Manipal University Jaipur
Terrestrial Ecosystem Conservation, Restoration, and Sustainable Use Policy

1. Introduction

Manipal University Jaipur acknowledges its responsibility to protect, restore, and sustainably manage the terrestrial ecosystems associated with its campus, including forests, mountains, and drylands. This policy demonstrates our commitment to conservation efforts that support environmental health, biodiversity preservation, and sustainable land use practices.

2. Purpose

The purpose of this policy is to:

a. Set forth guidelines and strategies for the conservation, restoration, and sustainable use of terrestrial ecosystems on university property.

b. Promote biodiversity, strengthen ecosystem resilience, and mitigate climate change impacts.

c. Foster educational and research opportunities focused on terrestrial ecosystem management and sustainability.

Raise awareness amongst stakeholders about sustainable life on land.

3. Policy Statements

3.1. Ecosystem Identification and Assessment

a. Manipal University Jaipur will conduct comprehensive assessments to identify and map the terrestrial ecosystems present on university-owned land.

b. Regular ecosystem assessments will evaluate the health and biodiversity of these ecosystems to inform management decisions.

MANIPAL UNIVERSITY JAIPUR

3.2. Conservation and Restoration

a. The university is committed to conserving existing terrestrial ecosystems and, where necessary, restoring degraded ecosystems.

b. Restoration efforts will prioritize native species, control invasive species, and address soil erosion and habitat loss.

3.3. Sustainable Land Use

a. Land use practices on university property will prioritize sustainability, with a focus on minimizing habitat fragmentation and soil disturbance.

b. Sustainable land management practices will include reforestation, afforestation, and soil conservation measures.

3.4. Biodiversity Protection

a. Manipal University Jaipur will take active measures to protect and enhance biodiversity within terrestrial ecosystems.

b. Monitoring and conservation of endangered or threatened species will be a priority.

3.5. Climate Mitigation and Adaptation

a. Terrestrial ecosystem management will contribute to climate change mitigation through carbon sequestration and reducing greenhouse gas emissions.

b. Adaptation strategies will be developed to address climate change's impacts on terrestrial ecosystems.

3.6. Education and Research

a. The university will integrate terrestrial ecosystem management into its academic programs, offering courses, research opportunities, and experiential learning related to conservation and sustainability.

b. Research initiatives will focus on ecosystem monitoring, restoration techniques, and sustainable land use practices.

4. Implementation

4.1. Responsibility

a. The Office of Registrar Manipal University Jaipur, in collaboration with relevant academic departments, will oversee the implementation and enforcement of this policy.

b. Each university department and research unit will be responsible for integrating terrestrial ecosystem management into their activities where applicable.

4.2. Compliance

a. All members of the university community, including students, faculty, staff, and contractors, are expected to adhere to this policy.

b. Non-compliance may result in disciplinary actions as per university policies.

5. Monitoring and Reporting

Regular assessments will be conducted to track progress toward ecosystem conservation and restoration goals.

6. Review and Revision

This policy will be reviewed annually to ensure its continued effectiveness in conserving, restoring, and sustainably using terrestrial ecosystems on university-owned land. Feedback from the campus community and evolving best practices in ecosystem management will inform any necessary revisions.

7. Conclusion

Manipal University Jaipur is committed to responsible stewardship of the terrestrial ecosystems associated with our campus. By diligently implementing this policy, we aim to protect, restore, and sustainably manage these vital natural resources, fostering biodiversity, enhancing environmental resilience, and providing meaningful educational and research opportunities for our community and future generations.

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Version History

Number	Year	Major Revision
Version 4.0	2023	Focus on Awarenes
Version 2.0	2022	Encourage education and research opportunities
Version 1.0	2020	Initial policy

Approval

MANIPAL UNIVERSITY JAIPUR

Manipal University Jaipur

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c. Encourage education and research opportunities related to terrestrial ecosystem management and sustainability.

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Manipal University Jaipur is committed to being a responsible steward of the terrestrial ecosystems associated with our campus. Through the diligent implementation of this policy, we aim to protect, restore, and sustainably use these vital natural resources, fostering biodiversity, enhancing environmental resilience, and providing valuable educational and research opportunities for our community and future generations.

MANIPAL UNIVERSITY • JAIPUR •

Manipal University Jaipur, Dehmikalan, Near GVK Toll Plaza Jaipur-Ajmer Expressway, Jaipur, Rajasthan 303007
Dir. 91 14 1399 9100 fax. 91 14 1399 9102 www.jaipur.manipal.edu

Version History

Number	Year	Major Revision
Version 2.0	2022	Encourage education and research opportunities
Version 1.0	2020	Initial policy

Approval

MANIPAL UNIVERSITY JAIPUR

Post Event Report

FACULTY OF DESIGN

5days Executive Development Program on

'Bamboo Renaissance: Modern Design Meets Sustainability'

Venue: Online platform

Time: 9:30 AM-12.00 PM (First day)

2:30 PM-4.00 PM (2nd to 5th day)

18th September- 22nd September 2023

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1. Introduction of the Executive development Program:

On World Bamboo Day, the Faculty of Design at Manipal University Jaipur organized a 5-day Executive Development Program titled "Bamboo Renaissance: Modern Design Meets Sustainability" in collaboration with their industrial partner, KONBAC, and the Indian Bamboo Forum, in association with the IGBC Student Chapter, MUJ, and MUJ-TEC. The program was conducted in virtual mode from September 18th to September 22nd, 2023.

2. Objectives of the Seminar:

- Understanding the various application of Bamboo in Exterior and interior spaces.
- To create awareness about bamboo in different regions.
- To understand its production and preservation technique techniques.

3. Beneficiaries of the Event:

- UG Students (Architecture, Design and Construction related Fields)
- PG Students (Architecture, Design and Construction related Fields)
- Research Scholars
- Academicians, Practitioners, and Industry Professionals in the fields of Architecture, Design, Civil, and Structural Engineering.

4. Details of the Speakers:

a) Dr. Jagdish Vengala, Head of EDC & Associate Professor at PVPSIT Vijayawada. Dr. Jagdish Vengala presented various components of bamboo and explained its diverse strength and elastic properties. He also discussed the various IS codes applicable in India for bamboo construction.

b) Prof. Sankalp, an associate professor from CEPT UNIVERSITY. Prof. Sankalp presented various construction techniques related to Bamboo construction, demonstrating proposals from different parts of the world. He elucidated innovative joinery details pertinent to bamboo construction.

c) Prof. Charruchandra K. faculty member at CTARA, IIT Mumbai,discussed various species of bamboo and highlighted their unique thermal, bending, tensile, and compressive strength properties. He also showcased the application of innovative joinery details using Bomcrete (HIB) technology in arch construction. In addition, Prof. Charruchandra K. presented models of bamboo structures subjected to different loads, demonstrating their strength and durability.

d) **Mr. Sanjeev Shashikant Karpe** is a qualified Electrical Engineer has been associated with bamboo Industry for last eighteen years and has pioneered the work in setting up of self-sustainable bamboo-based enterprise in rural India. He is a Founder and Director with Konkan Bamboo & Cane Development Centre (KONBAC), an organization working for sustainable development through use of bamboo as a resource & implementing various bamboo projects successfully for last 17 years. Mr. Sanjeev Karpe explained bamboo construction in India and worldwide.

He stated that bamboo has strong potential to grow in degraded land, requires less water compared to sugarcane, and consumes less embodied energy compared to conventional materials. In the global context, countries such as Colombia and Vietnam have embarked on large-scale bamboo projects, whereas in India, despite being the world's second-largest bamboo producer, its full potential remains largely untapped. In addition, Ar. Sanjeev Karpe presented models of bamboo structures subjected to different loads, demonstrating their strength and durability. Various experiments related to straightening of bamboo and bending it to achieve the required form were also demonstrated.

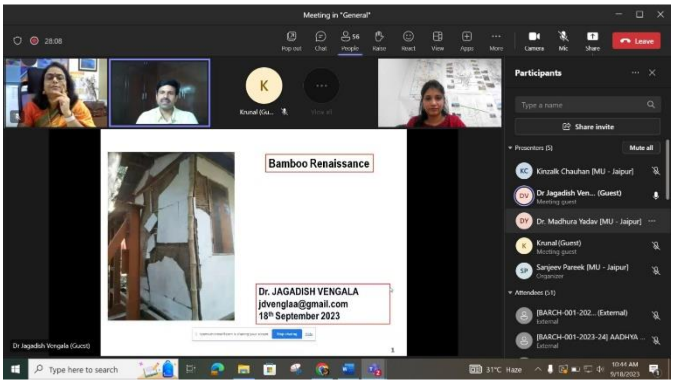
e) Mr. Amitava Sil, a Scientist at IWST (Indian Wood Science and Technology), Kolkata, renowned for his extensive knowledge and experience in the preservation treatment of bamboo species. Mr. Amitava Sil provided insights into preservative treatments and fire retardancy in structural bamboo. He elucidated various treatment methods and processes, highlighting their associated benefits. Furthermore, he offered a demonstration of bamboo's structural frame by showcasing its inherent structural properties.

5. Brief Description of the event:

In the context of a Global Environmental crisis, coupled with economic and health challenges, the time has come for radical cultural awareness, politicians. architects, engineers, developers, and construction companies have an enormous responsibility as the construction industry and processes have an enormous negative impact on the environment. Bamboo is a key natural resource and, together with conscious design, draws a new direction for Contemporary Architecture. The Executive Development Program "Bamboo Renaissance: Modern Design Meets Sustainability is a comprehensive initiative designed to explore the dynamic intersection of modern design principles and sustainable practices within the realm of bamboo. This program is carefully curated to provide Industry Professionals, Academicians, and Researchers with the knowledge and tools needed to harness bamboo's immense potential as an eco-friendly resource in contemporary design and construction. The EDP 2023 will be a great opportunity to facilitate networking with industry experts and peers, enabling participants to exchange ideas, collaborate on projects, and stay updated on emerging trends and innovations in sustainable design.

6. Images

1.Inaugural Address by Prof. (Dr.) Madhura Yadav, Dean, FoD



2. . First day expert lecture by Prof. (Dr.) Jagdish Vegala

3. . Second day expert lecture by Prof. (Dr.) Sankalp

4. . Third day expert lecture by Prof. (Dr.) Charuchandra

5. . Fourth day expert lecture by Mr. Sanjeev Karpe

6. . Fifth day expert lecture by Mr. Amitava Sil

7. . Valedictory session by Mr. Anand Mishra and Mr. Dhirendra Madan

7.Brochure of the event:

8 .Schedule of the event

S.No.	Description	Time
1	Welcome Address by **Prof. (Dr.) Madhura Yadav, Director, SA&D, Manipal University Jaipur**	9.30 AM
2	Inaugural Address by **Hon'ble Mr. Suresh Prabhu, Member of Parliament, India's Sherpa to G7 & G20**	9.35 AM
3	Address by **Prof. (Dr.) Anuradha Chatterjee, Dean, FoD, Manipal University Jaipur**	9.45 AM
4	Address by **Mr. Sanjeev Karpe, Director, KONBAC Maharashtra**	9.55 AM
5	Presidential Address by **Prof. (Dr.) G. K. Prabhu, President, Manipal University Jaipur**	10.10 AM
6	Vote of Thanks by **Prof. Kinzalk chauhan, SA&D, Manipal University Jaipur**	10.20 AM
7.	Fist day Expert Lecture by Dr. Jagdish Vengela	10.30 AM

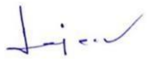
9. Attendance of the Event:

S.No	Full Name	Timestamp
1	Sanjeev Pareek [MU - Jaipur]	22/9/23, 3:53:32 pm
2	Guest	22/9/23, 3:54:07 pm
3	Guest	22/9/23, 5:54:32 pm
4	Archish Bahl	22/9/23, 4:00:51 pm
5	Archish Bahl	22/9/23, 4:04:18 pm
6	Archish Bahl	22/9/23, 4:11:51 pm
7	Archish Bahl	22/9/23, 5:53:53 pm
8	Nikhitha Naresh Moily [B.Des - ID - 2020]	22/9/23, 4:00:54 pm
9	Nikhitha Naresh Moily [B.Des - ID - 2020]	22/9/23, 4:01:23 pm
10	Nikhitha Naresh Moily [B.Des - ID - 2020]	22/9/23, 4:44:28 pm
11	Dr. Ashutosh Saini [MU - Jaipur]	22/9/23, 4:02:27 pm
12	Guest	22/9/23, 4:04:52 pm
13	Guest	22/9/23, 5:04:44 pm
14	Guest	22/9/23, 5:05:01 pm
15	Guest	22/9/23, 5:27:38 pm
16	Guest	22/9/23, 5:27:53 pm
17	Guest	22/9/23, 5:53:49 pm
18	Guest	22/9/23, 4:05:19 pm
19	Guest	22/9/23, 4:49:13 pm
20	Guest	22/9/23, 4:49:16 pm
21	Guest	22/9/23, 5:02:02 pm
22	Guest	22/9/23, 5:02:05 pm
23	Guest	22/9/23, 5:50:05 pm
24	Anjali Adhikari [B ARCH - 2021]	22/9/23, 4:08:47 pm
25	Anjali Adhikari [B ARCH - 2021]	22/9/23, 4:10:48 pm
26	Anjali Adhikari [B ARCH - 2021]	22/9/23, 4:50:38 pm
27	Anjali Adhikari [B ARCH - 2021]	22/9/23, 5:41:03 pm
28	Anjali Adhikari [B ARCH - 2021]	22/9/23, 5:41:07 pm
29	Anjali Adhikari [B ARCH - 2021]	22/9/23, 5:53:53 pm
30	Guest	22/9/23, 4:11:20 pm
31	Guest	22/9/23, 5:53:49 pm
32	Guest	22/9/23, 4:13:26 pm
33	Guest	22/9/23, 4:55:11 pm
34	Guest	22/9/23, 4:55:23 pm
35	Guest	22/9/23, 5:24:41 pm
36	Digvijay Singh Panwar [B.Arch - 2022]	22/9/23, 4:14:24 pm
37	Digvijay Singh Panwar [B.Arch - 2022]	22/9/23, 5:54:03 pm
38	Ananya Tandon [B.Arch - 2022]	22/9/23, 4:14:54 pm
39	Ananya Tandon [B.Arch - 2022]	22/9/23, 4:21:25 pm
40	Ananya Tandon [B.Arch - 2022]	22/9/23, 4:21:47 pm
41	Ananya Tandon [B.Arch - 2022]	22/9/23, 5:31:24 pm
42	Dr. Madhura Yadav [MU - Jaipur]	22/9/23, 4:15:24 pm
43	Dr. Madhura Yadav [MU - Jaipur]	22/9/23, 5:53:44 pm
44	Guest	22/9/23, 4:15:56 pm
45	Guest	22/9/23, 5:53:58 pm
46	Vanshika Sharma [B.Arch - 2022]	22/9/23, 4:17:00 pm
47	Vanshika Sharma [B.Arch - 2022]	22/9/23, 4:31:11 pm
48	Vanshika Sharma [B.Arch - 2022]	22/9/23, 4:32:39 pm
49	Vanshika Sharma [B.Arch - 2022]	22/9/23, 5:53:54 pm
50	Guest	22/9/23, 4:19:15 pm
51	Guest	22/9/23, 5:53:46 pm
52	Kinzalk Chauhan [MU - Jaipur]	22/9/23, 4:20:11 pm
53	Kinzalk Chauhan [MU - Jaipur]	22/9/23, 5:53:49 pm
54	Guest	22/9/23, 4:21:10 pm
55	Guest	22/9/23, 4:22:13 pm
56	Guest	22/9/23, 4:22:16 pm
57	Guest	22/9/23, 4:34:10 pm
58	Guest	22/9/23, 4:34:12 pm
59	Guest	22/9/23, 5:10:30 pm
60	Guest	22/9/23, 4:22:46 pm
61	Guest	22/9/23, 5:54:03 pm
62	Dr. Sunanda Kapoor [MU - Jaipur]	22/9/23, 4:24:48 pm
63	Dr. Sunanda Kapoor [MU - Jaipur]	22/9/23, 5:49:49 pm
64	Dr. Richa Jagatramka [MU - Jaipur]	22/9/23, 4:25:00 pm
65	Dr. Richa Jagatramka [MU - Jaipur]	22/9/23, 4:25:35 pm
66	Dr. Subhash Chandra Devrath [MU - Jaipur]	22/9/23, 4:25:15 pm
67	Dr. Subhash Chandra Devrath [MU - Jaipur]	22/9/23, 4:36:51 pm
68	Dr. Subhash Chandra Devrath [MU - Jaipur]	22/9/23, 4:56:45 pm
69	Dr. Subhash Chandra Devrath [MU - Jaipur]	22/9/23, 5:54:34 pm
70	Guest	22/9/23, 4:25:34 pm
71	Guest	22/9/23, 4:34:10 pm
72	Nehal Jain [B.Arch - 2022]	22/9/23, 4:26:08 pm
73	Nehal Jain [B.Arch - 2022]	22/9/23, 5:07:24 pm
74	Raunak Prasad [MU - Jaipur]	22/9/23, 4:26:49 pm
75	Raunak Prasad [MU - Jaipur]	22/9/23, 4:53:24 pm
76	Raunak Prasad [MU - Jaipur]	22/9/23, 5:13:20 pm
77	Raunak Prasad [MU - Jaipur]	22/9/23, 5:19:57 pm
78	Annie Iqbal [B.Arch - 2020]	22/9/23, 4:30:35 pm
79	Annie Iqbal [B.Arch - 2020]	22/9/23, 4:30:51 pm
80	Ritu Sharma [PhD - 2020]	22/9/23, 4:30:52 pm
81	Guest	22/9/23, 4:33:54 pm
82	Guest	22/9/23, 4:34:17 pm
83	Guest	22/9/23, 4:34:25 pm
84	Guest	22/9/23, 5:28:55 pm
85	Guest	22/9/23, 4:34:56 pm
86	Guest	22/9/23, 5:53:34 pm
87	Guest	22/9/23, 4:37:48 pm
88	Guest	22/9/23, 5:43:48 pm
89	Ishika Singhal [B-ARCH - 2019]	22/9/23, 4:38:08 pm
90	Ishika Singhal [B-ARCH - 2019]	22/9/23, 5:53:56 pm
91	Pavani Pandey [B-ARCH - 2019]	22/9/23, 4:38:12 pm
92	Pavani Pandey [B-ARCH - 2019]	22/9/23, 5:53:54 pm
93	Sneh Singh [MU - Jaipur]	22/9/23, 4:39:26 pm
94	Sneh Singh [MU - Jaipur]	22/9/23, 5:54:02 pm
95	Nandini Rawat [B-ARCH - 2019]	22/9/23, 4:40:02 pm
96	Nandini Rawat [B-ARCH - 2019]	22/9/23, 4:55:44 pm
97	Nandini Rawat [B-ARCH - 2019]	22/9/23, 4:56:05 pm
98	Nandini Rawat [B-ARCH - 2019]	22/9/23, 4:56:19 pm
99	Nandini Rawat [B-ARCH - 2019]	22/9/23, 4:56:47 pm
100	Nandini Rawat [B-ARCH - 2019]	22/9/23, 5:38:17 pm
101	HARSH VARDHAN PATHAK [B.Arch - 2019]	22/9/23, 4:41:49 pm
102	HARSH VARDHAN PATHAK [B.Arch - 2019]	22/9/23, 5:53:31 pm
103	[BARCH-001-2023-24] A ANANYA	22/9/23, 4:42:30 pm
104	[BARCH-001-2023-24] A ANANYA	22/9/23, 4:44:46 pm
105	[BARCH-001-2023-24] A ANANYA	22/9/23, 4:45:11 pm
106	[BARCH-001-2023-24] A ANANYA	22/9/23, 4:48:13 pm
107	[BARCH-001-2023-24] CHANDRIKA VERMA	22/9/23, 4:42:42 pm
108	[BARCH-001-2023-24] CHANDRIKA VERMA	22/9/23, 4:49:18 pm
109	Arunima Kiro [B-ARCH - 2019]	22/9/23, 4:42:42 pm
110	Arunima Kiro [B-ARCH - 2019]	22/9/23, 5:53:54 pm
111	[BARCH-001-2023-24] AANYA GUPTA	22/9/23, 4:42:45 pm
112	[BARCH-001-2023-24] AANYA GUPTA	22/9/23, 5:07:14 pm
113	Aamera Quazi [M. Des (Major Interior Design) - 2022]	22/9/23, 4:43:56 pm
114	Aamera Quazi [M. Des (Major Interior Design) - 2022]	22/9/23, 4:48:30 pm
115	Pushpak Bhagwati	22/9/23, 4:44:49 pm
116	Guest	22/9/23, 4:44:59 pm
117	Guest	22/9/23, 4:53:40 pm
118	Guest	22/9/23, 4:46:41 pm
119	Guest	22/9/23, 5:40:51 pm
120	Guest	22/9/23, 5:40:56 pm
121	Guest	22/9/23, 5:49:49 pm
122	Pooja (Guest)	22/9/23, 4:47:12 pm
123	Pooja (Guest)	22/9/23, 5:37:19 pm
124	Pooja (Guest)	22/9/23, 5:43:22 pm
125	Aashima Mathur [B-ARCH - 2019]	22/9/23, 4:47:19 pm
126	Aashima Mathur [B-ARCH - 2019]	22/9/23, 5:08:14 pm
127	Aashima Mathur [B-ARCH - 2019]	22/9/23, 5:08:32 pm
128	Mansi [B.Arch - 2020] (Guest)	22/9/23, 4:47:26 pm
129	Mansi [B.Arch - 2020] (Guest)	22/9/23, 5:53:49 pm
130	Guest	22/9/23, 4:51:12 pm
131	Guest	22/9/23, 5:43:30 pm
132	Bhavesh Khemka [B ARCH - 2021]	22/9/23, 4:51:41 pm
133	Kartik Gehlot [B ARCH - 2021]	22/9/23, 4:51:56 pm
134	Vaishnavi Shukla [B Arch - 2021]	22/9/23, 4:52:02 pm
135	Vaishnavi Shukla [B Arch - 2021]	22/9/23, 5:35:09 pm
136	abhijeet yadav (Guest)	22/9/23, 4:52:08 pm
137	Guest	22/9/23, 4:52:10 pm
138	Guest	22/9/23, 5:43:28 pm
139	Pranat Kothari [B.Arch - 2022]	22/9/23, 5:52:35 pm
140	Pranat Kothari [B.Arch - 2022]	22/9/23, 4:54:01 pm
141	Pranat Kothari [B.Arch - 2022]	22/9/23, 4:56:02 pm
142	Pranat Kothari [B.Arch - 2022]	22/9/23, 5:11:31 pm
143	[BARCH-001-2023-24] TANMAY GUPTA	22/9/23, 4:52:38 pm
144	Guest	22/9/23, 4:52:49 pm
145	Guest	22/9/23, 5:53:16 pm
146	Vanshika Chandel [B-ARCH - 2019]	22/9/23, 4:53:06 pm
147	Vanshika Chandel [B-ARCH - 2019]	22/9/23, 5:25:50 pm
148	Neha Saxena [MU - Jaipur]	22/9/23, 4:53:23 pm
149	Neha Saxena [MU - Jaipur]	22/9/23, 5:32:57 pm
150	Guest	22/9/23, 4:53:30 pm
151	Guest	22/9/23, 5:54:18 pm
152	Guest	22/9/23, 4:54:23 pm
153	Guest	22/9/23, 5:46:48 pm
154	Sajal Panwar [B.Arch - 2022]	22/9/23, 4:54:10 pm
155	Sajal Panwar [B.Arch - 2022]	22/9/23, 4:54:19 pm
156	Sajal Panwar [B.Arch - 2022]	22/9/23, 4:54:37 pm
157	Sajal Panwar [B.Arch - 2022]	22/9/23, 5:13:19 pm
158	Sajal Panwar [B.Arch - 2022]	22/9/23, 5:13:45 pm
159	Sajal Panwar [B.Arch - 2022]	22/9/23, 5:13:56 pm
160	Sajal Panwar [B.Arch - 2022]	22/9/23, 5:14:12 pm
161	Sajal Panwar [B.Arch - 2022]	22/9/23, 5:51:42 pm
162	Khushi Vipulkumar Chaudhari [B ARCH - 2021]	22/9/23, 4:55:09 pm
163	Khushi Vipulkumar Chaudhari [B ARCH - 2021]	22/9/23, 5:41:36 pm
164	Aishwarya Singh Rathore [B Arch - 2021]	22/9/23, 4:55:12 pm
165	Aishmeen Kaur [B ARCH - 2021]	22/9/23, 4:55:32 pm
166	Aishmeen Kaur [B ARCH - 2021]	22/9/23, 5:15:44 pm
167	Naveen Sharma	22/9/23, 4:58:59 pm
168	Guest	22/9/23, 4:59:12 pm
169	Guest	22/9/23, 5:25:53 pm
170	Guest	22/9/23, 5:03:45 pm
171	Guest	22/9/23, 5:26:59 pm
172	Harsh Shrivastav [B.Arch - 2021]	22/9/23, 5:05:52 pm
173	Harsh Shrivastav [B.Arch - 2021]	22/9/23, 5:46:09 pm
174	Arghya B S Bhagwat [B.Arch - 2022]	22/9/23, 5:07:24 pm
175	Aarya Chandiramani [B.Arch - 2022]	22/9/23, 5:08:13 pm
176	Aarya Chandiramani [B.Arch - 2022]	22/9/23, 5:28:01 pm

