachment after doing the needfull.

Pl. send the case again as discussed telephonically.

J.B.Phogat
Dean PGS,Dean CODST
Post Graduate Studies
Jan 14 2022 10:26AM

All the required information has already been attached please.

Sonia Sindhu
Professor & Head
Department of Vety. Physiology and Biochemistry
Jan 14 2022 10:32AM

For n/a pl.

J.B.Phogat
Dean PGS,Dean CODST
Post Graduate Studies
Jan 14 2022 10:37AM

The request of Dr. Sandeep Kumar to act as Co-Major Advisor in the Advisory Committee of the PG student from KU, Kurukshetra may kindly be perused. The case for inclusion of Dr. Sandeep Kumar has discussed in the 270th meeting of DAC held on 13.01.2022 at 12:00 noon and same has been recommended with the following riders: 1. There will be no financial liability on the University. 2. The publications/IPRs arising out of the said work will be jointly shared by the two Universities with LUVAS teacher as corresponding author/co-author. Keeping in view of above, the inclusion of name of Dr. Sandeep Kumar, Sr. Scientist, VPB, LUVAS as a Co-Major Advisor/Guide in the Advisory Committee of PG student (Pooja whi, Roll No. 2112) of KUK may be allowed under Rule 5.5 (a) of Chapter III of University Calendar Volume II as LUVAS has MoU with KUK. Therefore, if agreed, may allow the inclusion of Dr. Sandeep Kumar in the advisory committee of concerned student, please.

Rakesh Kumar
Clerk
Post Graduate Studies
Jan 22 2022 3:23PM

Allowed as proposed above

J.B.Phogat
Dean PGS,Dean CODST
Post Graduate Studies
Jan 22 2022 4:02PM

For information and necessary action

Sonia Sindhu

Chairperson
Department of Biochemistry
Kurukshetra University
KURUKSHETRA-136119

To,

The Chairperson,
Department of Biotechnology,
Kurukshetra University, Kurukshetra.

Subject: Regarding Synopsis Seminar Presentation.

Respected sir,

I, Nandini Sinhmar, Research Scholar, would like to present my synopsis seminar on the topic "Isolation, Characterization of Probiotics and Development of Dermal Health Products using Probiotics, Prebiotics and Synbiotics". I therefore request you to kindly allow me for synopsis seminar presentation. I shall be very thankful to you.

Thankyou.

7/2/22

Yours Sincerely,

(Supervisor)

Nandini

Nandini Sinhmar
Research scholar

Dr. Bindu Battan
Assistant Professor,
Department of Biotechnology,
KurukshetraUniversity, Kurukshetra

Forwarded to
Dean Faculty of Life Sc.
for suitable date and
time.

Dr. Surender Verma
Assistant Professor,
Department of Pharmaceutical Science,
Kurukshetra University, Kurukshetra.

Online seminar may be held on 2nd march at 2:30 pm

7-2-2022

CHAIRMAN
Department of Biotechnology
Kurukshetra University,
KURUKSHETRA-136119

Ph.SC-30

03/01/23

MAHARSHI DAYANAND UNIVERSITY, ROHTAK

(A State University established under Haryana Act No. XXV of 1975)
"A" Grade University Accredited by NAAC

No. R&S/Ph.D./R-9/22/_____
Dated _____

To

The Head
Department of Pharmaceutical Sciences
M. D. University, Rohtak

Subject: **Registration of Mr. Bhoj Raj S/o Sh. Bala Ram for Ph.D. Programme in the subject of** Pharmaceutical Science.

Sir/Madam,

It is to inform you that the recommendations of the Post Graduate Board of Studies in Pharmaceutical Sciences for Ph.D. Registration of the student, has been considered and approved by the Dean Academic Affairs as per orders of the Vice-Chancellor vide Endst. No. AC-VI/F-13/22/2601-2750 dated 31.01.2022. The Academic Council has also considered and approved vide Reso. No. 57 dated 19.10.2022 and resolved that **Mr. Bhoj Raj S/o Sh. Bala Ram, (Regn. No. 1918290134)** is allowed for registration to Ph.D. programme **w.e.f. 09.07.2022** on the topic of Research **"Preparation of Cyclodextrin Complex(es) of Selected Compound(s) and their Evaluation for Anti-diabetic Activity"** in the Department of Pharmaceutical Sciences under the supervision of Dr. Vikas Budhwar, Asso. Prof., (Supervisor), Department of Pharmaceutical Sciences, M.D. University, Rohtak and Dr. Manjusha Choudhary, Asstt. Prof., (Co-Supervisor), Institute of Pharmaceutical Sciences, Kurukshetra University, Kurukshetra.

Superintendent (R&S)
For Registrar

Endst. No. R&S/Ph.D./R-9/22/ 57 Dated 03/01/23

Copy of the above is forwarded to the following for information and necessary action:-

1. Dr. Vikas Budhwar, Associate Professor, (Supervisor), Department of Pharmaceutical Sciences, M.D. University, Rohtak.
2. Dr. Manjusha Choudhary, Asstt. Prof., (Co-Supervisor), Institute of Pharmaceutical Sciences, Kurukshetra University, Kurukshetra.
3. Assistant Registrar (Secrecy), M.D. University, Rohtak.
4. Mr. Bhoj Raj S/o Sh. Bala Ram, Research Scholar, Department of Pharmaceutical Sciences, M.D. University, Rohtak.

2/1/23

Superintendent (R&S)
For Registrar