10.Weblink:

https://jaipur.manipal.edu/content/dam/manipal/muj/fod/Document/eventlist/EDP%20ON%20Bamboo%20-Event%20report.pdf

11.Event Coordinators:



- Ar. Sanjeev Pareek (Assistant Professor, SA&D)
  Ar. Kinzalk Chauhan (Assistant Professor, SA&D)

MUJ/DSW/Society Connect/ Oct2023/03

DIRECTORATE OF STUDENT'S WELFARE

(SOCIETY CONNECT)

#DAANUTSAV 2023

Plantation Drive

3rd October 2023

Date: 3rd October 2023

MANIPAL UNIVERSITY
JAIPUR

Index

1. Introduction of the Event

"A nation that destroys its soils destroys itself. Forests are the lungs of our land, purifying the air and giving fresh strength to our people. " Trees are indispensable for life. Man can't live without trees. However, the present condition of forests in the world, especially developing countries is pathetic and miserable. Forests are the source of life. They are the giving angels. They give man oxygen, rains, wood, fruit, make the world look so beautiful, yet the sinister man kills them! Who will be more inhumane than man himself? Cutting of forests ultimately endangers man's own existence. Trees are important to the environment; they recycle water and process carbon dioxide in the atmosphere through photosynthesis. They are the world's full-time purifiers of air and water. Their cutting will disturb the natural water cycles which will lead to the shortage of fresh water in the water reserves of the world.

Rotaract Green Club under Society Connect organized a Plantation Drive on account of DAAN UTSAV 2031. It took place on the 3rd of October from 10 a.m. Students were taken to the Mahatma Gandhi School, Begus for the drive. The drive aimed to instill a sense of discipline and respect for the environment while doing our part.

2. Objective of the Event

- Spread awareness on the importance of afforestation
- Direct students' mind in constructive activities
- Contribution to the society
- Promote tree planting
- Create awareness regarding importance of ecology
- Attempt at reducing pollution and improve green ambience

3. Beneficiaries of the Event

Community

4. Brief Description of the event

Rotaract Green Club organized the Plantation Drive on the 3rd October at 9 a.m. on account of DAAN UTSAV 2023. The drive's main aim was to direct student's mind in constructive activities with the positive outcome through the facilitation of contributing to the nature and environment.

It also aimed at spreading awareness about the effects of global warming and the positive effects of planting trees. The students gathered on campus to go to the Mahatma Gandhi School, Begus.

The students participated in the drive enthusiastically and helped each other in planting the saplings. All the saplings were planted in the school ground by students. Participants were highly energetic to make the event a big success. A spirit of teamwork, exchange of ideas and enthusiasm of the participants especially among the students could be seen. Pictures were taken. The drive was successfully conducted by planting 40-50 saplings.

5. Photographs of the event

Image 1. Students and Faculty planting saplings

Image 2 Students participating in the Drive.

Students participating in the Drive.

Image 4 Giving the manure to the newly plant samplings

6. Brochure or creative of the event

Plantation Drive

7. Schedule of the event

S.NO.	Name of the Event	Time	Place
1.	Plantation Drive	10:00 AM	Mahatma Gandhi School (English Medium) Begus.

A bus from MUJ was taken to the school in the morning.

8. Attendance of the Event

Total attendee- 67

S.No.	Reg. NO.	Name of Students	Institute Name
1	23FE10ITE00079	Amisha anand	Manipal University Jaipur
2	23FE10CAI00360	shaivi adesh	Manipal University Jaipur
3	23FE10CSE00060	Amay Garg	Manipal University Jaipur
4	23FE10CDS00177	Manas Mathur	Manipal University Jaipur
5	23fe10bte00029	Saloni kamal	Manipal University Jaipur
6	23FE10CSE00508	Dev Dhawan	Manipal University Jaipur
7	23fe10cii00035	Bhargavi Anand	Manipal University Jaipur
8	220606004	Pranjal Puri	Manipal University Jaipur
9	23FA10BSP00028	Anupama Rustagi	Manipal University Jaipur
10	23FE10CCE00085	Siddhartha tiwari	Manipal University Jaipur
11	23FA10BAP00002	Tanisha Mathur	Manipal University Jaipur
12	23FD10BFD00009	Mariya Shabbir Baiwala	Manipal University Jaipur
13	23FE10CDS00224	Harsh Ajmera	Manipal University Jaipur
14	23fe10cds00125	Suryanshi Singh	Manipal University Jaipur
15	23fs10mat00009	Malavika ramdas	Manipal University Jaipur
16	221007021	Arshi Jain	Manipal University Jaipur
17	23FE10CSE00137	Stuti Dixit	Manipal University Jaipur
18	23fe10cii00094	Aarohi Tyagi	Manipal University Jaipur
19	23FE10CSE00152	Gautam Kakkar	Manipal University Jaipur
20	23FE10CSE00318	Krish Ray	Manipal University Jaipur
21	23FE10CII00076	Kriissh Marwaha	Manipal University Jaipur
22	229310321	Shiv Rajput	Manipal University Jaipur
23	23FS10BIO000051	Ragini Singh Thakur	Manipal University Jaipur
24	23FS10BIO000052	Anukriti sharma	Manipal University Jaipur
25	220901073	Diya Mittal	Manipal University Jaipur
26	23FE10CSE00081	Smmayan Gupta	Manipal University Jaipur
27	229309083	Raghav Gupta	Manipal University Jaipur
28	23FE10CDS00397	Hrishita Singh Timaney	Manipal University Jaipur
29	23FE10ITE00203	Sarah Sharda	Manipal University Jaipur
30	23fa10bsp00025	Jasleen kaur	Manipal University Jaipur

31	23FA10BSP00039	Jiya Kumar	Manipal University Jaipur
32	23FA10BSP00004	Aarya Mahale	Manipal University Jaipur
33	220606020	Chaarvi Kumar	Manipal University Jaipur
34	23fa10bsp00058	Kashvi Mahajan	Manipal University Jaipur
35	229301095	Shaurya Singh	Manipal University Jaipur
36	23fe10ece00024	Kushagra agrawal	Manipal University Jaipur
37	23FA10BSP00017	Megha Sharma	Manipal University Jaipur
38	23FM10BBA00162	Alina Nadeem	Manipal University Jaipur
39	23FM10BBA00178	Avishi Akhaury	Manipal University Jaipur
40	221007004	Urvi Thakare	Manipal University Jaipur
41	23FA10BAP00027	Natasha Joan Menezes	Manipal University Jaipur
42	23FA10BLE00004	Tanisha chaturvedi	Manipal University Jaipur
43	23fe10cai00579	Arjun Malhotra	Manipal University Jaipur
44	23FE10CAI00352	Maanyata Aul	Manipal University Jaipur
45	220901322	Divyanshi Singh	Manipal University Jaipur
46	229310412	Jatin Verma	Manipal University Jaipur
47	229301094	Yashovardhan Pratap Singh	Manipal University Jaipur
48	23FM10BBA00348	Niska kedia	Manipal University Jaipur
49	221105005	Dhruv Nair	Manipal University Jaipur
50	23FM10BBA00170	Shambhavi Agrawal	Manipal University Jaipur
51	23FE10CDS00241	Armaan Setia	Manipal University Jaipur
52	23FE10CAI00105	Mritunjay Singh	Manipal University Jaipur
53	229311075	Aarna Tyagi	Manipal University Jaipur
54	229302051	Prince jindal	Manipal University Jaipur
55	23FA10BHE00035	Taneesha puri	Manipal University Jaipur
56	220903033	Suhani Jain	Manipal University Jaipur
57	220901391	Dipika Agarwal	Manipal University Jaipur
58	229310222	Aayush Sharma	Manipal University Jaipur
59	221003007	Yachna Jain	Manipal University Jaipur
60	220901002	Anshu jangir	Manipal University Jaipur
61	23FE10CDS00284	Anant Barjatya	Manipal University Jaipur
62	221015074	Rupal Sharma	Manipal University Jaipur
63	23fa10bsp00047	Vartika Agarwal	Manipal University Jaipur
64	23FA10BSP00041	Kali Vithlani	Manipal University Jaipur
65	23FM10BBA00030	Harshal Saini	Manipal University Jaipur
66	23FE10CSE00746	Daksh Sharma	Manipal University Jaipur
67	23FS10BIO00034	PC Rahul	Manipal University Jaipur

9. Feedback of the Event:- The students participated enthusiastically.

(Hemant Kumar)

Assistant Director, Society Connect

Directorate of Student's Welfare

(Prof. AD Vyas)

Director, Directorate of Student's Welfare

DIRECTOR STUDENT WELFARE & PROCTOR
MANIPAL UNIVERSITY, JAIPUR

MANIPAL UNIVERSITY JAIPUR

MUJ/DSW/Society Connect/ 31 Oct 2023

MANIPAL UNIVERSITY JAIPUR

DIRECTORATE OF STUDENT'S WELFARE

(SOCIETY CONNECT)

And

Faculty of Management and Commerce

Department of Business Administration

Activity on

SWACH BHARAT

OCTOBER 31, 2023

1. **Introduction of the Event**
School of Business and Commerce in collaboration with Directorate of Student Welfare (NCC, NSS) and Rotaract Club (Rotary Bapu Nagar) organized a "Awareness on Environment Protection" on October 31, 2023. 40 students and 2 faculty members participated in the campaign. The event took place in Dehmi Kalan hamlet.

2. **Objective of the Event**

The aim of the campaign was to raise awareness about plantation and Environmental Protection.

3. **Beneficiaries of the Event**

Through this initiative, students and villagers had better communication and understanding of the situation.

4. **Details of the Guests**

The event was laid by the students of BBA, BBA(BA), IMBA and Club Members of Rotaract Club MUJ

5. **Brief Description of the event**

School of Business and Commerce, Department of Business Administration in collaboration with Directorate of Student Welfare, Directorate of sports and NCC, NSS organized a plantation drive for creating awareness on environment protection on 31st October 2023. 20 students and 2 faculty members participated in the drive. The group visited various houses in the Begas Village Road and planted saplings and encouraged villagers to take care about environment and newly planted saplings. Students also learned various communication skills and interactive skills with the villagers.

6. **Photographs**

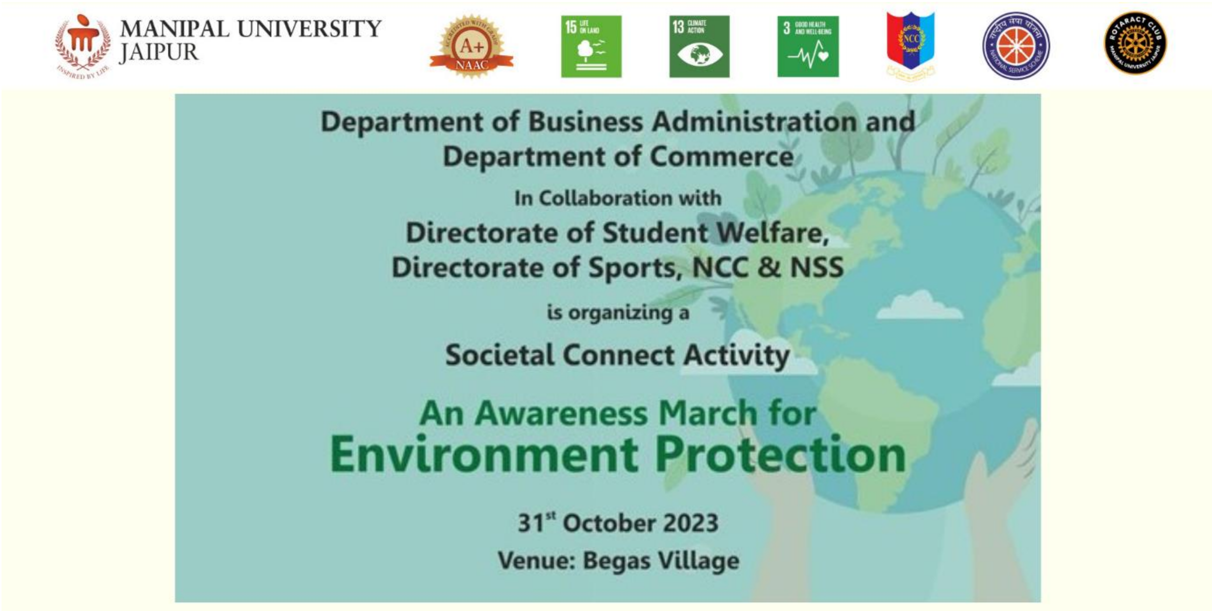
Fig 1 Students at Begus Village for Plantation

Fig 2 Students doing Plantation.

Fig 2 Students & Faculty doing Plantation.

Fig 4 Students & Faculty doing Plantation.

7. Brochure or creative of the event



8. Schedule of the Event

The event took place on October 31, 2023

9. Attendance of the Event (60 student)

Sr. No	Registration No	Attendee Name	Name of Institution
1	23FM10BBA00197	VIPUL SHARMA	Manipal University Jaipur
2	23FM10BBA00198	MUKUND MAHESHWARI	Manipal University Jaipur
3	23FM10BBA00199	ROSHAN GUPTA	Manipal University Jaipur
4	23FM10BBA00200	VANSH MULCHANDANI	Manipal University Jaipur
5	23FM10BBA00227	PAWAN POTALIYA	Manipal University Jaipur
6	23FM10BBA00232	AKSHAT KUMARCHOUDHARY	Manipal University Jaipur
7	23FM10BBA00233	DHAIRYA BANSAL	Manipal University Jaipur
8	23FM10BBA00230	YASH ARORA	Manipal University Jaipur
9	23FA10BSP00028	Anupama Rustagi	Manipal Univesrity Jaipur
10	23FE10CCE00085	Siddhartha tiwari	Manipal Univesrity Jaipur
11	23FA10BAP00002	Tanisha Mathur	Manipal Univesrity Jaipur
12	23FD10BFD00009	Mariya Shabbir Baiwala	Manipal Univesrity Jaipur
13	23FE10CDS00224	Harsh Ajmera	Manipal Univesrity Jaipur
14	23fe10cds00125	Suryanshi Singh	Manipal Univesrity Jaipur
15	23fs10mat00009	Malavika ramdas	Manipal Univesrity Jaipur
16	221007021	Arshi Jain	Manipal Univesrity Jaipur
17	23FE10CSE00137	Stuti Dixit	Manipal Univesrity Jaipur
18	23fe10cii00094	Aarohi Tyagi	Manipal Univesrity Jaipur
19	23FE10CSE00152	Gautam Kakkar	Manipal Univesrity Jaipur

20	23FE10CSE00318	Krish Ray	Manipal Univesrity Jaipur
21	23FE10CII00076	Kriissh Marwaha	Manipal Univesrity Jaipur
22	229310321	Shiv Rajput	Manipal Univesrity Jaipur
23	23FS10BIO000051	Ragini Singh Thakur	Manipal Univesrity Jaipur
24	23FS10BIO000052	Anukriti sharma	Manipal Univesrity Jaipur
25	220901073	Diya Mittal	Manipal Univesrity Jaipur
26	23FE10CSE00081	Smmayan Gupta	Manipal Univesrity Jaipur
27	229309083	Raghav Gupta	Manipal Univesrity Jaipur
28	23FE10CDS00397	Hrishita Singh Timaney	Manipal Univesrity Jaipur
29	23FE10ITE00203	Sarah Sharda	Manipal Univesrity Jaipur
30	23fa10bsp00025	Jasleen kaur	Manipal Univesrity Jaipur
31	23FA10BSP00039	Jiya Kumar	Manipal Univesrity Jaipur
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36	23fe10ece00024	Kushagra agrawal	Manipal Univesrity Jaipur
37	23FA10BSP00017	Megha Sharma	Manipal Univesrity Jaipur
38	23FM10BBA00162	Alina Nadeem	Manipal Univesrity Jaipur
39	23FM10BBA00178	Avishi Akhaury	Manipal Univesrity Jaipur
40	221007004	Urvi Thakare	Manipal Univesrity Jaipur
41	23FA10BAP00027	Natasha Joan Menezes	Manipal Univesrity Jaipur
42	23FA10BLE00004	Tanisha chaturvedi	Manipal Univesrity Jaipur
43	23fe10cai00579	Arjun Malhotra	Manipal Univesrity Jaipur
44	23FE10CAI00352	Maanyata Aul	Manipal Univesrity Jaipur
45	220901322	Divyanshi Singh	Manipal Univesrity Jaipur
46	229310412	Jatin Verma	Manipal Univesrity Jaipur
47	229301094	Yashovardhan Pratap Singh	Manipal Univesrity Jaipur
48	23FM10BBA00348	Niska kedia	Manipal Univesrity Jaipur
49	221105005	Dhruv Nair	Manipal Univesrity Jaipur
50	23FM10BBA00170	Shambhavi Agrawal	Manipal Univesrity Jaipur
51	23FE10CDS00241	Armaan Setia	Manipal Univesrity Jaipur
52	23FE10CAI00105	Mritunjay Singh	Manipal Univesrity Jaipur
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59	221003007	Yachna Jain	Manipal Univesrity Jaipur
60	220901002	Anshu jangir	Manipal Univesrity Jaipur

Dr Narendra Singh Bhati Ho

HOD, BBA

(Hemant Kumar)
Assistant Director, Society Connect
Directorate of Student's Welfare

(Prof. AD Vyas)
Director, Directorate of Student's Welfare

DIRECTOR STUDENT WELFARE & PROCTOR
MANIPAL UNIVERSITY, JAIPUR

MANIPAL UNIVERSITY JAIPUR

Faculty of Management and Commerce

Department of Business Administration

Societal Connect Activity on

Bird Nest Installation

NOVEMBER 30, 2023

Head
Department of Business Administration
Manipal University Jaipur

1. **Introduction of the Event**

Introduction of the Event: School of Business and Commerce organized a activity to install bird nests in the nearby village on November 30, 2023. 5 students and 1 faculty member participated in the campaign. The event took place in nearby village of Manipal university.

2. **Objective of the Event**

The primary objective of the event was to promote environmental awareness and conservation by actively contributing to the well-being of local bird populations. Through the installation of bird nests, the aim was to create a sustainable habitat for birds in the nearby village, fostering biodiversity and ecological balance.

3. **Beneficiaries of the Event**

The beneficiaries of the event included the local bird species in the nearby village. By providing suitable nesting spaces, the initiative sought to enhance the living conditions for birds, contributing to the overall ecosystem health. Additionally, the participating students gained hands-on experience in environmental stewardship.

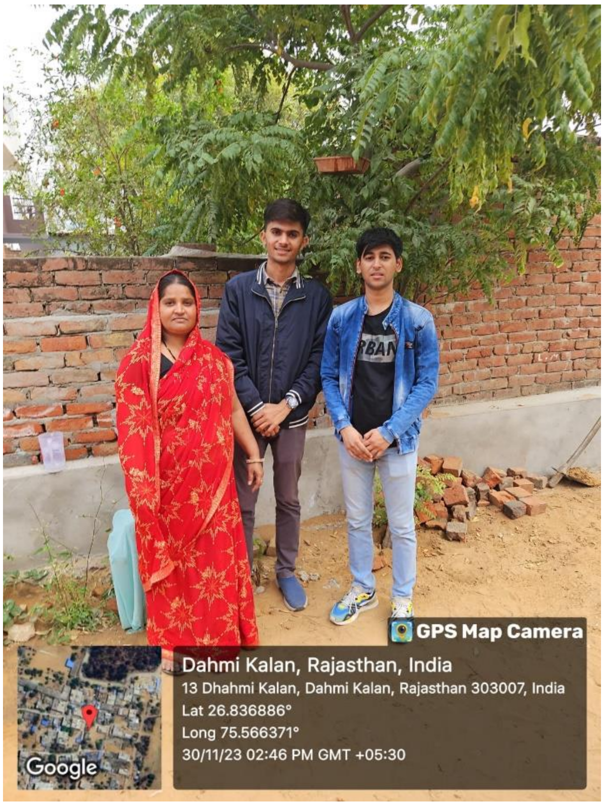
4. **Details of the Guests**

The event was laid by the students of BBA.

5. **Brief Description of the event**

The activity involved the installation of bird nests in the nearby village of Manipal University, with students and faculty members actively engaging in the process. Participants worked together to strategically place the nests, considering the local ecology and the needs of various bird species. The event not only contributed to the local environment but also provided a unique learning experience for the students, emphasizing the importance of hands-on conservation efforts. Overall, the initiative aimed to create a positive impact on the local ecosystem while instilling a sense of environmental responsibility among the participants.

6. **Photographs**

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13 Dhahmi Kalan, Dahmi Kalan, Rajasthan 303007, India
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Google


GPS Map Camera
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Google


GPS Map Camera
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Google

RBAN
GPS Map Camera
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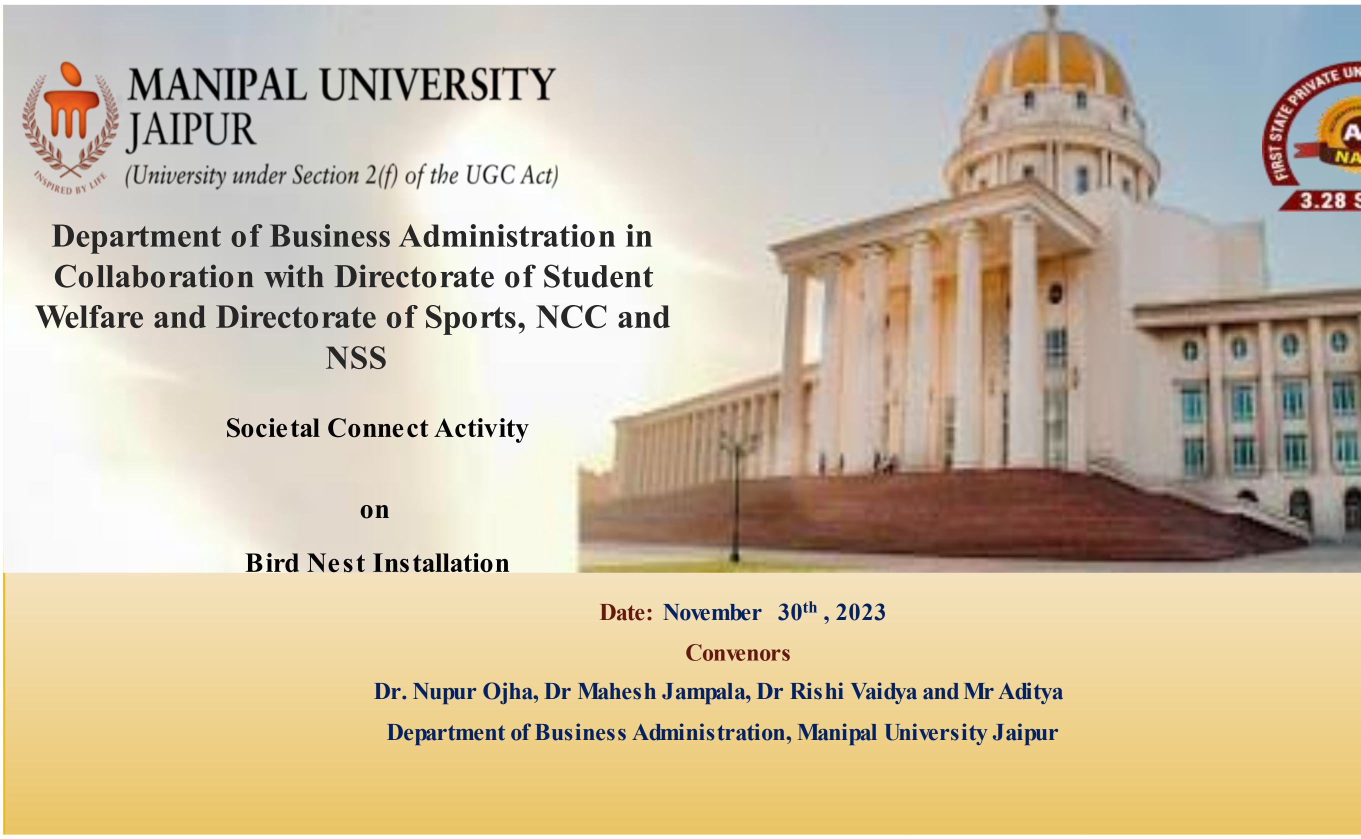
Google

7. Brochure or creative of the event



8. Schedule of the Event

The event took place on November 30, 2023

9. Attendance of the Event

Sr. No	Name of Institution	Registration Number/ Employee Code	Attendee Name
1	Manipal University Jaipur	MUJ0099	Dr. Mahesh Jampala
2	Manipal University Jaipur	MUJ1538	Dr Rishi Vaidya
3	Manipal University Jaipur	MUJ0623	Dr. Nupur Ojha
4	Manipal University Jaipur	MUJ1490	Mr. Aditya Dhiman
5	Manipal University Jaipur	23FM10BBA00204	DINESH CHOUDHARY
6	Manipal University Jaipur	23FM10BBA00200	VANSH MULCHANDANI
7	Manipal University Jaipur	23FM10BBA00214	GOPAL BISHNOI
8	Manipal University Jaipur	23FM10BBA00215	AKSHAT SHARMA
9	Manipal University Jaipur	23FM10BBA00216	KHUSHWANT SANKHLA
10	Manipal University Jaipur	23FM10BBA00205	AYUSHMAN GUPTA

Head
Department of Business Administration
Manipal University Jaipur

MANIPAL UNIVERSITY JAIPUR

FACULTY OF ARTS

SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

DEPARTMENT OF ARTS

Tree plantation Drive

Social outreach event in collaboration with DSW and NCC

06/09/2023

Index

1. **Introduction of the Event**
   The Department of Arts in collaboration with the DSW (NCC and NSS) organized a tree plantation drive with a number of BA(Liberal Arts) students.

2. **Objective of the Event** **(bullet points or about 50 words)**

To make the students aware of the importance of tree plantation.

3. **Beneficiaries of the Event**

   Government school, Begas, an adopted school of MUJ

4. **Brief Description of the event**
   The Department of Arts in collaboration with the DSW (NCC and NSS) organized a tree plantation drive with a number of BA(Liberal Arts) students. The objective of the event was to make the students aware of the importance of tree plantation.

5. Photographs

Students engaged in a tree plantation drive in the government school, Begas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Begas, Rajasthan, India
VHF2+FP2, Begas, Rajasthan 303007, India
Lat 26.873903°
Long 75.552877°
06/09/23 11:26 AM GMT +05:30
Google

MUJ students with the government school students

MUJ department students during the plantation drive

6. Brochure or creative of the event (insert in the document only)

8x4.5 feet

MANIPAL UNIVERSITY JAIPUR
INSPIRED BY LIFE

7. Schedule of the event (insert in the report)

6th September, 11:00 a.m. to 12:00 p.m.

8. Attendance of the Event (insert in the document only)
Total attendee-16

Sr. No	Name of Institution	Place of Institution	Name of Attendee	Name of Dept
1.	MUJ	Jaipur	Chandravardhan	Arts
2.	MUJ	Jaipur	Kumesh Mishra	Arts
3.	MUJ	Jaipur	Soumya Pareek Dhanushree	Arts
4.	MUJ	Jaipur		Arts
5.	MUJ	Jaipur	Karan Mallick	Arts
6.	MUJ	Jaipur	Vanshika Agarwal	Arts
7.	MUJ	Jaipur	Prithviraj	Arts
8.	MUJ	Jaipur	Akshatt Singh	Arts
9.	MUJ	Jaipur	Dhruv Nair	Arts
10.	MUJ	Jaipur	Krishna	Arts
11.	MUJ	Jaipur	Gaury	Arts
12.	MUJ	Jaipur	Sudeepti Dhruv Dahiya	Arts
13.	MUJ	Jaipur	Aditi Panigrahi	Arts
14.	MUJ	Jaipur	Aradhya Khandelwal	Arts
15.	MUJ	Jaipur	Komal Chadha	Arts
16.	MUJ	Jaipur	Krritika Khandelwal Pragya Sharma	Arts
17.	MUJ	Jaipur	Prachi Randhawa	Arts
18.	MUJ	Jaipur	Gurmehr Singh	Arts
19.	MUJ	Jaipur	Himmat di Charan	Arts
20.	MUJ	Jaipur	Sameer Khan	Arts
21.	MUJ	Jaipur	Ananya Thakur	Arts
22.	MUJ	Jaipur	Harshita Das	Arts
23.	MUJ	Jaipur	Manan Sharma	Arts

24.	MUJ	Jaipur	Surendra Singh	Arts
25.	MUJ	Jaipur	Joy Tak	Arts
26.	MUJ	Jaipur	Soumya harma	Arts
27.	MUJ	Jaipur	Deepak	Arts
28.	MUJ	Jaipur	Anup Choudhary	Arts
29.	MUJ	Jaipur	Prithviraj Hada	Arts
30.	MUJ	Jaipur	Tanisha Vashisht	Arts

9. Link of MUJ website stating the event is uploaded on website

https://jaipur.manipal.edu/muj/news-events/events-list.html

Dr. Mani Sachdev
Head, Department of Arts
Manipal University Jaipur

15.9.23

Seal and Signature of HOD

MANIPAL UNIVERSITY JAIPUR

INSPIRED BY LIFE

Department of Interior Design

FACULTY OF DESIGN

Make & Take

Kokedama

Hands-on Workshop

22/11/2023

Content of Report

1. Introduction of the Event

The Department of Interior Design, Faculty of Design at Manipal University Jaipur organized a Kokedama Workshop on 22.11.2023, as a part of the curriculum for 3rd-year B.Des (ID) students. This workshop was conducted under the subject Interior Landscape (ID3105) to provide students with a practical, hands-on experience in the art of preparing Kokedamas. Along with 3rd year B. Des students, this workshop is open for all Manipal University Jaipur students (Diploma, Undergraduate and Postgraduate), Research Scholars, Academicians, Faculty Housing Women, And Industry Professionals with fees of Rs 300/- that included all the materials.

An introduction and demonstration to Kokedama was given by Ms. Geeta Ahluwalia, General Secretary, Kitchen Garden Association, Jaipur. Kitchen Garden Association is an all women lead non-profit organisation in Jaipur. Ar. Sneh Singh (HoD Interior Design) along with Ar. Megha Prabhu K (Asst. Professor, Interior Design) conducted a hands-on 'Make & Take' Kokedama Workshop.

2. Objective of the Event

- Provide 3rd-year B. Des (ID) students with a hands-on experience in the preparation of Kokedamas.
- Enhance the understanding of interior landscaping principles among participants and foster practical skills in crafting Kokedamas, focusing on plant selection, soil composition, and wrapping techniques.
- Facilitate knowledge exchange and collaboration among participants from diverse academic backgrounds, including students, research scholars, academicians, and industry professionals.
- Encourage creativity and innovation in Interior Design through the exploration of Japanese moss ball planters.
- Provide a platform for participants to engage in a Q&A session, allowing for a deeper understanding of the art of Kokedama.
- Create a supportive and inclusive learning environment for all attendees, fostering a sense of community and collaboration within Manipal University Jaipur.

3. Beneficiaries of the Event

The workshop was open to a diverse audience, including 3rd-year B.Des(ID) students, students from other programs (Diploma, Undergraduate, and Postgraduate) at Manipal University Jaipur, research scholars, academicians, Faculty Housing Women, and industry professionals. The inclusive nature of the workshop aimed to foster collaboration and knowledge exchange among participants.

4. Details of the Guests

The honoured guest for the event was Ms. Geeta Ahluwalia, the Secretary of the Kitchen Garden Association Jaipur. Kitchen Garden Association is an all women lead non-profit organisation in Jaipur. Ms. Ahuwalia's expertise in the field brought a valuable perspective to the workshop, and her presence added significant value to the overall learning experience for the participants.

5. Brief Description of the event

The Kokedama workshop provided a unique opportunity for participants to explore the creative and technical aspects of crafting Kokedamas, which are Japanese moss ball planters. The event kicked off with a warm welcome to all attendees, followed by an insightful introduction to the art of Kokedama and its relevance in interior design.

Participants were guided through the step-by-step process of creating their own Kokedamas, emphasizing the selection of suitable plants, soil composition, and wrapping techniques. Ms. Ahuwalia shared her expertise and provided practical tips, enriching the learning experience for everyone involved.

MANIPAL UNIVERSITY JAIPUR

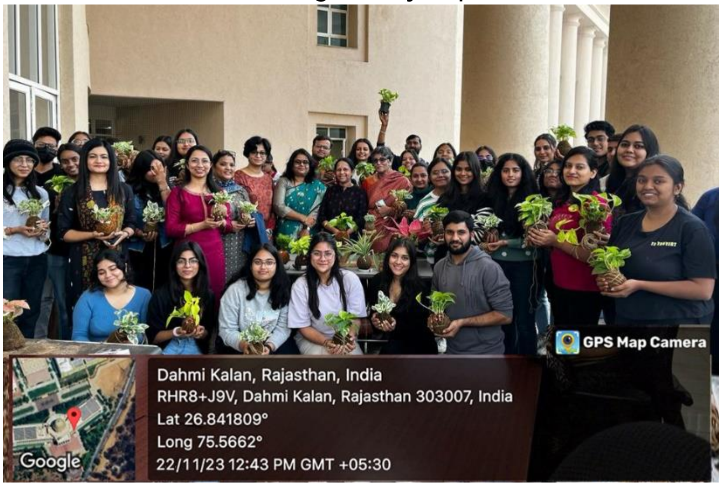
INSPIRED BY LIFE

6. Photographs of the Event



Introduction and Demonstration given by Expert, Ms. Geeta Ahluwalia


Demonstration of Kokedama given by Expert, Ms. Geeta Ahluwalia



Participants showcasing their works

7. Poster of the event

8. Schedule of the event

'Make & Take' Kokedama Workshop 22 November 2023, Wednesday	
Porch Area, 1st Floor, Administration Building, MUJ	
Time	**Event**
09:30 am	Registration and Reporting
10:30 am	Welcome address by Ar. Megha Prabhu Karkala Introduction of the Guest Adress by Dean, Prof. (Dr.) Madhura Yadav, Dean, FoD
10:45 am	Expert Lecture and Introduction to Kokedama by Ms. Geeta Ahuwalia
11:00 am	Practical Session: Crafting Kokedamas
11:30 am	Making Kokedamas by students
12:45 pm	Completion of Kokedamas and Q&A Session
01:00 pm	Felicitation of Ms. Geeta Ahuwalia and Closing Remarks
01:15 pm	Group Photographs and Exhibition of Students works

9. Attendance of the Event

Sl.No	Participate Name	Participant	Deparment	Registration No.
1	Kashish Kriplani	Student	B.Des (Interior Design)	210606041
2	Kartik Totla	Student	B.Des (Interior Design)	210606011
3	Aakash Singh	Student	B.Des (Interior Design)	210501007
4	Garima Vijaycharan	Student	B.Des (Interior Design)	210606021
5	Kumari Anjali	Student	B.Des (Interior Design)	210606008
6	Himanshi Sharma	Student	B.Des (Interior Design)	210606028
7	Esha Giri	Student	B.Des (Interior Design)	210606031
8	Anisha Chopra	Student	B.Des (Interior Design)	210606020
9	Rutu Shah	Student	B.Des (Interior Design)	210606007
10	Anushka Rai	Student	B.Des (Interior Design)	210606019
11	Rishika	Student	B.Des (Interior Design)	210606029
12	Paridhi Verma	Student	B.Des (Interior Design)	210606017
13	Naman	Student	B.Des (Interior Design)	210606013
14	Diya Ramchandani	Student	B.Des (Interior Design)	210606039
15	Krishangee Goyal	Student	B.Des (Interior Design)	210606026
16	Avinash Yadav	Student	B.Des (Interior Design)	210606047
17	Himanshi Yadav	Student	B.Des (Interior Design)	210606014
18	Hridyanshi Vyas	Student	B.Des (Interior Design)	210606018
19	Khushi Bhargava	Student	B.Des (Interior Design)	210606010
20	Madhu Tanwar	Student	B.Des (Interior Design)	210606027
21	Riddhi Agarwal	Student	B.Des (Interior Design)	210606038
22	Michelle Earnest	Student	B.Des (Interior Design)	210606043

23	Pooja Jain	Student	B.Des (Interior Design)	23fd10bid00020
24	Shreshtha Gaur	Student	B.Des (Interior Design)	210606012
25	Geetika Gupta	Student	B.Des (Interior Design)	210606037
26	Manya Agarwal	Student	B.Des (Interior Design)	210606015
27	Riya	Student	B.Des (Interior Design)	210606035
28	Ananya Thakan	Student	B.Des (Interior Design)	210606006
29	Devanshi Jain	Student	B.Des (Interior Design)	210606046
30	Drishti Sharma	Student	B.Des (Interior Design)	210606045
31	Sejal Sharma	Student	B.Des (Interior Design)	210606023
32	Samarth Gandhi	Student	B.Des (Interior Design)	210606003
33	Saija Tanya	Student	B.Des (Interior Design)	210606044
34	Garvit Garg	Student	B.Des (Interior Design)	210606001
35	Shruti Dubey	Student	B.Des (Interior Design)	210606022
36	Keshav Katta	Student	B.Des (Interior Design)	210606005
37	Grishma Korjani	Student	B.Des (Interior Design)	210606016
38	Shweta Sharma	Non-Teaching Staff	Non- Teaching Staff	MUJ1134
39	Megha Prabhu Karkala	Assistant Professor	Faculty of Design	MUJ1434
40	Smriti Saraswat	Assistant Professor	Faculty of Design	MUJ1248
41	Dr. Shilpi Gupta	Assistant Professor	Department of Economics	MUJ0403
42	Malini G Prabhu	Faculty Housing Member	Faculty Housing Member	NA
43	Rajendar Kumar	Non-Teaching Staff	GSA	MUJ1300
44	Reetika Choudary	Non-Teaching Staff	Admission Department	MUJ1406
45	Priyanka Samarth	Non-Teaching Staff	Admission Department	MUJ1408
46	Panchami Sharma	Non-Teaching Staff	HR Department	MUJ11002438
47	Kusuma Jinka	Faculty Housing Member	Faculty Housing Member	NA
48	Madan	Non-Teaching Staff	GSA	
49	Gopal	Non-Teaching Staff	GSA	
50	Kush Jee Kamal	Assistant Professor	Faculty of Design	MUJ1714
51	Man Mohan Mehta	Non-Teaching Staff	Admission Department	MUJ0170

Manipal University Jaipur
Department of Interior Design I FOD
II Year III Semester - ID3105-Interior Landscape
KOKEDAMA WORKSHOP - 22.11.2023

Sl. No.	ROLL. No.	NAME	SIGN
1	210606001	GARVIT GARG	
2	210606003	SAMARTH GANDHI	
3	210606004	VISHVA SAMIRBHAI DAVE	ABSENT
6	210606005	KESHAV KATTA	
5	210606006	ANANYA THAKAN	
6	210606007	RUTU DILIP KUMAR SHAH	
7	210606008	KUMARI ANJALI	
8	210606010	KHUSHI BHARGAVA	
9	210606011	KARTIK TOTLA	
10	210606012	SHRESHTHA GAUR	
11	210606013	NAMAN HODKASIA	ABSENT
12	210606014	HIMANSHI YADAV	
13	210606015	MANYA AGARWAL	
14	210606016	GRISHMA KORJANI	
15	210606017	PARIDHI VERMA	
16	210606018	HRIDYANSHI VIRESH VYAS	
17	210606019	ANUSHKA RAI	
18	210606020	ANISHA CHOPRA	
19	210606021	GARIMA VIJAY CHARAN	
20	210606022	SHRUTI DUBEY	
21	210606023	SEJAL SHARMA	
22	210606026	KRISHANGEE GOYAL	
23	210606027	MADHU TANWAR	
24	210606028	HIMANSHI SHARMA	
25	210606029	RISHIKA	
26	210606031	ESHA GIRI	
27	210606034	KREETI YADAV	ABSENT
28	210606035	RIYA GAUTAM ROY	
29	210606036	HRIDAY SINGH	ABSENT
30	210606037	GEETIKA GUPTA	
31	210606038	RIDDHI AGARWAL	
32	210606039	DIYA RAMCHANDANI	
33	210606041	KASHISH KRIPLANI	
34	210606043	MICHELLE EARNEST	
35	210606044	SAIJA TANYA	
36	210606045	DRISHTI SHARMA	
37	210606046	DEVANSHI JAIN	
38	210606047	AVINASH YADAV	
39	210501007	AKASH	

Manipal University Jaipur
Department of Interior Design
Faculty of Design
KOKEDAMA WORKSHOP - 22.11.2023

Sl. No.	MUJ ID/ Roll No	NAME	Department	SIGN
1	MUJ1300	Rajendra Kumar	G/S/P	
2	MUJ1406	Reetika Choudhary	Admission	
3	MUJ1408	Priyanka Samanta	Admission	
6				
5	MUJ11002438	Panchami Sharma	HR	
6	FH member	Malini G Prabhu	Faculty Housing	Malini Prabhu
7	FH member	Kusuma Jinka	Faculty Housing.	
8	MUJ403	Dr. Shilpi Gupta	Economics.	
9		Madan	GSA	
10		Gopal	GSA.	
11	MUJ1134	Srweeta Sharma,	Senior-Personal Assistant	
12	MUJ1714	[illegible]	ID	
13	[illegible]	Man Mohan [illegible]	Admission	
14				

10. Link of MUJ social media page

LinkedIn: https://www.linkedin.com/feed/update/urn:li:activity:7134914090002526208
Facebook:

- https://www.facebook.com/share/p/veNm8xBHeCEpUkJh/?mibextid=WC7FNe
- https://www.facebook.com/share/p/SESHp8BN95zt4VCP/?mibextid=WC7FNe

Instagram:

- https://www.instagram.com/p/C0JntI-LnvS/?utm_source=ig_web_copy_link&igshid=MzRlODBiNWFlZA==
- https://www.instagram.com/p/C0Jwf4orIKQ/?utm_source=ig_web_copy_link&igshid=MzRlODBiNWFlZA==

Head, Department of Interior Design
SP&D, Faculty of Design
Manipal University Jaipur

MANIPAL UNIVERSITY JAIPUR

VENDOR NAME & ADDRESS	WORK ORDER
BHUVANESHWARI INDUSTRIAL SERVICES	ORDER NO. : **MUJ/23-24/0683**
SHOP NO 05, PRIYANSHU VIHAR, SIRSI ROAD, SIRSI, JAIPUR, RAJASTHAN, 302012 # 9351937174 E-Mail: bhuvaneshwariservices@yahoo.com **GST No. : 08HWBPS9547E1ZY**	DEPARTMENT: **Civil Engineering - Instruments Repair** DATE OF ORDER : **06/03/2024**

BILL TO/SHIP TO -

REGISTRAR,

Manipal University Jaipur
VPO - Dehmi Kalan, Near GVK Toll Plaza,Jaipur-Ajmer Expressway, Jaipur, Rajasthan
Jaipur-303007,RAJ
PH. 0141 3999100
MUJ GST No. : 08AAAJM1881F1Z6

Kindly arrange the supply of following services

S.NO.	ITEM / DESCRIPTION	CGST		SGST		IGST		UOM	QTY	RATE (Rs.) / UNIT	AMOUNT (Rs.)
1	Lab Exp Repair charges of Hot air oven with parts	9%	502.72	9%	502.72	0%	-	NOS	1	6,000.00	6,000.00
2	Lab Exp Rapid Moisture Meter (New)	9%	293.25	9%	293.25	0%	-	NOS	1	3,500.00	3,500.00
3	Lab Exp Dial Gauge	9%	237.95	9%	237.95	0%	-	NOS	1	2,840.00	2,840.00
4	Lab Exp Rubber Membrane 38mm Triaxial membrane	9%	46.08	9%	46.08	0%	-	NOS	1	550.00	550.00
TOTAL										Rs.	**12,890.00**
DISCOUNT										Rs.	890.00
NET TOTAL										Rs.	**12,000.00**
CGST										Rs.	1080.00
SGST										Rs.	1080.00
										Rs.	2,160.00
GRAND TOTAL										Rs.	**14,160.00**

Total : **FOURTEEN THOUSAND ONE HUNDRED SIXTY RUPEES AND ZERO** PAISA ONLY

Terms & Conditions:

1. GST : Included
2. Packing and Forwarding :No
3. Freight : No
4. Delivery : Within 20 days
5. Installation & Demonstration : No
6. Payment : Within 20 days from the date of complete work
7. Contact Person : For further co-ordination, contact with Mr. Raghuvesh Tiwary # raghuvesh.tiwary@jaipur.manipal.edu
8. Other Terms : Delay in supply / execution of order with more than 7 days will attract penalty clause of 2% per week. Order will be consider as cancelled due to delay by more than 10 days without giving any reason thereof.
9. Dispute: Any dispute related to this order shall be subject to Courts of Jaipur juridiction only. This order shall be governed in accordance with Law of India.

EMS Related Terms :

1. Invoice to be raised in the name of MANIPAL UNIVERSITY JAIPUR
2. You are requested to deliver material on working days, 9:00 AM to 5:00 PM only. Please confirm for working day of MUJ, before sending the material
3. Any special disposal instruction at the end of life cycle of the product may be intimated, keeping in mind the environmental hazardous requirements,if any.
4. The supplier/manufacturer should grant access to their facility to MUJ to conduct second party audit wherever it is recognized as critical to the environment.

5. The packing materials used should be environment friendly as far as possible.

Note :

1. This document is not valid without an authorized signature and Purchase Order No.
2. Please show the Order No. and item codes on all invoices, Delivery slips and packages.
3. Please bill in duplicate

07/03/2024

Authorized Signatory

Stock Reg. No - 50 page No. 25, 140

Tax Invoice

Bhuvaneshwari Industrial Services
Shop no. 5 Priyanshu Vihar, Sirsi Road, Jaipur, Rajasthan - 302012
Phone no.: 9461454512, 9351937174
Email: bhuvaneshwariservices@yahoo.com
GSTIN: 08HWBPS9547E1ZY
State: 08-Rajasthan

Invoice No. **BI/23-24/3900105**	Date **28-03-2024**
Due Date: **12-04-2024**	Place of supply **08-Rajasthan**

Bill To
Manipal University
Jaipur-Ajmer Express Highway, Dehmi Kalan, Near GVK Tool Plaza, Jaipur, Rajasthan -303007
GSTIN : 08AAAJM1881F1Z6
State: 08-Rajasthan

#	Item name	HSN/ SAC	Quantity	Unit	Price/ Unit	Discount	GST	Amount
1	**Repairing Charge of Hot Air Oven** (with parts)	998717	1	Nos	₹ 6,000.00	₹ 600.00 (10%)	₹ 972.00 (18%)	₹ 6,372.00
2	**Rapid Moisture Meter** (new)	9027	1	Nos	₹ 3,500.00	₹ 245.00 (7%)	₹ 585.90 (18%)	₹ 3,840.90
3	**Dail Gauge** (new)	9027	1	Nos	₹ 2,840.00	₹ 0.00 (0%)	₹ 511.20 (18%)	₹ 3,351.20
4	**Rubber Membrane 38 mm** (Iriaxial membrane)	9027	1	Nos	₹ 549.00	₹ 43.92 (8%)	₹ 90.91 (18%)	₹ 595.99
	Total		**4**			**₹ 888.92**	**₹ 2,160.01**	**₹ 14,160.09**

Invoice Amount In Words
Fourteen Thousand One Hundred Sixty Rupees only

Amounts	
Sub Total	₹ 14,160.09
Round off	- ₹ 0.09
Total	**₹ 14,160.00**
Received	₹ 0.00
Balance	₹ 14,160.00
You Saved	**₹ 1,048.93**

HSN/ SAC	Taxable amount	CGST		SGST		Total Tax Amount
		Rate	Amount	Rate	Amount	
9027	₹ 6,600.08	9%	₹ 594.01	9%	₹ 594.01	₹ 1,188.01
998717	₹ 5,400.00	9%	₹ 486.00	9%	₹ 486.00	₹ 972.00
Total	**₹ 12,000.08**		**₹ 1,080.01**		**₹ 1,080.01**	**₹ 2,160.01**

Bank Details
Name : UCO BANK, SIRSI ROAD - JAIPUR
Account No. : 21560210003923
IFSC code : UCBA0002156

Terms and conditions
1. Goods once sold will not be take back.
2. Goods are dispatched at consignee's risk.

Inward No. 1770
Date 29/03/24

For: Bhuvaneshwari Industrial Services
BHUVANESHWARI INDUSTRIAL SERVICES JAIPUR
Authorized Signatory

Checked by in 12.40
S/w. Har Swarup
Code HA502
Date - 28/3/24

checked & Received
28/3/24

Received
28/3/24

Environmental Science and Pollution Research (2023) 30:77713–77728
https://doi.org/10.1007/s11356-023-28004-y

RESEARCH ARTICLE

Geophysical and geostatistical assessment of groundwater and soil quality using GIS, VES, and PCA techniques in the Jaipur region of Western India

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Abstract

In present study, geophysical and geostatistical variability of ground water and agricultural soil investigated in the Jaipur region of Rajasthan (Western India) by applying the geographic information system (GIS), vertical electrical sounding (VES) ,and statistical analysis. Ground water and soil samples collected from different sites from the selected study area and variation pattern of quality parameters were assessed. A contour map analysis of distribution of metals and other contaminants in the samples was conducted using GIS. Maximum concentration of metals recorded in the soil samples in order of Fe, 11.25 mg kg^{-1} > Mn, 8.6 mg kg^{-1} > Zn, 7.2 mg kg^{-1} > Cu, 0.455 mg kg^{-1}; however, maximum concentration of metals in the ground water samples was found as Zn, 2.64 mg L^{-1} > Cu, 0.86 mg L^{-1} > Fe, 0.39 mg L^{-1} > Mn, 0.18 mg L^{-1} > Pb, 0.065 mg L^{-1} > Ni, 0.016 mg L^{-1}. Observed data emphasis variability in groundwater and soil quality parameter by PCA technique indicated 84.60% and 66.98% of variance, respectively. Soil quality index (SQI) value was observed as 0.482 indicating that 46% of soil sampling sites deteriorated and shown poor quality. Similarly, water quality index (WQI) value indicates good water quality at the sampling sites TW1, TW8, TW10, and TW12; however, TW3, TW4, TW6, TW19, TW20, and TW22 sites showed very poor water quality. The present study concludes that overexploitation of groundwater and unregulated discharge of wastewater leads to depletion of water and soil quality. Further, applying geographical and geostatistical techniques in assessing water and soil quality could be more effective tools in environmental monitoring and management for environmental and health safety.

Keywords Bioaccumulation · Bioavailability · Biotransformation · Contamination · Groundwater · Metals · Principal component analysis (PCA) · Water quality

Introduction

Rapid urbanization leads to several environmental issues, including poor living conditions, changes in land use pattern, overexploitation of water and soil, transportation congestion, resettlement, disasters, and environmental pollution (Kalayci Onac et al. 2021; Aksoy et al. 2022; Tay and Ocansey 2022; Dogan et al. 2023). Fresh water including ground water is one of the most important components of the environment and essential for human survival and wellbeing (Gavrilescu 2021). However, extensive exploitation of water by human being leads to substantial environmental cost due to contamination, scarcity, and depletion of water resources affecting water supply and health safety (Tzanakakis et al. 2020; Singh et al. 2022). Scarcity of safe drinking water is now becoming a problem due to

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extensive urbanisation, industrialization, agriculture, and climate change affecting about 40% of human population globally (Calzadilla et al. 2011; Bilge Ozturk et al. 2022). Groundwater found underground in cracks and crannies in rock, sand, and soil is the main source of drinking water supply. Exploitation of groundwater may result in dissolution of numerous contaminants as it passes through the rocks and soil during leaching and percolation (Saleem et al. 2018). Trace metals emanating from different industrial, transportation, construction, and agricultural activities affect soil and water quality as recalcitrant and toxic contaminants (Romic and Romic 2003; Cetin et al. 2022a; Sahin et al., 2022). Link between soil quality and socioeconomic well-being of humans, particularly, global food security and human health have been reported (Yu et al. 2018; Kopittke et al. 2019). Soil and water contamination occurs due to various anthropogenic activities and geological processes releasing metals and other elements; therefore, assessment of soil and water quality is becoming more crucial in adapting appropriate strategies to prevent and preserve the land and water resources for human wellbeing (Ahmet et al. 2006; Cesur et al. 2021). More common metal contaminants in soil and water are Pb, Cr, As, Zn, V, Cd, Cu, and Sn reported with high levels of toxicity for biota (Yang et al. 2016; Hanfi et al. 2020; Cetin et al. 2022b).

India is one of the emerging nations with more industrial and other developmental activities having wastewater generation and discharge on the land and in the aquatic ecosystems leads to soil and water contamination (Tiwari et al. 2011). Metals persist in the soil and water, accumulates in the plants by roots uptake, and biomagnifies in the animals through food chain, which causes detrimental impact to the biota (Luo et al. 2012; Ali et al. 2019; Cetin and Abo Aisha 2023). Certain metals easily enter the food chain due to their bioavailability in the rhizosphere, uptake, and accumulation in the plants and can reach to other animals and humans through food (Gu et al. 2016; Rajendran et al. 2022). It has been reported that excessive accumulation of trace elements like cadmium, lead, and nickel in the plants causes toxicity and slows down the growth and productivity (Pandey and Sharma 2002; Zouboulis et al. 2004). A substantial threat to aquatic and terrestrial biodiversity as well as health hazards for humans posed by contaminated water and soil (Olayinka-Olagunju et al. 2021). Types of rock, physicochemical characteristics of soil, atmospheric precipitation, and surface geochemical processes affect the groundwater quality parameters and contamination (Garg and Hassan 2007; Cesur et al. 2021). Groundwater is most reliable source even in India because it provides a significant proportion of the country's drinking and agricultural water requirements (Mahmood and Kundu 2005).

Physico-chemical characteristics of soil also affects the water quality of groundwater at a given regions (Griffiths et al. 2010; Hermans et al. 2020). Different physio-chemical and biological indicators have been used in various studies to evaluate the soil quality (Filip 2002; Schloter et al. 2003). GIS has evolved into a trustworthy instrument for absorbing, analyzing, and displaying spatial data that can be utilized for environmental monitoring, planning, and resource management applications (Cetin 2015; Singha et al. 2015). The geographical information system (GIS) has become an important tool in research for resource management as it allows users to use geographical data in a variety of context and way in an integrated approach. Remote sensing (RS) and GIS studies in integration make it easier to work in relatively broad areas, particularly in environmental impact assessment for sustainable urban planning and resource utilization (Cetin 2019; Pekkan et al. 2021; Cetin et al. 2022c). Convergence of data concerning environmental assessment-related issues as well as the manipulation of spatial data into various forms in response to geosocial requirements may be accomplished using GIS (Cetin et al. 2022d). The principal component analysis (PCA) is a prominent statistical analysis tool for investigating data patterns thorough factor analysis approach. Basic purpose of PCA is to create new variables as principal components, from a set of existing original variables (Wu et al. 2020). Potential of geophysical information system-based geostatistical methodologies in assessing the region's groundwater and soil quality as well as its susceptibility to water-borne diseases reported (Ali and Ahmad 2020).

The Sanganer, Jaipur region of Rajasthan, Western India, having more industrial activities specially printing and dyeing operations leads to huge amount of wastewater generation and discharge in water and agricultural soil through unregulated disposal and irrigation practices. Very limited data are available related to using geographical information system and geostatistical techniques in the ground water and soil quality assessment. Therefore, the present study was conducted to assess ground water and soil quality at different sites based on a minimal set of interconnected geophysical and chemical criteria at Sanganer, Jaipur region of Rajasthan, Western India, and apply geophysical and geostatistical including GIS, VES, and PCA techniques to emphasize the water and soil quality parameters for environmental monitoring and assessment.

Materials and methods

Study area

The whole study conducted in the industrial and agricultural tracts in the north of Jaipur–Sanganer regions at different selected sampling sites, situated between 26° 49° and 26° 51° N and 75° 46° and 75° 51° E in the Jaipur district, Rajasthan, Western India (Fig. 1). One selected study site, the Sanganer, is famous for its hand-printed textiles have land size of 78.24 square kilometres, situated on NH-12, 10 kilometres to the southwest of Jaipur City. The Sanganer is well-known for its distinctive type of printing "Sanganer Printing" basically in the small-scale industries of the Chippas community, involving dyeing and printing of textiles (Dadhich et al. 2016). Dyeing and printing processes release wastewater during water-based color fixing procedure and discharged in the surrounding areas which pollutes water and soil. The chippas community either transport the textiles to a well dug on the bank of the Dravyawati River or

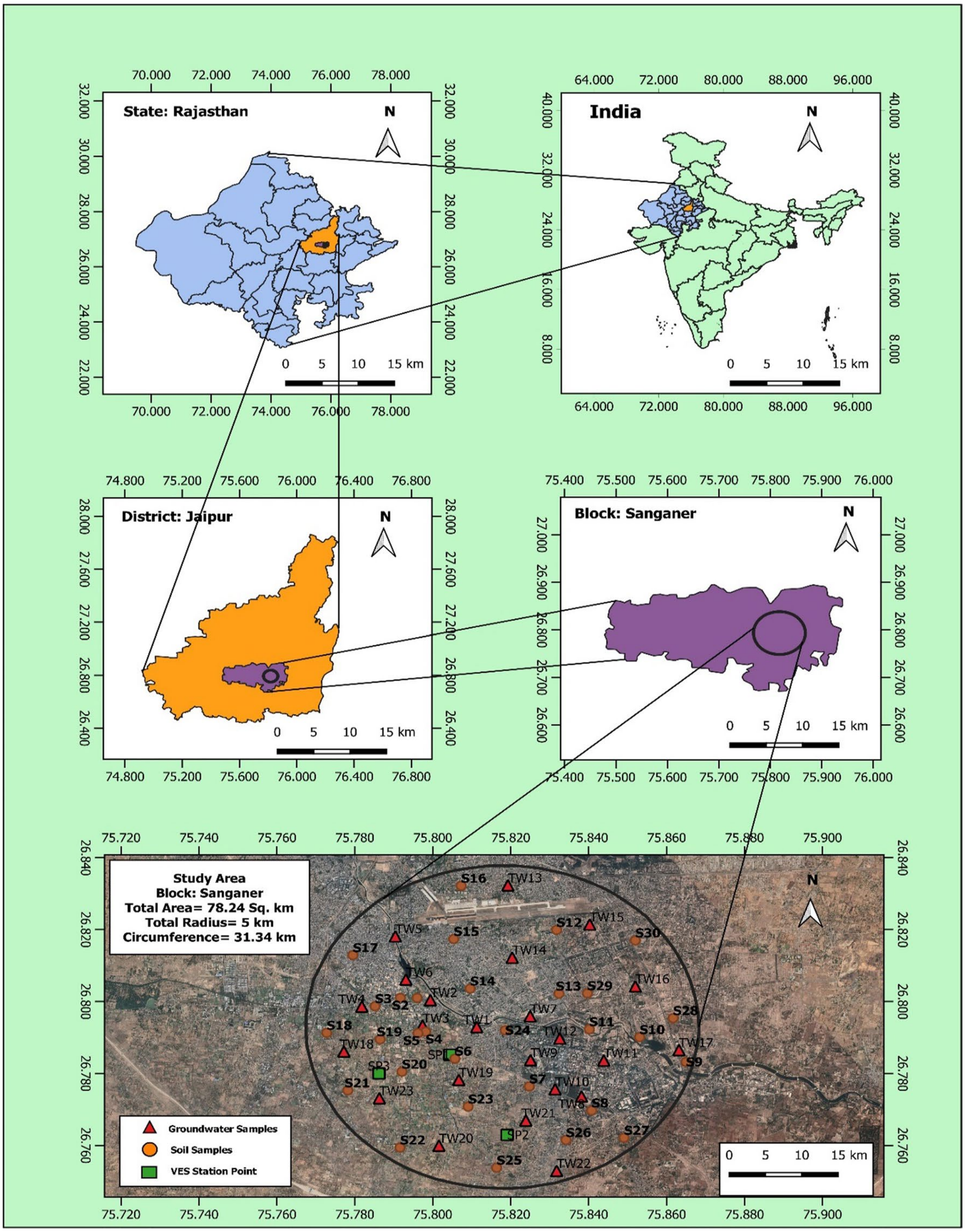

Fig. 1 Sampling sites of soil and ground water selected in the study area, Sanganer, Jaipur, Rajasthan, India

wash it at their wells in the city at various places randomly. Textile wastewater along with sewage from across the of Jaipur city discharged directly into the Dravyawati river in the selected study area is being polluted. Historically, Sanganer was primarily an agricultural region; however, during the last decade, the textile and dying industries have dramatically risen in the area and encroached the previously untapped agricultural land. With more than 250 separate printing units connected, it has emerged as one of the major centers of the printing and dying industries nowadays today in India. Growing demand and low production costs leads to the introduction of synthetic and chemical dyes, which have several environmental impacts. The regions of Jaipur–Sanganer with a high number of dyeing and printing industrial units releasing tonnes of waste into the aquatic environment, agricultural fields, and on open spaces nearby, polluting the water and soil (Sharma et al. 2014). Contamination of water and soil have negative impact on nutrition and human health due to deterioration of drinking water quality and food quality; however, at severe stage, poor quality may prevent soil from performing its natural physio-chemical and biological functions and deteriorate region's overall productivity of the terrestrial ecosystem.

Sampling sites and sampling

One-liter capacity plastic bottle rinsed with distilled water used to collect the groundwater samples. Grab sampling conducted for groundwater water sampling and samples preserved in the bottles with adjusted pH 2 and stored in refrigerator at 4 °C with slightly acidified with nitric acid (HNO_3) for analysis of water quality parameters including metals (Mn, Cu, Ni, Zn, Pb, and Cu). In Sanganer industrial region, having a new industrial area (RICCO) and an industrial zone (RSMDC), a quantitative soil and water sampling conducted to evaluate the water and soil quality parameters of the agricultural land as well as the degree of contamination in water due to industrial activities. Soil samples (250 g) taken from 30 randomly selected sites with a depth of 45 to 60 cm within a 5-kilometer radius of the Sanganer industrial zone and packed in fresh plastic zip-lock bag separately to determine the soil quality parameters (Fig. 2). All the sampling sites were precisely geotagged and labeled from S1 to S30 using a Garmin GPS device (model 68 s), allowing for the retrieval of a variety of location-specific data (Luo et al. 2011). Description of location and sampling sites are shown in the Table 1. The geoelectrical resistivity approach used to conduct field surveys in the study region which requires injecting a man-made current through several electrodes (AB) into the subsurface medium and observing the voltage changes at the potential electrodes (MN) to assess the variation in the ground's resistivity (Binley et al. 2015).

Analysis of soil and water quality parameters

Collected soil samples analyzed for 10 functional indicators parameters (i.e., pH, EC, OC, P, S, K, Zn, Fe, Cu, and Mn) for soil quality (YanBing et al. 2009). Similarly, collected water samples from different selected sites analyzed for water quality parameters in the laboratory. Average of all sets of triplicates calculated and values recorded into the data system (Juhos et al. 2019). All the analysis conducted following the procedure established by the American Public Health Association (Baird and Bridgewater 2017). A typical laboratory digital micro-processor pH meter used to estimate hydrogen ion concentration (pH) in the water samples (Salem et al. 2020). Similarly, electrical conductivity (EC) determined using an electrical conductivity meter (an EC probe and equipment that had been calibrated) by following the procedure of McNeill 1992. A digital water quality test kit used to evaluate total dissolved solids (TDS); however, EDTA titration method was used to calculate total hardness in the water samples. An argentometric titration used to quantify the amount of chloride in a water sample followed by alkalinity determined using the titrimetric method. UV-visible spectrophotometer used to determine the amount of fluoride in the collected water samples. Titration method used to estimate soil organic carbon (SOC) in the soil samples (Walkley and Black 1934) which involves oxidizing organic material in sulfuric acid with a predetermined quantity of chromate (Sato et al. 2014; Gelman et al. 2012). The Johnson–Nishita procedure used to measure sulfur content in the soil samples (Dean 1966). Sulfur and other minerals present in soil solution specially SO_4 ions adsorbed are the principal source of sulfur in soil. The replacement of SO_4 ions is of the utmost importance, and phosphate ions substituted wherever possible for adsorption and monocalcium phosphate, or phosphate ions, are present in the soil. The SO_4 ions are replaced with $CaCl_2$ ions in a more effective way throughout the extraction process and SO_4 extract turbulence determined by using a spectrophotometer. Potash content in soil samples estimated using a flame photometer following the procedure of Brondi et al. (2016).

Metal estimation

The concentration of Fe, Cu, Zn, Ni, Mn, and Pb in groundwater samples, whereas the metal Fe, Zn, Cu, and Mn analyzed in the soil samples estimated after complete digestion in $HClO_4$ and HNO_3 (3 : 1), using hollow cathode lamp at a certain wavelength into an atomic absorption spectrophotometer (AAS, Shimadzu) in comparison to standard metal solutions.

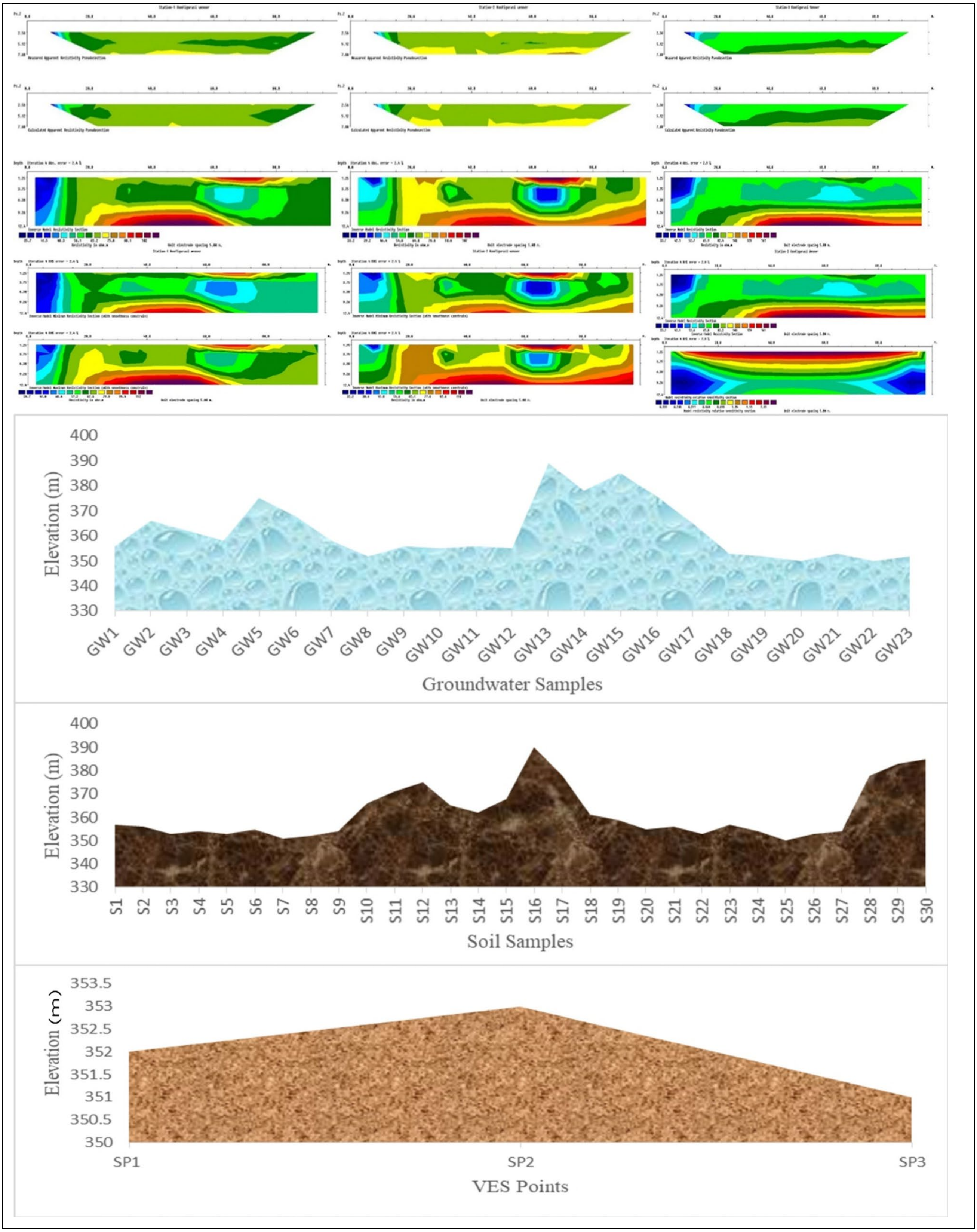

Fig. 2 Geoelectrical layers and elevation point of different sampling sites at the study area, Sanganer, Jaipur, Rajasthan, India

Table 1. Description of sampling sites of ground water samples, soil samples and VES station selected at Sanganer study area, Jaipur (Rajasthan), India

Ground water sample			Soil samples		
Sampling site	Latitudinal and longitudinal position	Elevation (m)	Sampling site	Latitudinal and longitudinal position	Elevation (m)
GW1	26.7929 N, 75.8113 E	357	S1	26.8010 N, 75.7960 E	354
GW2	26.8004 N, 75.7994 E	356	S2	26.8010 N, 75.7917 E	350
GW3	26.7933 N, 75.7974 E	353	S3	26.7987 N, 75.7852 E	353
GW4	26.7986 N, 75.7818 E	354	S4	26.7916 N, 75.7982 E	354
GW5	26.8181 N, 75.7904 E	353	S5	26.7912 N, 75.7962 E	378
GW6	26.8061 N, 75.7931 E	355	S6	26.7841 N, 75.8057 E	383
GW7	26.7959 N, 75.8250 E	351	S7	26.7764 N, 75.8248 E	385
GW8	26.7736 N, 75.8382 E	352	S8	26.7697 N, 75.8408 E	356
GW9	26.7837 N, 75.8251 E	354	S9	26.7832 N, 75.8650 E	366
GW10	26.7756 N, 75.8314 E	366	S10	26.7901 N, 75.8531 E	362
GW11	26.7836 N, 75.8439 E	371	S11	26.7923 N, 75.8402 E	358
GW12	26.7897 N, 75.8326 E	375	S12	26.8199 N, 75.8318 E	375
GW13	26.8323 N, 75.8193 E	365	S13	26.8022 N, 75.8324 E	368
GW14	26.8122 N, 75.8204 E	362	S14	26.8036 N, 75.8096 E	358
GW15	26.8214 N, 75.8403 E	368	S15	26.8174 N, 75.8054 E	352
GW16	26.8042 N, 75.8520 E	390	S16	26.8322 N, 75.8073 E	356
GW17	26.7865 N, 75.8632 E	378	S17	26.8129 N, 75.7795 E	355
GW18	26.7861 N, 75.7772 E	361	S18	26.7913 N, 75.7728 E	356
GW19	26.7782 N, 75.8067 E	359	S19	26.7895 N, 75.7865 E	355
GW20	26.7599 N, 75.8016 E	355	S20	26.7805 N, 75.7921 E	389
GW21	26.7669 N, 75.8239 E	356	S21	26.7753 N, 75.7782 E	378
GW22	26.7529 N, 75.8318 E	353	S22	26.7594 N, 75.7916 E	385
GW23	26.7731 N, 75.7863 E	357	S23	26.7708 N, 75.8091 E	376
			S24	26.7920 N, 75.8186 E	365
	VES		S25	26.7538 N, 75.8164 E	353
SP1 (VES)	26.7852 N, 75.8044 E	352	S26	26.7615 N, 75.8342 E	352
SP2 (VES)	26.7629 N, 75.8191 E	353	S27	26.7621 N, 75.8491 E	350
SP3 (VES)	26.7800 N, 75.7862 E	351	S28	26.7954 N, 75.8617 E	353
			S29	26.8023 N, 75.8397 E	350
			S30	26.8170 N, 75.8520 E	352

Geostatistical analysis

To assess overall quality of water and soil samples collected from the different sites in the study area, data of soil and water quality parameters analysed thoroughly by applying geostatistical tools. Quantitative evaluation's framework combines geotechnical and physicochemical analysis of water and soil samples with descriptive statistics and statistical modelling. Outcome data is gathered after the laboratory chemical analysis of selected soil and water samples, followed by review with analysis of data on SPSS software (version 22 for Windows). Discriminating analysis (correlation) of data performed using Statistical Package for the Social Sciences (SPSS) for Windows, version 23.0. (Ukah et al. 2019, 2020). Several statistical methods used in data analysis and models including MV, SD, and CV (Li et al. 2016; Zhu et al. 2019). Further, water quality index (WQI) and soil quality index (SQI) evaluated to assess the region's overall variations and patterns of water and soil quality parameters using site-specific indicator evaluation outputs. Weighted arithmetic mean technique for WQI was used in this investigation (Tyagi et al. 2013).

$$WQI_A = \sum_{i=1}^{n} qi\ X\ Wi,$$

$$\sum_{i=1}^{n} Wi = 1,$$

where Wi is the unit weight of each parameter, qi is the 0–100 subindex rating for each variable, and n is the number of subindices aggregated. Multivariate statistical technique, the principal component analysis (PCA), was used to reduce the dataset into new variables, create a minimum data set (MDS), and analyze relationships between different metal contents in the water and soil samples and other quality parameters including pH, TOC, and EC along with factor analysis (FA) to identify specific factor weight of a particular metal (Weissmannová and Pavlovský 2017). The SAS Systems for Windows 10 platform and Statistica 12.5® software used to perform principal component analysis (PCA), followed by a Varimax rotation used to rotate each PCA component. The Varimax rotation method of factor analysis and the principal component primary result analysis performed by following the procedure of Kaiser 1958 and Maiz et al. 2000. For the GIS-based evaluation, SQI and WQI maps, spatial distribution maps, area maps, and thematic maps for the region produced by using Sentinel 2 Satellite data (March 2021) in bands: 3, 4, 8 developed on ArcGIS software 10.8 (2020).

Results

Groundwater samples (23) and soil samples (30) collected from selected sampling sites of the study area, Jaipur regions of Rajasthan, Western India, analyzed for quality parameters. Based on the sounding data, the present study inferred with three geoelectrical layers comprising topsoil, unsaturated, and saturated zones (Fig. 2). For all the sections topmost layer assumed to be topsoil, above the water table and substantially drier more often reflects greater resistivity. Peat investigated in the topsoil layer by resistance correlation with soil lithology from neighboring boreholes. Regional lithology of Sanganer shown in the Table 2 which indicates formation depth range as alluvium, 0.0–95 m; weathered, 0.69–128 m; and hard rock, 9.2 m. In present study, the third layer of all the sections represent highest concentration of geoelectrical sections with low resistivities (less than 10 m). Values and their variation pattern of water quality parameters in 23 groundwater samples at different sites of the study area depicted in Fig. 3. Maximum values of different parameters of groundwater samples recorded as pH, 8.0; electrical conductivity (EC), 3.01 S/m, TDS, 1501 mg/l; fluoride, 1.9 mg/l; total hardness, 273 mg/l; Ca, 88.1 mg/l; Mg, 12.67 mg/l; chloride, 227.42 mg/l; HCO_3, 61.87 mg/l; and CO_3, 58.29 mg/l. However, maximum metal concentration in groundwater samples recorded as Zn, 2.64 mg/l; Cu, 0.862 mg/l; Fe, 0.392 mg/l; Mn, 0.181 mg/l, Pb, 0.065 mg/l; and Ni, 0.016 mg\l. pH and TDS level in the ground water samples found in the range of 7.0 to 8.0 and 559 to 1501 mg/l, indicate that values are within the range of 6.5 to 8.5 and 500 to 1500 mg/l, respectively, as per WHO standard of water quality. Similarly, for 30 soil samples, maximum values of soil quality parameters recorded as pH, 8.4; electrical conductivity (EC), 0.27 μS/m; organic carbon, 0.23 %; phosphorous, 50.23 mg/kg; potash, 786 mg/kg; sulfur, 29.68 mg/kg. However, maximum metal concentration in the soil samples recorded as Fe, 11.25 mg/kg; Mn, 8.65 mg/kg; Zn, 7.26 mg/kg; and Cu, 0.45 mg/kg as shown in Fig. 4. Result shows that none of the parameters including pH have a strong correlation. Samples' scores and loadings plots together showed physio-chemical characteristics of soil that affect each order on the score plots. Retained variables divided into groups using the factor analysis technique in accordance with statistical factors and correlation matrix (Table 3). As depicted in the Table 4, maximum WQI found in groundwater sample collected at sampling site TW22 and minimum in the sample collected from TW12. Results of PCA and FA analysis for groundwater revealed that the first component (PC1), which accounted for 39.12% of the total variance, included Mn, pH, and EC; however, S, OC, and P made the second component (PC2) with a total variance of 12.54%. Similarly, pH, Mn,

Table 2. Regional lithology of the study area, Sanganer, Jaipur (Rajasthan), India

Aquifers depth (m)	Aquifers	Geological formation	Depth (m)	Laboratory experiment model
0–95	Alluvium	Surface soil, sandy clay	0–4	
		Clayey sand	4–13	
		Clayey kankar	13–19	
0.6–128	Weathered	Sandy clay with kankar	19–29	
		Kankar and clay	29–38	
		Kankar and sand	38–47	
9.2	Hardrock	Weathered schist	47–73	
		Schist	73–150	

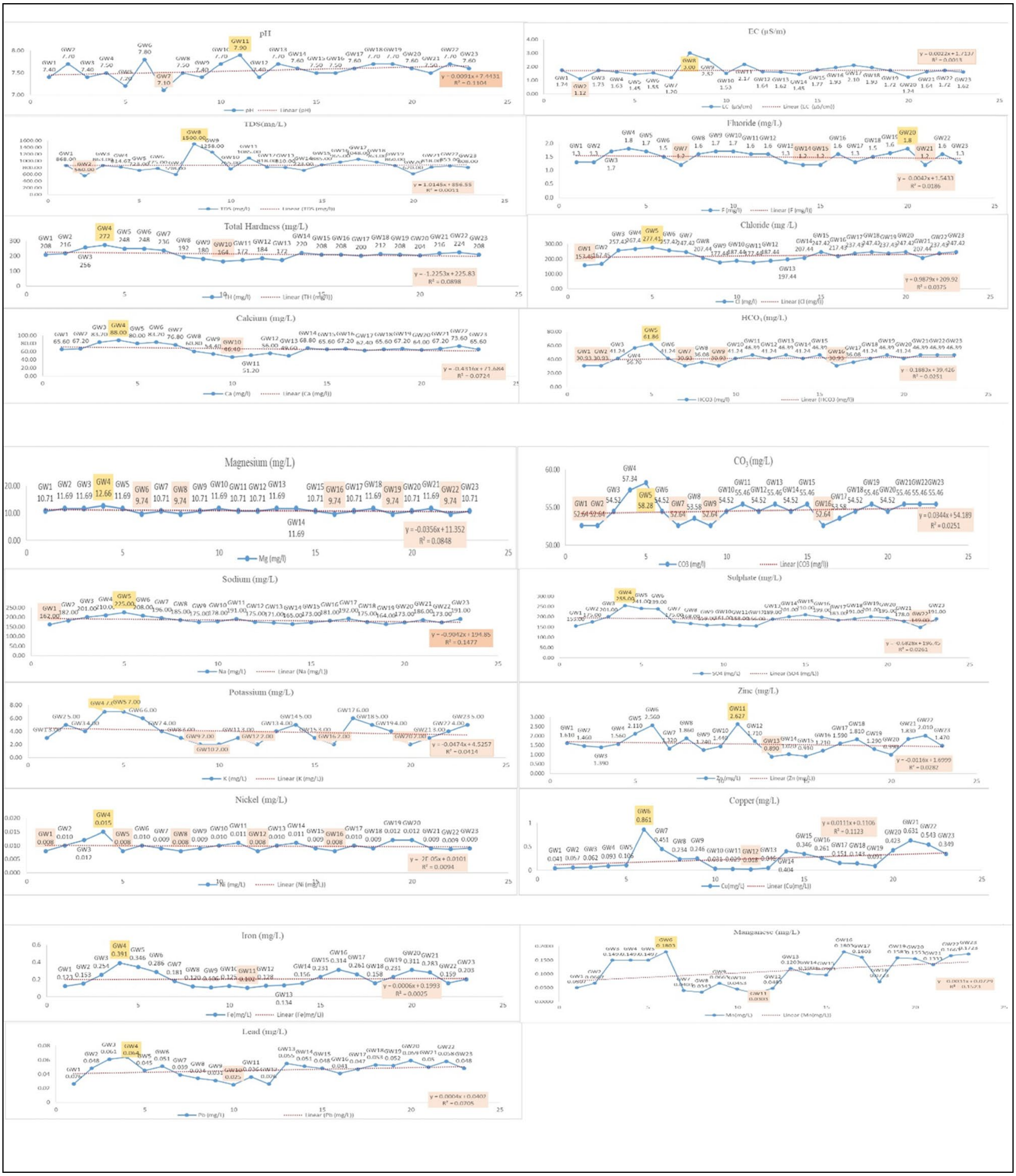

Fig. 3 Variations in water quality parameters of ground water samples collected from in different sites at the study area, Sanganer, Jaipur, Rajasthan, India

and Cu made PC3 with a total variance of 11.42% followed by phosphorous made PC4 a total variance of 9.06%, while all four extraction factors accounted for 72.15% of the overall variation. However, in case for soil samples Mn, pH, and EC produced the first component (PC1) with 24.26% of the variance followed by the second component (PC2) produced included S, OC, and P with a total variation of 17.48%, while PC3 made up of pH, Cu, and Mn with a total variance of

Fig. 4 Variations in soil quality parameters of soil samples collected from different sites at the study area, Sanganer, Jaipur, Rajasthan, India

13.65% and PC4 contained phosphorus with a total variance of 11.58% (Fig. 5A). Result shows that water quality of groundwater samples collected at TW1, TW8, TW10, and TW12 sampling sites in the Sanganer area are in very good quality category; however, groundwater samples from TW3, TW4, TW6, TW19, and TW22 sites recorded under very poor water quality category with high level of contaminants (Fig. 5B). Similarly, total 9 soil quality parameters including pH, EC, OC, P, S, K, Zn, Fe, and Mn used to evaluate the soil quality index (SQI), and an average soil quality index (SQI) value 0.517 recorded for the selected study area based on MDS, with a range of 0.341 to 0.635 (Fig. 5B). According to the suggested framework, the SQI values for the entire selected region divided into three categories viz; category 1 (C1), SQI value less than 0.4 (degraded); category 2 (C2), SQI value between 0.41 and 0.5 (moderately degraded); and category 3 (C3), SQI value greater than 0.51(least degraded). SQI revealed that soil samples at S19 site showed highest SQI score, 0.636, followed by S6, S7, S12, S13, S15, S16, S17, S18, S20, S21, S22, S23, S25, S27, S29, and S30 more than average as shown in Fig. 5B. Data shows that 13.3% of the soil samples from the study area have low soil pollution with good soil health; however, 40% of the soil samples have moderate contamination with SQI values in the range of 0.41 to 0.5 and 46.6% of soil samples shown as degraded soil under the poor-quality category with SQI values more than 0.51. At 5 kilometers away from the Sanganer industrial regions, high-intensity farming techniques, and conventional farming practices, excessive fertilizer use may be responsible for the soil degradation in the selected sites. Based on SQI score, the S19 site showed highly contaminated soil in the study area; however, it is crucial to note that the high score may be due to increased chemical build-up and other components like sulfur rather than trace metals having low concentration; however, it may be useful in environmental health assessment. Results of the factor analysis (FA) recorded insufficient if the Kaiser–Meyer–Olkin (KMO) test result value found to be less than 0.5; however, KMO found less FA findings in the test's outcome than the chemical examination of soil samples. FA did not alter KMO testing significantly because there is no related cut-off point, and the results for the sample given a less clear indication of the applicability of the FA as KMO values estimated 0.487 and 0.466 (less than 0.5) for the groundwater and soil samples, respectively. Percentage (%) of variance evaluated by placing three components out of

Table 3. Correlation matrix[a] of ground water and soil samples collected from different sites at Sanganer study area, Jaipur, Rajasthan, India

Groundwater quality parameters

		pH	EC	TDS	F	TH	Ca	Mg	Cl	HCO_3	CO_3	Na	K	SO_4	Zn	Ni	Mn	Cu	Fe	Pb
Correlation	pH	1.000	.080	.082	.047	− .348	− .338	− .–	− .207	.078	.078	− .284	.008	− .087	.250	.300	.121	.047	− .213	.219
	EC	.080	1.000	1.000	.217	− .366	− .327	− .371	− .211	− .185	− .185	− .088	− .251	− .282	.214	− .241	− − .241	− .147	− .309	− .326
	TDS	.082	1.000	1.000	.217	− .367	− .328	− .370	− .212	− .185	− .185	− .088	− .252	− .279	.212	− .239	− .242	− .149	− .308	− .326
	F	.047	.217	.217	1.000	.068	.074	− .040	.194	.267	.267	.257	− .111	.155	.213	.337	.131	− .259	.240	.036
	TH	− .348	− .366	− .367	.068	1.000	.993	.217	.695	.320	.320	.605	.671	.698	.153	.351	.491	.322	.693	.599
	Ca	− .338	− .327	− .328	.074	.993	1.000	.096	.705	.282	.281	.586	.641	.676	.180	.307	.517	.374	.687	.580
	Mg	− .132	− .371	− .370	− .040	.217	.096	1.000	.028	.361	.361	.241	.346	.280	− .190	.399	− .131	− .366	.156	.244
	Cl	− .207	− .211	− − .212	.194	.695	.705	.028	1.000	.538	.538	.572	.569	.734	.044	.295	.645	.345	.735	.659
	HCO_3	.078	− .185	− .185	.267	.320	.282	.361	.538	1.000	1.000	.441	.480	.560	.242	.343	.381	− .032	.462	.449
	CO_3	.078	− .185	− .185	.267	.320	.281	.361	.538	1.000	1.000	.441	.480	.560	.242	.343	.381	− .032	.462	.449
	Na	− .284	− .088	− .088	.257	.605	.586	.241	.572	.441	.441	1.000	.615	.590	.498	.154	.288	.115	.582	.215
	K	.008	− .251	− .252	− .111	.671	.641	.346	.569	.480	.480	.615	1.000	.672	.284	.314	.411	.074	.459	.529
	SO_4	− .087	− .282	− .279	.155	.698	.676	.280	.734	.560	.560	.590	.672	1.000	− .010	.451	.589	.185	.811	.590
	Zn	.250	.214	.212	.213	.153	.180	− .190	.044	.242	.242	.498	.284	− .010	1.000	− .145	− .054	.175	− .008	− .143
	Ni	.300	− .241	− .239	.337	.351	.307	.399	.295	.343	.343	.154	.314	.451	− .145	1.000	.281	− .117	.388	.604
	Mn	.121	− .241	− .242	.131	.491	.517	− .131	.645	.381	.381	.288	.411	.589	− .054	.281	1.000	.393	.750	.695
	Cu	.047	− .147	− .149	− .259	.322	.374	− .366	.345	− .032	− .032	.115	.074	.185	.175	− .117	.393	1.000	.270	.288
	Fe	− .213	− .309	− .308	.240	.693	.687	.156	.735	.462	.462	.582	.459	.811	− .008	.388	.750	.270	1.000	.582
	Pb	.219	− .326	− .326	.036	.599	.580	.244	.659	.449	.449	.215	.529	.590	− .143	.604	.695	.288	.582	1.000

Soil quality parameter

		pH	EC	OC	Phosphorus	Sulfur	Potash	Zn	Fe	Cu	Mn
Correlation	pH	1.000	.163	− .071	.166	.148	.111	− .324	.291	− .039	− .089
	EC	.163	1.000	.125	.059	.113	.075	− .064	.079	.131	− .264
	OC	− .071	.125	1.000	− .237	.226	− .174	.023	− .382	− .331	.288
	Phosphorus	.166	.059	− .237	1.000	.290	.250	− .178	.385	.400	− .109
	Sulfur	.148	.113	.226	.290	1.000	.493	− .101	.202	− .026	.314
	Potash	.111	.075	− .174	.250	.493	1.000	− .291	.160	− .064	− .012
	Zn	− .324	− .064	.023	− .178	− .101	− .291	1.000	− .362	.149	.110
	Fe	.291	.079	− .382	.385	.202	.160	− .362	1.000	.054	− .234
	Cu	− .039	.131	− .331	.400	− .026	− .064	.149	.054	1.000	− .059
	Mn	− .089	− .264	.288	− .109	.314	− .012	.110	− .234	− .059	1.000

Table 4. Water quality and soil quality Index

Groundwater quality index						
Parameters	Quantity of sample	WQI (mean)	Std. deviation	Std. error	Maximum	Minimum
pH	23	7.5522	.0035	.0020	8.0000	7.0000
EC (μS/m)	23	1.7400	.0027	.0015	3.0100	1.1100
TDS (mg/l)	23	868.7246	.7633	.4407	1501.0000	559.0000
Fluoride (mg/l)	23	1.4928	.0054	.0031	1.9000	1.1000
TH (mg/l)	23	211.1304	.5325	.3074	273.0000	163.0000
Ca (mg/l)	23	66.5043	.0035	.0020	88.1000	46.3000
Mg (mg/l)	23	10.9249	.0009	.0005	12.6700	9.7300
Cl (mg/l)	23	221.7787	.0025	.0014	277.4200	157.4400
HCO_3 (mg/l)	23	41.6862	.0041	.0024	61.8700	30.9200
CO_3 (mg/l)	23	54.6017	.0082	.0047	58.2900	52.6300
Na (mg/l)	23	184.0000	.6035	.3484	226.0000	161.0000
K (mg/l)	23	3.9565	.6745	.3894	8.0000	1.0000
SO_4 (mg/l)	23	188.2609	.8165	.4714	256.0000	148.0000
Zn (mg/l)	23	1.5612	.0083	.0048	2.6400	1.6000
Ni (mg/l)	23	0.0098	.0010	.0006	.0160	.0011
Mn (mg/l)	23	0.1099	.0004	.0002	.1810	.0300
Cu (mg/l)	23	0.2442	.0008	.0005	.8620	.0170
Fe (mg/l)	23	0.2068	.0008	.0005	.3920	.1010
Pb (mg/l)	23	0.0456	.0008	.0004	.0650	.0240
Soil quality index						
Parameters	Quantity of sample	SQI (mean)	Std. deviation	Std. error	Maximum	Minimum
pH	30	8.11	.0064	.0037	8.40	7.98
EC (μS/m)	30	.2240	.0008	.0005	.2760	.1580
Organic carbon (%)	30	.1793	.0061	.0035	.2300	.1400
Phosphorous (mg kg^{-1})	30	38.1197	.0009	.0005	50.2310	21.0500
Sulfur (mg kg^{-1})	30	24.9634	.0006	.0004	29.6810	18.3620
Potash (kg/ha)	30	607.1889	.7385	.4264	786.00	410.00
Zn (mg kg^{-1})	30	5.6635	.0010	.0006	7.2630	4.0890
Fe (mg kg^{-1})	30	9.0579	.0006	.0003	11.2510	7.2890
Cu (mg kg^{-1})	30	.3261	.0005	.0003	.4550	.2130
Mn (mg kg^{-1})	30	6.8290	.0007	.0004	8.6560	4.6810

the four PC ranges (component based on Jolliffe's criterion) and recorded 84.60% and 66.98% for groundwater and soil samples, respectively (supplementary data).

Discussion

Collected samples from the selected study area, Jaipur regions of Rajasthan, Western India, evaluated for water and soil quality parameters which indicate slightly basic in nature as pH varied within the ranged of 7.0 to 8.0 in the samples. pH is one of the essentially functional parameters for evaluating the quality of soil and water (Filip 2002). Depending on the underlying geological units' actual resistivity, the geoelectrical characteristics utilized to create earth models which displayed as subsurface stratigraphy and from which possible aquifer zones mapped for sampling and assessing the groundwater quality parameters at different sites in the selected region (Mogaji and Omobude 2017). Higher value of EC in groundwater samples indicates impurity as compared to pure water which is not an excellent conductor of electricity having a lower EC than the groundwater. According to previous studies, groundwater exhibits low resistivities between 10 and 100 Ωm in the context of sedimentary (Adagunodo et al. 2018). Kaiser's criterion replaced with Joliffe's criterion since it is too high and allows for a graphic representation of the factor loading through a dipole using the first three components (Jolliffe 1972). However, soil solutio"s EC indicates total amount of salts and ions present in the soil (Bronson et al. 2005; Peralta and Costa 2013). A significant indicator of the soil quality is electrical conductivity, which reflects the salinity of the soil

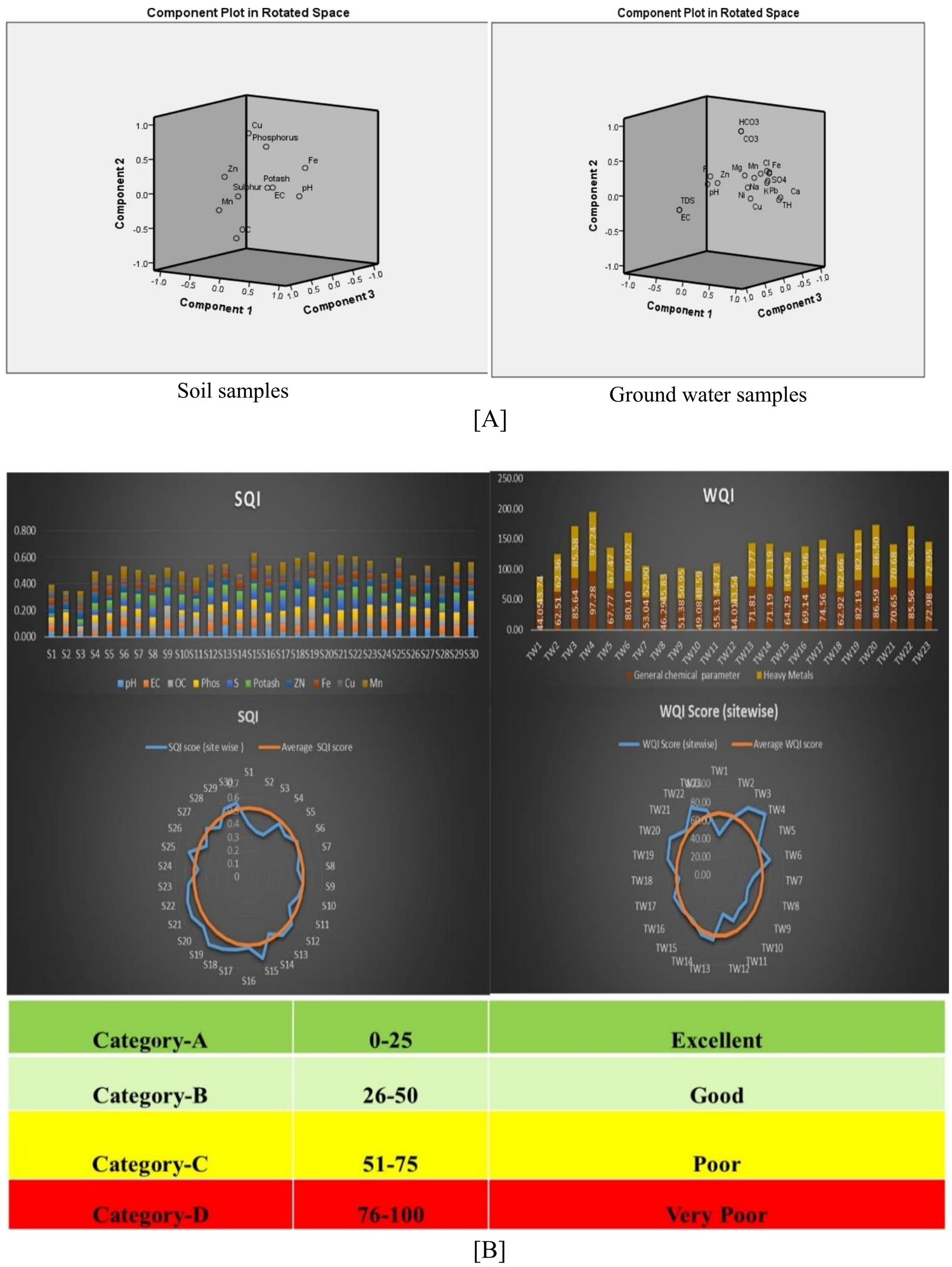

Fig. 5 Component plot of ground water and soil samples (**A**). Soil quality index (SQI) and water quality index (WQI) of collected samples (**B**)

(Hardie and Doyle 2012). Studies revealed that low resistivity values inside the underlying strata likely caused by high ion concentrations and fine-grained sediments like silt and clay (Amaya et al. 2018). Another soil quality parameter of soil is known as soil organic carbon (SOC) contains organic remains of dead animals and plants at various stages of decomposition which affects physicochemical characteristics of the soil (Campbell 1978). Concentration of SOC in the soil samples is one of the fundamental criteria for soil quality (Unger 1997). Agricultural production, plant development, and soil fertility also depend on phosphorus content, which is the second-most important macronutrient in soil after nitrogen (Malhotra et al. 2018). Similarly, soil fertility, pH levels, plant development, and efficient nitrogen fixation processes dependent on its existence in the soil (Jordan and Ensminger 1959). Potash content is another essential macronutrient for preserving soil fertility and pH homeostasis. Fertilizer used usually to supplement K into the soil in case of its deficiency because plants require K for their growth and development during the life cycle (Morgan and Connolly 2013). However, high concentration of potash in soil also effects soil quality and causes soil degradation (Sillanpaa 1982). Water and soil quality assessment studies have sparked interest on a global scale due to growing attention on the depletion of water and soil quality to assess the environmental impact of anthropogenic activities for environmental sustainability (Raiesi and Kabiri 2016). Various attempts have been made to measure the quality of the soil and water using different indicators (Armenise et al. 2013; Seybold et al. 2018). Water quality index makes it possible to examine water quality in a variety of ways that affect a stream's ability to sustain by its processes and to ensure sustainable use of water resources to minimize risks and preserve aquatic ecosystems (Akkaraboyina and Raju 2012). WQI is an important distinctive grade which summarizes overall quality of water and helps in selecting the most effective treatment strategy for wastewater before its final discharge and disposal to prevent water contamination (Tyagi et al. 2013). Status and level of contamination of water has been evaluated by using water quality parameters and quality index (Shah and Joshi 2017). The WQI and SQI approach is one of the best and most widely used techniques for assessing the quality of soil and water for adapting treatment and conservation strategies (Arshad and Martin 2002; YanBing et al. 2009). Physio-chemical and biological characteristics of soil indicated by the soil quality which is crucial to its long-term functionality and productivity and sustainability. An encompassing view of the region's overall soil quality evaluated assessing the soil quality index (Bhattacharyya 2017). Similarly, minimum data set (MDS) for the data reflecting the soil's functional capacity used in evaluating the soil quality index (Klimkowicz-Pawlas et al. 2019). By using multivariate geostatistical techniques, contemporary data analysis and metal content estimation of four metals (Zn, Cu, Mn, and Fe) in the soil and six metals (Zn, Cu, Mn, Fe, Pb, and Ni) in groundwater emphasis water and soil quality (Lu et al., 2010). Metals Zn, Ni, Mn, Cu, Fe, and Pb chosen based on PCA, FA, and CA investigations as reference elements for soil and groundwater contamination. Several studies evaluated metal contamination of soil and water in the different urban and industrial regions using principal component analysis (Manta et al. 2002; Skrbic and Djurisic-Mladenovic, 2007, Guo et al., 2013). PCA technique used to show the relationship among metals concentration and other parameters (pH, EC, TOC) in the soil and water (Weissmannová and Pavlovský 2017). FA produced using a constant value for all the soil and water quality parameters with a correlation matrix to minimize the effect of varying units on the variables (Lin et al. 2002). Kaiser–Meyer–Olkin (KMO) test used to evaluate whether the sample is large enough to use factor analysis (Kaiser 1974). In principal component analysis (PCA), variables referred to as principal components (PC) used to illustrate the relation between two elements (Esbensen and Geladi 2010). In similar study, Tripathi and Singal (2019) evaluated water quality of the Ganga River using PCA technique. In contrast, Praus (2019) used primary component weighted index (PCWI) for assessing the quality of both untreated and treated wastewater to evaluate WQI. Data indicate that unregulated discharge of wastewater including urban sewage contaminate water and soil by the process of seepage and leaching or irrigation with wastewater leads to depletion of groundwater and soil quality. High concentration of metals and other contaminants in the soil and groundwater may be due to continuous and long-term disposal of wastewater containing metals from industrial units leading to health hazards (Wuana and Okieimen 2011). Therefore, applying geographical and geostatistical techniques with an integrated approach could be more effective ways in environmental monitoring and assessment of soil and water contamination to ensure environmental and health safety.

Conclusion

Groundwater and soil quality parameters of water and soil samples varied with different sites of the selected study area, indicate about 13.3% of the sites found to have good soil health with minimum contamination level followed by 40% of sites with moderate contamination; however, 46.6% of sites shown high level of contamination of soil. Evaluating WQI and SQI values in the present study offers insightful information about site-wise variation pattern of quality parameters including metals identifying the sites with high level of contamination to opt appropriate strategies and mitigation measures to ensure preserving groundwater and soil quality. Further, a study concludes that contamination of water and soil with metals and other contaminants leads to depletion of quality parameters which affects nutrients cycling in the aquatic and terrestrial ecosystem with more imbalances in availability of NPK. GIS-based WQI maps provide more description of sites in categorizing contaminated regions to ensure safe water supply and developing wastewater treatment facilities for sustainable urban planning. Besides, water and soil quality assessment using GIS and geostatistical technique provide regional and spatial variability of contaminants with their correlation to establish standards of soil health and drinking for effective natural resource management in a particular region. Therefore, the present study could be a new insight in in environmental monitoring involving quantitative and qualitative assessment of water and soil quality for sustainable resource utilization and conservation applying geographical and geostatistical techniques.

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Author contribution All authors contributed to the study conception and design. Sampling of water and soil samples, analysis, and drafting of manuscript were performed by J. Khan and G. Gupta. All authors commented on previous versions of the manuscript. Hypothesis and designing of the experiment were done by N. K. Singh; data analysis and improving the manuscript were done by V.N. Bhave and V. Bhardwaj; map designing and statistical analysis were done by P. Upreti and R. Singh; and geophysical analysis and editing were done by A. K. Sinha. All authors read and approved the final manuscript.

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Declarations

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RESEARCH ARTICLE

WILEY

Efficacy evaluation of newly isolated zinc solubilizing bacteria for their potential effect on maize (*Zea mays* L.) under zinc deficient soil conditions

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Abstract

Zinc solubilizing bacteria (ZSB) induces the conversion of fixed and unavailable soil zinc to readily available zinc contributes plant zinc nutrition and fortification. The present research intended to determine the screening of plant growth-promoting (PGP) traits of potent ZSB, biochemical and molecular characterization of ZSB, and assessment of potent ZSB for crop yield at the field level. Therefore, in the present study, molecular and functional characterization of native ZSB isolates was done to examine their response to plant growth performance and yield, mobilization of zinc, and acquisition by maize plants. Zinc solubilizing bacterial isolates namely, ZSB1, and ZSB 17 were solubilized insoluble zinc namely, $ZnCO_3$, ZnO, $Zn_3(PO_4)_2$ and significantly induced growth performance of maize crop at field conditions. A biochemical study revealed that both ZSB isolates were positive for catalase and urease production. Isolates ZSB1 & ZSB17 showed different PGP attributes like production of Indole-3-acetic acid (IAA), siderophore, NH_3, and HCN. Both isolates were solubilized phosphate, potassium, and silica and showed 1-aminocyclopropane-1-carboxylate (ACC)-deaminase activity. 16S rRNA amplification and sequence study of ZSB1 and ZSB17 revealed that both the isolates were *Cupriavidus* sp. and *Pantoea agglomerans*, respectively, and novel. The results elucidated from pot studies demonstrated that both ZSB1 & ZSB17 were the more suitable isolates than other ZSB isolates, and these isolates were further tested for field studies. *Cupriavidus* sp. and *Pantoea agglomerans* strains increased Zn-translocation toward grains and yield of Maize (cv: P3441) by 19.01% and 17.64%, respectively. We conclude that the novel indigenous ZSB strains substantially heightened zinc mobilization, the yield of maize crop, restore soil health, and can be suitable for biofortification and biofertilizers technology.

KEYWORDS

16S rDNA sequencing, field experiment, PGP attributes, zinc solubilizing bacteria, zinc translocation index

1 | INTRODUCTION

The availability of plant necessary elements has a direct impact on soil fertility and agricultural crop productivity. The availability of plant essential elements may change as a result of the buildup of higher concentrations of metals and metalloids in contaminated soil (Alengebawy et al., 2021). A mediated metabolic pathway requires minimal metalloids and heavy metals at appropriate concentrations for root microbiota, soil fertility, and plant growth (Barra & Terenzi, 2021; Upadhyay et al., 2022). Few metalloids and heavy metals, on the other hand, are even at low concentrations hazardous to plant development and soil fertility (Chibuike & Obiora, 2014). Man-made activities such as mining, developing industrial zones, chemicals and pesticides, waste disposal, and so forth are increasing the prevalence of these contaminants (Alengebawy et al., 2021; Upadhyay & Edrisi, 2021).

Essential elements such as Zn (zinc), Cu (copper), Fe (iron), Mg (magnesium), and so forth are necessary to plant growth at an optimum concentration (White & Brown, 2010). Plant growth and soil fertility are also reduced by (i) a higher concentration of essential elements, and (ii) incompatible form of essential elements in the soil (Baldantoni et al., 2019), hence optimum concentration of essential micronutrients is required for soil productivity. Microbes can mobilize or solubilize trapped essential elements in contaminated soil by releasing extra-cellular enzymes; these enzymes may be facilitated by redox reactions (Garcia-Arellano et al., 2004).

Plant growth promoting rhizobacteria (PGPR) plays remarkable and promising role in phyto-stimulation by releasing plant hormones like Indole-3-acetic acid (IAA), Gibberellins and so forth (Upadhyay & Chauhan, 2022), and other solubilized trapped essential elements of soil and increasing essential element uptake in plants (Singh et al., 2022; Upadhyay et al., 2009). These procedures are known as PGPR direct mechanisms (Mahmud et al., 2021; Singh et al., 2022). The production of exo-polysaccharides (Upadhyay et al., 2011), antibiotics, antioxidants (Upadhyay & Singh, 2015), biocontrol action to reduce phytopathogens, and so forth are indirect mechanisms of PGPRs (Mahmud et al., 2021). Mobilization and solubilization of trapped essential elements by rhizobacteria can be effective sustainable approaches to improving plant growth performance and enhancing soil fertility in zinc-contaminated soil (Bhojiya et al., 2022).

The ZSB (zinc solubilizing bacteria) are renowned for their effectiveness in the solubilization of zinc when combined with plant root exudates, which function as a chemo-attractant and improve the availability of native rhizobacteria promotes plant growth (Upadhyay et al., 2022). ZSB thus facilitate native zinc for plant assimilation, leading to plant growth promotion (Shakeel et al., 2015). Previously, studies on the utilization of ZSB to enhance the Zn acquisition in crops such as wheat, mung-bean etc. and correcting Zn deficiency in soil by increasing over 50% available Zn levels in the harvest soil samples has been reported (Dinesh et al., 2018; Mumtaz et al., 2017; Sirohi et al., 2015). In more than 300 enzymes, zinc and zinc ion plays a vital biological role by maintaining protein structure & stability and is found in many metalloenzymes as essential cofactor (Sarathambal et al., 2010).

Zinc deficiency leads to biomass and fertility reduction directly reduces crop plant yield, chlorosis in leaves which negatively impact photosynthesis, increased iron accumulation causing cellular toxicity, and increased oxidative stress with reduced Cu/Zn SOD activities (Thiébaut & Hanikenne, 2022). Zinc deficiency in maize is very likely to result in stunting, acute chlorosis, reduced pollen viability, and male sterility (Brown, 2008). Due to the selective cultivation of high-yield maize varieties with synthetic fertilizers to boost cropping and quality over the past few decades, zinc deficiency has ravaged into the soil-crop environment, making maize the most susceptible cereal crop to Zn deficiency (Fageria et al., 2002).

Fifty percent of global and Indian soils are zinc deficient which is projected to increase to an estimated 63% by 2025 leading to reductions not only in crop yield but also in food quality (Hussain et al., 2022; Shukla et al., 2021). In India, 51.2% soils from the states Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Telangana, and Uttar Pradesh were deficient in available Zn (Shukla et al., 2021). Zn solubilization and mobilization by soil microbes has sustainable perspectives in comparison to chemical fertilizers. Therefore, the intent of current investigation was focused on (i) isolation and screening of potent ZSB and its plant growth-promoting (PGP) attributes, (ii) 16SrRNA characterization of potent screened bacterial isolates, (iii) Influence of potent isolates on plant growth and soil health in zinc infested soil at field level.

2 | MATERIALS AND METHODS

2.1 | Physico-chemical properties of rhizospheric soil samples

The rhizospheric soils of chickpea plant were obtained from the Dungarpur (23.85° N; 73.68° E) and Pratapgarh (23.56° N;73.74° E) districts of Rajasthan (Figure 1), both the sites were adjacent to ZAWAR mines (Latit-24.3540034; Long-73.733064). Physico-chemical properties such as EC (Electrical conductivity), OC (Organic Carbon), Av. N (available nitrogen), Av. P (available phosphorus), Av. K (available potassium), and diethylenetriaminepentaacetic acid (DTPA) extracted zinc were analyzed as per standard procedures (Jain, Kour, et al., 2020; Vance et al., 1987).

2.2 | Isolation of ZSB and screening of its zinc solubilizing potential

The ZSB isolation was done with serial dilution plate method on specific media namely, Mineral salt media (Saravanan et al., 2007) and Bunt & Rovira medium (Bunt & Rovira, 1955) supplemented with different insoluble zinc source such as ZnO, $ZnCO_3$, and $Zn_3(PO_4)_2$ to produce a clear halo zone after 48 h incubation at 28°C ± 2°C were purified and considered as ZSB. To evaluate zinc solubilization efficiency of the isolates, the halo zone forming bacterial isolates were put on Bunt and Rovira agar and MSM media plates with a 0.1% insoluble zinc-source and at 28°C ± 2°C plates were incubated for 48 h. Zn solubilization efficiency was calculated as given equation.

$$\text{Solubilization efficiency} = \frac{\text{Zone diameter}}{\text{Diameter of colony growth}} \times 100$$

Further, for quantitative estimation (broth assay) of zinc solubilizing potential of ZSB strains were determined by following Gandhi

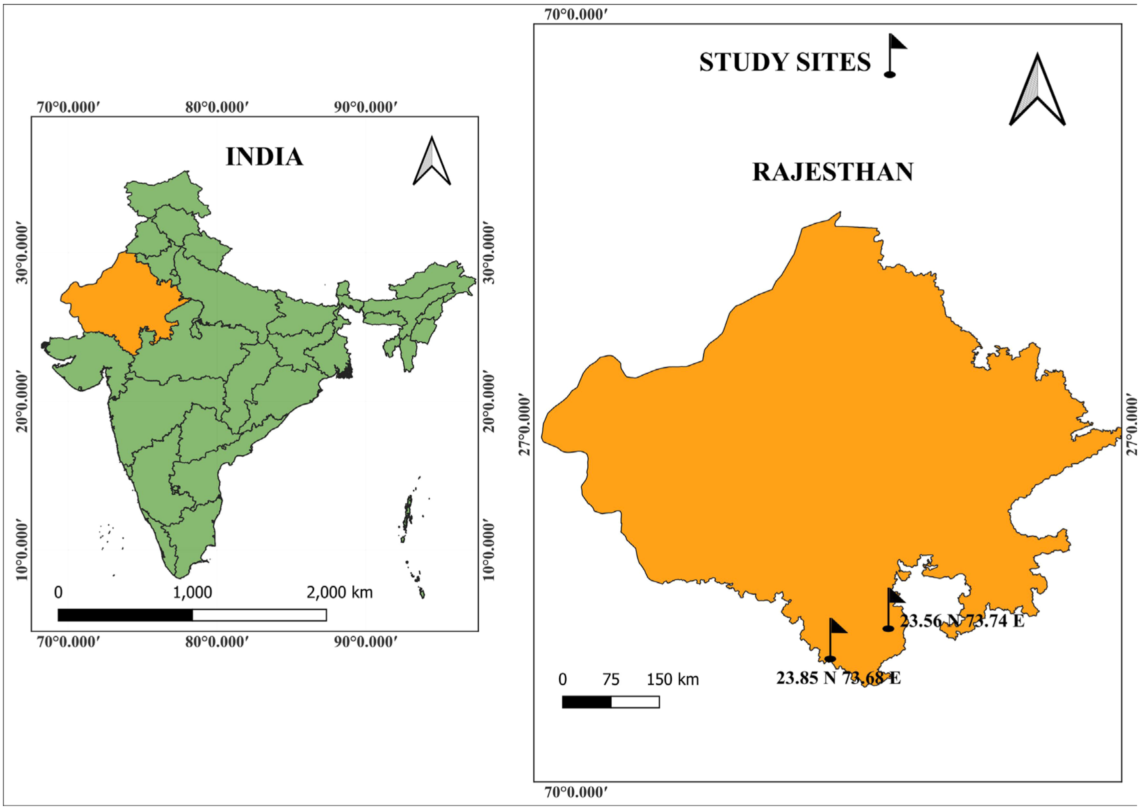

FIGURE 1 Map of the state of Rajasthan showing the geographic locations of collection of soil samples for the isolation of zinc solubilizing bacteria. [Colour figure can be viewed at wileyonlinelibrary.com]

et al. (2014). Briefly, the available zinc concentration was measured using atomic absorption spectrophotometer (AAS 4141 model, Electronics Corp. of India Ltd., India) in the culture filtrate of ZSB grown in MSM broth containing different insoluble zinc source (0.1%) at 4th, 8th, and 16th day of incubation (Gandhi et al., 2014). The pH shift of culture filtrate and uninoculated medium were also analyzed using pH meter.

2.3 | Morphological, biochemical, and molecular identification of potent ZSB

Morphological characteristics namely, form, elevation, margin, cell form, colony color, appearance colony morphology, growth, Gram staining (Gram, 1884) and basic biochemical test namely, Catalase test, Urease test, and Gelatin Liquification test were studied using the standard procedure (Blazevic & Ederer, 1975). Molecular identification of the screened ZSB isolates was carried out through 16S rRNA PCR amplification by using universal primers according to Weisburg et al. (1991) and Jain, Sanadhya, et al. (2020) and sequenced. The 16S rDNA sequences of ZSB isolates were subjected to a BLAST analysis (Altschul et al., 1990) in order to retrieve closely related sequences of type strains and further aligned using online tool CLUSTAL-W (Thompson et al., 1994). The MEGA 6.06 software was employed to construct phylogenetic tree (Tamura et al., 2013).

2.4 | HPLC and GCMS analysis for gluconic acid

The production of gluconic acid by ZSB isolates were tested by injecting the 5 days pre incubated culture filtrate in to a RP-HPLC (Agillent) having C18 column and the mobile phase acetonitrile: water (30:70 v/v) with a flow-rate @ 1.0 mL/min was used with an isocratic flow to detect gluconic acid at 210 nm through UV/Vis-detector (Jain, Kour, et al., 2020). The culture filtrates were further evaluated for the presence of various organic acids and other moieties using GCMC (GCMSQP2020, Shimadzu). Briefly, the methanol extracts (500 μL) of lyophilized culture filtrate 100 μL of N-Methyl-N-(trimethylsilyl) trifluoroacetamide and 100 μL of pyridine were added and the reactions were heated (60°C for 30 min gently) in a water bath and left 12 h for stabilization. These processed samples were analyzed through GC–MS (source temperature 200°C, ionizing voltage 70 eV) and operated with scan mode (50–700 m/z) with temperature ranged 70–260°C and data was compared with NIST library.

2.5 | Physiological and PGP attributes of potent ZSB

Physiological attributes of potent ZSB isolates such as tolerance of pH (Graham, 1992), tolerance of salinity (Upadhyay et al., 2009) tolerance of temperature (Graham, 1992), tolerance of drought (Abolhasani et al., 2010), antibiotic resistance (Li & Ramakrishna, 2011) was performed by using standard protocols. Zinc solubilizing bacterial isolates were examined for their multiple PGP traits such as production of IAA, siderophore-production, 1-aminocyclopropane-1-carboxylate (ACC) deaminase activity, phosphate-solubilization, potassium and silica solubilization, HCN, ammonia and exopolysaccharides production with standard published methodologies (Jain, Kour, et al., 2020; Naureen et al., 2015; Siddiqui et al., 2021; Upadhyay et al., 2011; Yadav et al., 2022). Hydrolytic enzymes (αamylase, cellulase, pectinase, and protease) was measured by the method of Cappuccino and Sherman (1992) & lipase (Ertugrul et al., 2007), chitinase activity (Kumar et al., 2012), and glucanase activity (Fawzy and Monaim, 2016) were screened by using standard protocols.

2.6 | Bio efficacy evaluation of potent ZSB

2.6.1 | Pot experiment

Bio efficacy and plant growth promotion ability of selected ZSB1 and ZSB17 strains as liquid microbial inoculants was evaluated under pot culture in triplicate following complete randomized design according to our previously published research (Jain et al., 2021). The maize seeds (5–10) were treated with ZSB liquid inoculants (>8.5–$\times 10^8$ cfu mL^{-1}) and placed in 4.0–5.0 cm deep in each pot. All the pots were given uniform recommended dose of fertilizers (RDF) namely, N (@ 120 kg N: P@ 60 kg P_2O_5 and K @ 40 kg K_2Oha^{-1}; Omara et al., 2016). After 30 days of sowing, plant growth parameters namely, average shoots, root-length, root-number, leaf-number, and leaf chlorophyll content (Ronen & Galun, 1984) were analyzed using standard protocols.

2.6.2 | Field experiment

The field studies were undertaken at Krishi Vigyan Kendra, Dungarpur and Instructional farm, Rajasthan College of Agriculture (RCA), (composite soil analysis reports of both experimental fields were summarized in Supplementary data sheet Table S1.1), where the DTPA extractable zinc content is low (<0.6 PPM) in 2 years of kharif seasons to differentiate the effect of two ZSB isolates on growth and yield of Maize variety P3441. The field experiment was laid out in a RBD (randomized block design) with 15 treatments in three replications including two ZSB isolates and uninoculated control (S_1: 100% RDF, T_1: ZSB1 ONLY, $T_{2:}$ ZSB1+ 100% RDF, $T_{3:}$ ZSB1 + 75% RDF, $T_{4:}$ ZSB1 + 50% RDF, $T_{5:}$ ZSB1 + 100% RDF + $ZnSO_4$, $T_{6:}$ ZSB1 + 75% RDF + $ZnSO_4$, $T_{7:}$ ZSB1 + 50% RDF + $ZnSO_4$, $T_{8:}$ ZSB17 ONLY, $T_{9:}$ ZSB17 + 100% RDF, $T_{10:}$ ZSB17 + 75% RDF, $T_{11:}$ ZSB17 + 50% RDF, $T_{12:}$ ZSB17 + 100% RDF + $ZnSO_4$, $T_{13:}$ ZSB17 + 75% RDF + $ZnSO_4$, $T_{14:}$ ZSB17 + 50% RDF + $ZnSO_4$) as similar approach was adopted by earlier reported work of Upadhyay et al. (2019). The sowing was done by manual dibbling the seeds at a distance of 60 cm × 40 cm row to plant (Fahad et al., 2016).

ZSB liquid biofertilizer @ 5 mL kg^{-1}treated to seed before sowing. To enhance the health of cropping over the crop season, all recommended agronomical practices namely, sowing, weeding, manuring, harvesting, and so forth were taken. Ten plants were randomly selected from every plot at physiological maturity of the crop (106–110 days from sowing), the parameters of yield and harvest including cob length (cm); number of grains per row; number of rows per cob; weight of cobs per plot; weight of grain (g); thousand grain weight (g); biological yield per plot (g); harvest index (%) were evaluated manually (Supplementary data sheet: experimental details) (Gheith et al., 2022). Data analysis was accomplished by using the analysis of variance determining levels of significance.

2.7 | Analysis of Zn-content and Zn-translocation index (ZTI)

The powdered sample (shoot and grain) from all 15 treatments were digested using a triacid mixture (HNO_3: H_2SO_4: $HClO_3$ in the ratio of 9:2:1) and the Zn-content were measured using AAS to quantify the Zn translocation index (ZTI) (Rengel & Graham, 1996).

$$ZTI = \frac{\text{Zn concentration in grains}}{\text{Zn concentration in shoot}} \times 100$$

3 | RESULTS

In the present study, the physico-chemical characteristics of Dungarpur and Pratapgarh soil samples are described in Table S1.2. The soil samples textured with clay loam and sandy loam, while the soil pH ranged from acidic to neutral. The rhizospheric soils contains moderate to high range of ECe, OC, Av. N, Av. P, and Av. K. The DTPA extractable concentrations of Zn-soil (available Zn) were observed as 0.572 and 0.686 ppm.

3.1 | Isolation and assay (qualitative and quantitative) for zinc solubilization by ZSB

Microorganisms have varied solubilization response with different insoluble form of zinc hence, in the present study, ZSB isolates ZSB1 and ZSB17 were selected based on their capabilities in solubilizing multiple forms of insoluble zinc namely, ZnO, $ZnPO_4$, and $ZnCO_3$ in plate assay. Qualitative screening of zinc solubilization was carried out in MSM media and R&B media plates supplemented with different insoluble Zn compounds (Table 1). Zn solubilization zone with ZSB1 was observed in MSM media plates was 3.78 mm, 5.46 mm and 4.10 mm with $ZnCO_3$, ZnO, and $Zn_3(PO_4)_2$, respectively, and by ZSB17 was 3.09 mm, 3.79 mm, and 6.56 mm with $ZnCO_3$, ZnO, and Zn3 $(PO_4)_2$, respectively whereas in R&B media maximum zone of solubilization was observed with ZSB1 was 3.78 mm, 5.43 mm, and 4.10 mm with $ZnCO_3$, ZnO, and $Zn_3(PO_4)_2$, respectively, and by ZSB17 (3.09 mm, 2.85 mm, and 6.56 mm with $ZnCO_3$, ZnO, and $Zn_3(PO_4)_2$, respectively). Higher solubilization of Zn was observed in plates containing MSM media.

TABLE 1 Qualitative and quantitative assay for Zinc solubilization by ZSB strains on different insoluble Zn compounds.

	Qualitative assay for zinc solubilization by measuring solubilizing index (SI)					
	SI ON R&B (ZNO)	SI ON R&B (ZNC)	SI ON R&B (ZNP)	SI ON MSM (ZNO)	SI ON MSM (ZNC)	SI ON MSM (ZNP)
ZSB-1	5.43 ± 0.05	3.78 ± 0.02	4.1 ± 0.02	5.46 ± 0.05	3.78 ± 0.02	4.10 ± 0.02
ZSB-17	2.85 ± 0.04	3.09 ± 0.08	6.56 ± 0.01	3.79 ± 0.02	3.09 ± 0.08	6.56 ± 0.01

	Qualitative assay (broth assay) by measuring soluble Zinc (μg/mL) using AAS			
	4th day (μg/mL)	8th day (μg/mL)	16th day (μg/mL)	pH
ZSB-1	5.1800 ± 0.0436	14.5767 ± 0.0416	17.3033 ± 0.0603	30.2
ZSB-17	6.1100 ± 0.0201	14.2500 ± 0.0657	14.6533 ± 0.6240	40.1

Abbreviations: MSM, mineral salt media; R&B, bunt & Rovira medium; ZNO, Zinc oxide; ZNC, Zinc carbonate; ZNP, Zinc phosphate.

Both ZSB strains were further evaluated for quantitative Zn-solubilization at different time intervals in MSM broth (broth assay). The results raveled that the amount of Zn solubilized from insoluble zinc-oxide, zinc-carbonate, and zinc-phosphate by both the ZSB isolates, and Zn solubilization rate was proportional with incubation time (Table 1). Maximum available Zn registered by ZSB1 was 5.18 μg mL^{-1} on the fourth day, which peaked to 14.57 μg mL^{-1} during the eighth day, followed by 17.30 μg mL^{-1} during the 16th day whereas zinc solubilization by ZSB17 was 6.11 μg mL^{-1} on the 4th day, which peaked to 14.25 μg mL^{-1} during the eighth day, followed by 14.65 μg mL^{-1} during the 16th day. Zn solubilization and reduction in pH of the culture medium showed positive correlation for both the ZSB isolates.

3.2 | Morphological, biochemical, and molecular characterization of ZSB isolates

The shape of ZSB1 and ZSB17 isolate was rod and cocci respectively, while both were gram negative. Colony characteristics as colony color, form, elevation, margin and appearance were also noted along with key biochemical tests and described in Supplementary data sheet Table S2. Biochemical analysis revealed that both ZSB isolates were negative for gelatin liquification test, while both were positive for catalase and urease production. The 16S rRNA gene sequence of isolate ZSB1 showed 95.49% homology with 16S rRNA sequence of *Cupriavidus campinensis* strain BT HNGU56 (Accession number KY010351) already submitted to GenBank data repository of the NCBI. The sequence of 16S rRNA gene of isolate ZSB17 showed 99.68% homology with 16S rRNA sequence of *Pantoea* sp. strain AS-43 (Accession number OL604306) already submitted to GenBank data repository of the NCBI [ZSB1: *Cupriavidus* sp. (Accession number: KY244144); ZSB17: *Pantoea agglomerans* strain ZSB17 (Accession number: MK773870)]. The phylogenetic position of the species is shown in Figure 2.

3.3 | Gluconic acid production by potent ZSB isolates

The reduction of pH from in broth assays was validated by measuring gluconic acid from the chosen ZSB isolates using HPLC (Supplementary data sheet Figure S1). Both the ZSB isolates showed the secretion of gluconic acid on comparison with the standard gluconic acid and ZSB 1 and ZSB17 produced 286.14 and 102.74 mg/mL gluconic acid respectively after 5 days of incubation in Zn-supplemented MSM media. Further the culture filtrates were subjected to GCMS analysis which also revealed the secretion of different organic acids (Supplementary data sheet Figures S2 and S3).

3.4 | Physiological and PGP attributes of potent ZSB

The isolates ZSB1 and ZSB17 was screened primarily for physiological attributes that includes pH tolerance, salinity tolerance, temperature tolerance, drought tolerance, antibiotic sensitivity (Supplementary data sheet Table S3). Strain ZSB1 was able to tolerate at 1% salt concentration while ZSB17 strain were able to tolerate 2% salt concentration. Both isolates were exposed to temperature stress and ZSB1 was able to grow at various temperatures ranging from 25°C to −40°C while strain ZSB17 showed growth at temperature ranging from 20°C to −45°C. Further the drought tolerant capacities of ZSB were assessed using varying concentration of PEG on MSM-broth and ZSB1 were able to grow upto 40% PEG whereas ZSB17 were tolerated upto 10% PEG. The zinc solubilizing isolates resisted the antibiotics peniciline (μg) and ampicillin (μg) and sensitive toward kanamycin (μg), cefixime (μg), and rifampicin (μg).

Multiple PGPR activities of both ZSB isolates (Table 2) revealed that strain ZSB1 and ZSB17 were suitable plant growth promoting candidates. In the presence of L-tryptophan ZSB1 and ZSB17 produced 64.49 μg/mL IAA and 66.81 μg/mL IAA respectively. Phosphate solubilization by strain ZSB1 was 2.63 ± 0.4 and by strain ZSB17 2.97 ± 0.7 mm diameter around the colonies. Both ZSB isolates were also found positive for potassium solubilization. Both ZSB isolates were able to solubilize potash as forming clear zones in Aleksandrov agar media supplemented with mica. Zone of potash solubilization by strain ZSB1 was 2.86 ± 0.3 mm and by ZSB17 was 3.53 ± 0.02. Both isolates were also subjected for silica solubilization test. Silica solubilization by ZSB1 was 3.83 ± 0.17 and by strain ZSB17 2.64 ± 0.04 mm diameter around the colonies. These selected ZSB isolates have evaluated for different enzymes production by conducting enzyme assays. Research findings showed that both ZSB isolates

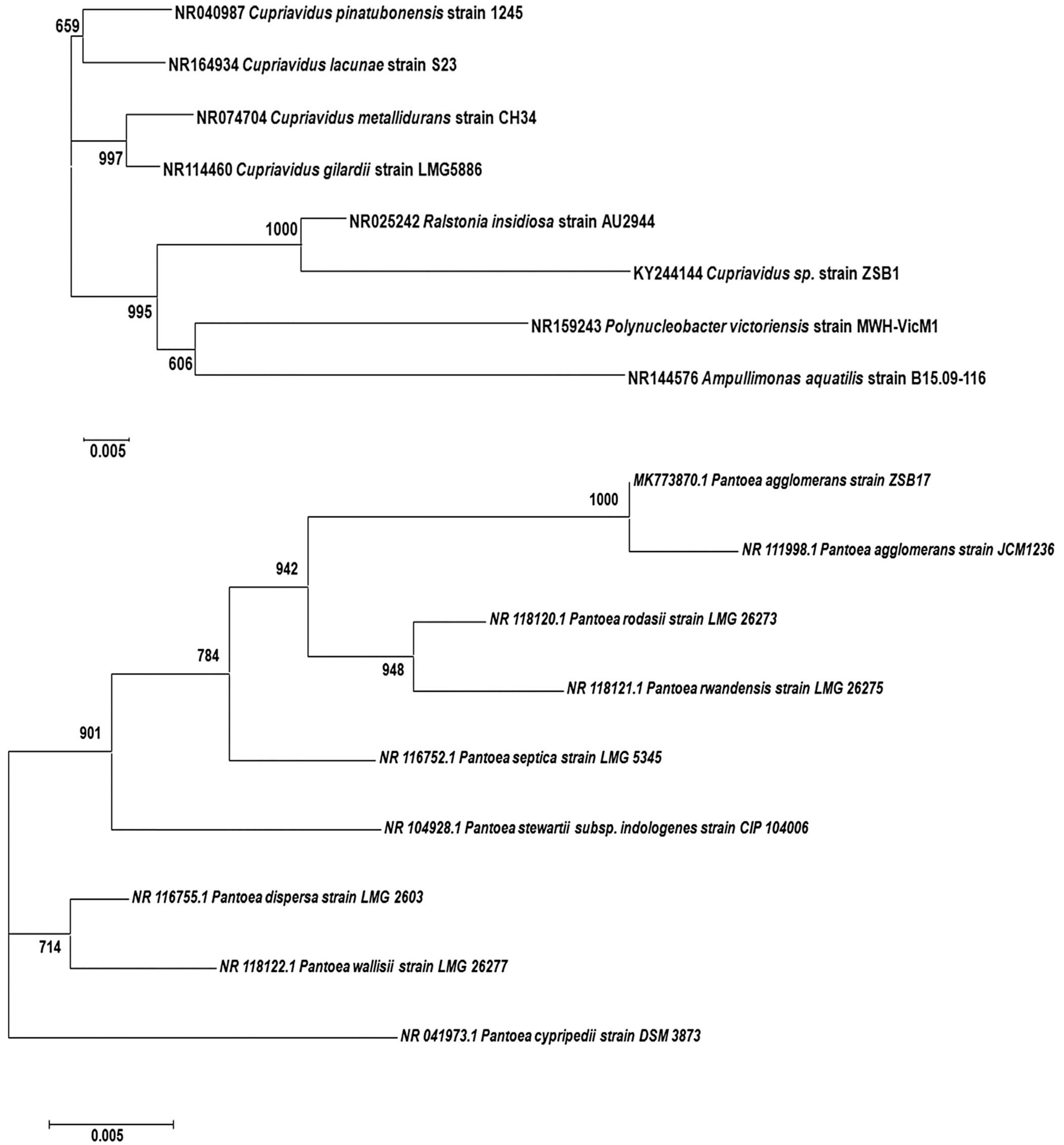

FIGURE 2 Phylogenetic analysis of potent ZSB isolates.

were positive for amylase, lipase, protease, and cellulase production and negative for chitinase and glucanase production with respect to hydrolytic enzymes.

3.5 | Bio efficacy evaluation: Pot and field study

The results from pot experiments reveled that both the ZSB isolates significantly induces maize plant growth-performance. Zinc solubilizing isolates inoculation showed substantial growth in leaf no., leaf-length, shoots-length as compared to uninoculated control and significantly enhanced the root-length, root-number, and leaf chlorophyll content (Supplementary data sheet Table S4). The untreated control showed minimum value in all studied plant growth parameters.

Field experiment was conducted following in-vitro authentication for both selected ZSB isolates ZSB1 and ZSB17 on 13 selected growth and yield related attributes were recorded in Table 3

TABLE 2 PGP and hydrolytic enzyme production traits in ZSB isolates.

Plant growth promoting traits	ZSB1	ZSB17
ACC Deaminase	+	+
Ammonia production	+	+++
Sidero-phore	+	+
HCN	+	+
EPS	−	−
IAA (µg/mL)	640.49	668.17
P solubilization index (cm)	2.63 ± 0.04	2.97 ± 0.07
K solubilization index (cm)	2.86 ± 0.03	3.53 ± 0.02
Si solubilization index (cm)	3.8367 ± 0.17	2.6467 ± 0.04
Lipase activity	+	+++
Amylase activity	+	+
Protease activity	+	+
Cellulase activity	+	+
Chitinase activity	−	−
Glucanase activity	−	−

Note: Value (mean of triplicate) ± standard deviation.

(Supplementary data sheet). In the present research, the preferred maize variety P3441 was used with implementing all favored SAP (standard-agronomic-practices). For field experiment 15 treatments along with control were designed with combination of RDF and $ZnSO_4$. Among all the treatments, the highest biological yield (q/ha) was observed in treatment T_5 (143.82 ± 5.65q/ha) which were combination of 100% RDF, ZSB1 isolates and $ZnSO_4$ followed by treatment T_{12}, T_6, T_{13}, T_2, T_{14}, T_3, T_7, T_9, T_{10}, T_4, T_{11}, T_1, T_8 over the control. The maize plant growth and production have been significantly increased through seed bacterization with ZSB isolates. The difference was significant on yield was recorded in treated than control. Table 3 presents data on the parameters of crop growth and yield trend for maize.

The impact of ZSB isolates on the maize grain Zn content & ZTI are summarized in Table 4. In treatment T_5 (ZSB1+ 100% RDF + $ZnSO_4$) highest ZTI was observed (ZTI = 55.21%) followed by the maize plants treated with treatment T_{12} (ZSB17 + 100% RDF + $ZnSO_4$; ZTI = 53.4%). This clearly illustrates the role of ZSB isolates in translocating Zn toward maize grains. Zinc translocation analysis revealed that zinc acquisition in grain and shoot was significantly enhanced with strain ZSB1 than strain ZSB17 and un-inoculated control.

4 | DISCUSSION

The growth and productivity of crops were significantly impacted by a zinc shortage in the soil ultimately lead to low zinc contents in crops (Hafeez et al., 2013; Hussain et al., 2022). Following previously published studies, the ZSB isolates were obtained from rhizospheric soil in this research (Bhatt & Maheshwari, 2020; Sunithakumari et al., 2016). *Cupriavidus* sp. and *Pantoea agglomerans* were identified as the effective ZSB strains ZSB1 and ZSB17 by 16S rRNA gene sequencing. The biochemical characterization represents the intrinsic biochemical and structural properties of the bacteria to adopt in the specific environment. In medium supplied with zinc phosphate and zinc carbonate, ZSB1 shown higher solubilization efficiency, but ZSB17 demonstrated higher solubilization in medium supplemented with zinc oxide. Ramesh et al. (2014) showed that the findings of the current investigation are supported by the ZSB strains MDSR7 and MDSR14 solubilizing all three zinc compounds (zinc, zinc-phosphate, and zinc-oxide). The current study reports that the higher Zn-solubilization zone was observed in ZnO supplemented medium compared to $ZnCO_3$ amended medium (Goteti et al., 2013; Mishra et al., 2017). In this work, a broth test was used to quantitatively evaluate the solubilization of zinc. As zinc solubilization increased over time, the highest amount of zinc was registered in ZSB17 on day 16 at 14.65 g mL^{-1}. Similar findings with isolated ZSB solubilized insoluble ZnO (40.81 $mL^{-1}$to 62.48 mL^{-1} soluble Zn) were also reported by Mishra et al. (2017). One important mechanism for the solubilization of metals and minerals is the secretion of OA (organic acids) by PGPRs, and gluconic acid is thought to be the main OA involved in the solubilization of insoluble minerals in soil (Sunithakumari et al., 2016). This will be the primary intermediary for solubilization due to the presence of 2-ketogluconic acid as a main product in cultures altered with the solubilization of insoluble zinc source (Gontia-Mishra et al., 2017) and likely as a result of increased acidity (Dinesh et al., 2018).

More or less every organism has a different active mechanism of zinc solubilization, which relies on the type of bacteria present. The ability of the ZSB strains in the current study to withstand stress, including pH, temperature, salt, and drought, is an inherent biochemical characteristic that aids in their survival in challenging rhizosphere conditions (Upadhyay et al., 2019). If a PGPR displays a variety of PGP properties, it might be a good candidate for microbial inoculants (Singh et al., 2022; Upadhyay & Chauhan, 2022). The ZSB1 and ZSB17 strains were positive for multiple PGP traits namely, ACC-deaminase-activity, siderophore-production, HCN-production, and ammonia-production. Rhizobacterial isolates are well established organisms, which may be remarkable assets for plant growth promotion through different mechanisms (Nadeem et al., 2010; Upadhyay et al., 2022; Upadhyay & Singh, 2015). ACC, a precursor for the ethylene stress hormone as the only source of nitrogen plays an important role for plant growth promotion (Mishra et al., 2017). HCN is a secondary metabolite of bacteria that inhibits growth of pathogenic microorganisms (Siddiqui, 2006). Similarly, recently Jain et al. (2020a) demonstrated that zinc tolerant PGPR produce siderophores and induced growth of plants. Ramesh et al. (2014) demonstrated that strong ammonia-producing bacterial isolates can be beneficial as a source of nitrogen for plant growth-performance.

This study, the IAA production capacities of ZSB isolates is consistent with other researchers' findings (Abaid-Ullah et al., 2015; Zhao et al., 2011). Gandhi & Muralidharan (2016) demonstrated that

TABLE 3 Effect of ZSB strains on growth and yield parameters of maize under field experiment.

Treatment	Biological yield (kg)	Cob length (cm)	Weight of cob/plot (kg)	No of cobs/ plot	No of rows/ cob	No of grains/ row	Weight of grain/plot (kg)	Grain yield (q/ha)	Weight of fodder/ plot (kg)	Stover yield (q/ha)	Biological yield (q/ha)	Harvest index (%)	1000 grain wt (g)
S_1	60.40	20.00	40.20	24.00	14.00	40.00	20.59	54.00	30.81	79.31	133.31	40.48	210.65
T_1	40.80	18.00	20.92	22.00	12.00	36.00	20.30	48.00	20.50	51.98	99.98	48.28	245.66
T_2	60.10	22.00	40.10	27.00	16.00	42.00	3.12	65.00	20.98	62.06	127.06	51.26	289.82
T_3	50.90	20.20	30.90	25.00	14.00	36.00	2.83	59.00	30.07	63.90	122.90	48.58	253.00
T_4	50.40	19.00	30.40	24.00	14.00	36.00	20.54	53.00	20.86	59.48	112.48	47.45	254.00
T_5	60.90	23.00	4.58	29.00	18.00	44.00	30.26	68.00	30.64	75.82	143.82	47.23	292.65
T_6	60.40	21.50	40.30	28.00	16.00	40.00	20.98	62.00	30.42	71.31	133.31	46.62	268.00
T_7	50.80	20.00	40.00	26.00	14.00	38.00	20.69	56.00	30.11	64.81	120.81	46.35	278.00
T_8	40.40	17.70	20.46	20.00	12.00	34.00	2.21	46.00	20.19	45.65	91.65	50.19	269.00
T_9	50.80	20.60	30.50	26.00	16.00	40.00	3.02	63.00	20.78	57.81	120.81	52.35	285.00
T_{10}	50.50	19.80	30.20	24.00	14.00	38.00	20.74	57.00	20.76	57.57	114.57	50.03	269.00
T_{11}	50.10	18.40	30.10	23.00	14.00	36.00	20.50	52.00	20.60	54.23	106.23	49.05	288.00
T_{12}	60.60	22.00	40.30	28.00	16.00	41.58	30.07	64.00	30.53	73.48	137.48	47.11	288.51
T_{13}	60.30	21.00	40.10	25.00	16.00	40.00	20.78	58.00	30.52	73.23	131.23	44.50	285.48
T_{14}	60.10	20.50	30.80	23.00	14.00	38.00	20.54	53.00	30.56	74.06	127.06	41.71	255.00
SEm±	00.270	00.937	00.169	10.160	00.638	10.632	00.113	20.362	00.286	50.962	50.602	20.794	90.111
CD at 5%	00.780	20.705	00.488	30.351	10.841	40.712	00.328	60.823	00.827	17.221	16.180	80.069	26.313
CD at 1%	10.051	30.643	00.658	40.513	20.480	60.345	00.441	90.187	10.113	23.188	21.787	10.866	35.431

Note: The data express the pooled value of the triplicate data collected in two sessions.

TABLE 4 Effect of ZSB isolates on Zinc translocation from shoot to grain; Zinc Translocation Index.

Treatment	Zn in grain	Zn in Stover	Zinc translocation index (%)
S_1	25.93	78.60	32.9
T_1	23.20	78.37	29.62
T_2	35.33	68.03	51.9
T_3	33.70	70.79	47.6
T_4	30.30	73.47	41.14
T_5	38.20	68.77	55.21
T_6	34.77	70.00	49.5
T_7	32.97	70.83	46.4
T_8	21.47	79.00	**27**
T_9	34.60	71.23	48.5
T_{10}	31.83	69.80	45.5
T_{11}	27.50	70.33	39.11
T_{12}	35.50	66.33	53.4
T_{13}	31.50	65.73	47.9
T_{14}	29.17	69.03	42.1
SEm±	0.961	1.227	
CD at 5%	2.777	3.543	
CD at 1%	3.739	4.771	

Note: The data express the pooled value of the triplicate data collected in two sessions.

phytohormone IAA (auxin) was produced by AGM3 (an isolate) at 45.61 g mL^{-1}, followed by the AGM9 37.27 g mL^{-1}in IAA broth medium. The capability of PGP isolates to solubilize insoluble P form to a plant available P form significantly improves crop production under P limiting conditions (Majeed et al., 2015).

According to the findings of an experiment performed by Dinesh et al. (2018), *B. megaterium* (Strain CDK25) is capable of soluble and mobilized phosphate, both inorganic and organic. *Bacillus licheniformis* (BHU18) and *Pseudomonas azotoformans* (BHU21), two KSB isolates, demonstrated noticeably higher K-solubilization than the results seen in the current research, according to Saha et al. (2016). According to Naureen et al. (2015), 29 out of a total of 111 bacterial isolates can dissolve mineral silicates. Zhao et al. (2011) reported on the isolation and characterization of ZSB strains with multiple PGP traits and stated that *Bacillus* spp. exhibit numerous plant growth promoting attributes that support plant growth, including Zn and P solubilization, IAA production, oxidase activity, catalase activity, and phytohormone development. The increase in plant growth could be attributed to ZSB isolates' capacity to supply nutrients through nitrogen fixation, phosphate solubilization, siderophores synthesis, and the release of phytohormones (Mumtaz et al., 2017; Jain et al., 2017). Amylase, lipase, protease, and cellulase synthesis were found in zinc solubilizing isolates, and these enzymes indirectly aid plant growth by controlling soil-borne phytopathogens (Jha et al., 2012).

Zinc solubilizing isolates inoculation under pot conditions significantly improved the root length, root no., and leaf chlorophyll content and the results were well supported by Karnwal (2021) reported zinc solubilizing *Pseudomonas* spp. isolated from vermicompost significantly improves plant growth and maximum zinc content in Okra fruit compared to uninoculated control. Application of ZSB substantially improves plant growth by increasing Zn bioavailability in soil to crop plants hence reduce the use of synthetic zinc fertilizers. The field experiment was conducted following in vitro authentication for ZSB1 and ZSB17 strains on 13 selected growth and yield-related attributes, among all the treatments, the highest biological yield (q/ha) was observed in treatment T5 (143.82 ± 5.65 q/ha) which were a mixture of 100% RDF, ZSB1 isolates and $ZnSO_4$. The maize plant growth and production have been significantly increased through seed bacterization with ZSB isolates. Hussain et al. (2015) recorded an increase in plant growth attributes primarily shoot length, root length, shoot fresh and dry biomass, and root fresh and dry biomass when Zn solubilizing *Bacillus* sp. (AZ6) was inoculated under field conditions. Sarathambal et al. (2010) have demonstrated that the dry weight of the maize is increased compared with control by the inoculation of zinc solubilizing *Gluconacetobacter diazotrophicus*. An experiment conducted by Goteti et al. (2013) in which they revealed that seed bacterization with zinc solubilizing PGP bacteria facilitates the growth of plant height (root and height of the shoot); leaf area; and dry mass.

The results of the study on the effect of ZSB isolates on zinc translocation index (ZTI) in maize plant are presented in Table 4. Zinc translocation index is used in this study as a similar notion to the translocation factor (TF) that can be viewed as the ratio of an element in a plant's shoots and roots (Upadhyay et al., 2021). The maize plant showed the highest ZTI (55.21%) in treatment T5 (ZSB1 + 100% RDF + $ZnSO_4$), followed by treatment T12 (ZSB17 + 100% RDF + $ZnSO_4$; 53.4%). This clearly shows ZSB isolates have role in translocation of Zn toward maize grains and similar finding was earlier reported by Goteti et al. (2013) and Omara et al. (2016). In comparison to the control, the introduction of *B. aryabhattai* isolates to wheat and soybean crops dramatically boosted Zn uptake as well as shoot and seed weight (He et al., 2010). In addition to synergistic impact on plants' growth and yield, ZSBs have a strong capacity to enhance the Zn content of cereals which ultimately improves human health and immunity (Abaid-Ullah et al., 2015; Wang et al., 2014). Krithika and Balachandar (2016) reported that ZSB up-regulated the expression of Zn-regulated transporters and iron (Fe)-regulated transporter-like protein (ZIP) genes in rice suggested its important role in zinc fertilization and fortification. Uptake of micronutrients (Zn) by the plants from soil is a mutually dependent process (Bouain et al., 2014). Using microbial tools to enhance the availability of soil Zn to crop plants is one of the sustainable ways of reducing the Zn deficiency and improving Zn content of food crops grain in zinc deficient soils (Sirohi et al., 2015). Furthermore, such microbial tools will improve the zinc deficient soil and restore them to healthy soil by improving available zinc in soil. The ZSB isolates from the present study can be used for development of liquid biofertilizers to improve zinc acquisition in different crop plants cultivated in southern Rajasthan based on dedicated field studies.

5 | CONCLUSION

The primary issue that inhibits plant growth performance in degraded soil is the type of zinc that is not readily available to plants; zinc-deficient soil is frequently observed in the current research sites. Zn is a crucial micronutrient needed for healthy plant development and growth, and a deficiency does more than just harm human health and crop productivity. The findings of this research demonstrated that two distinct native bacteria, *Cupriavidus* sp. and *Pantoea agglomerans*, had the highest potential to solubilize insoluble zinc in the form of zinc that was readily available and to promote maize growth at the field level. Both isolates (*Cupriavidus* sp. and *P. agglomerans*) demonstrated a variety of PGP properties and produced catalase and urease, both of which promoted plant development. *Cupriavidus* sp. and *P. agglomerans* increased the yield of maize by 19.01% and 17.64%, respectively, and improved Zn translocation toward grains. We conclude that the *Cupriavidus* sp. and *P. agglomerans*, considerably improved soil health, maize crop production, and both unique strains could play a spectacular and promising role in bio-fertilizer technology.

AUTHOR'S CONTRIBUTION

Devendra Jain designed the research. Aradhana Sukhwal performed the experiments. Vimal Sharma interpreted the data. Gajanand Jat performed soil and AAS analysis. Aradhana Sukhwal performed HPLC and GCMS studies. Devendra Jain and Sudhir K. Udpadhay wrote the manuscript. All authors reviewed the manuscript.

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CONFLICT OF INTEREST STATEMENT

No potential conflict of interest was reported by the authors.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Sukhwal, A., Jain, D., Sharma, V., Ojha, S. N., Jat, G., K. Mohanty, S., Singh, A., & Mohanty, S. R. (2023). Efficacy evaluation of newly isolated zinc solubilizing bacteria for their potential effect on maize (*Zea mays* L.) under zinc deficient soil conditions. *Land Degradation & Development*, 1–12. https://doi.org/10.1002/ldr.4818

Minutes of the Meeting 22nd BOS of Department of Law

17th May, 2023

The 22nd BOS meeting of the Department of Law was held as per the following schedule: -

Date & Time: May 17th, 2023 at room no. 208 in 2AB

Mode: Offline at 2 o'clock, room no. 208 2AB

Members of the BoS are as follows: -

1. Dr. Sony Kulshrestha-Chairperson
2. Prof. Jayaram ER-Special Invitee
3. Prof. Vijaylaxmi Sharma- Special Invitee
4. Prof. Richa Arora- Internal Member
5. Prof. Nitu Bhatanagar- Ex-Officio Member
6. Prof. Mridul Srivastava- External Member
7. Mr. Abhay Jain (ADJ)- Industry Member
8. Dr. Susruta Samanta- Member, Directorate of Academics
9. Dr. Ashu Maharshi- Convener

The following agenda points were placed before the BOS: -

Agenda Points:

A. Discussion:

Item I: Approval of SWAYAM/NPTEL courses for the Even and Odd sessions ie. Jan-Dec. 2023 to be included in CWS of all programs. Annexure I

Item II: Approval of revamped course structure and first year syllabi of existing programs BALLB(H), BBALLB(H), LLB and LLM (Corporate and Commercial Law) and (Criminal and Security Law) and course structure and syllabi of new programs ie. B.Com. LLB(H), B.Sc. LLB(H) and LLM (Intellectual Property Law) to be introduced and implemented from AY 2023-24. Annexure II

Item III: Approval of the course codes and syllabi of courses to be introduced in Department of Business Administration and Department of Commerce ie. School of Business and Commerce. Annexure III

Item IV: Approval of course codes and syllabi of first-degree courses offered by SBC for BBALLB(H) and BCom.LLB(H) programs, SHSS for BALLB(H) program and FoS for BSc.LLB(H) program. Annexure IV

Item V: Approval of Vision and Mission of the Department of Law in line with the Vision and Mission of the University. Annexure V

Item VI: Approval of CWS for Odd semester i.e. August to December 2023. Annexure VI

Item VII: Approval of Value Added courses to be introduced in AY 2023-24. Annexure VII

Item VIII: Discussion on the result of the Even Semester (Jan-May 2023) and scopes for improvements. Annexure VIII

Item IX: Discussion on PO attainment, individual course attainment and consequent discussion on the scopes for improvement. Annexure IX

Item X: Program Advisory Committee to be formed in the School of Law Department for course outcomes, Program outcomes preparations. Annexure X

B. Ratification:

1. Approval of Minutes of Meeting of 21st BoS meeting held on 25th January 2023 in the previous academic session.

C. Miscellaneous:

Any other matter with the permission/ suggestion of the Chair.

Following are the recommendations of BoS members:

Item I: Board discussed the SWAYAM/NPTEL courses for the Even and Odd sessions ie. Jan-Dec. 2023 to be included in CWS of all UG programs and recommended to be placed in FB for the approval.

Item II: Board discussed the revamped course structure for BALLB(H), BBALLB(H), B.Com. LLB(H), B.Sc. LLB(H), LLB and LLM (All branches) and syllabi of the First year to be introduced and implemented from AY 2023-24 and recommended to be placed in FB for the approval.

Item III: Approval was given by the Board to the syllabi of courses (with course codes) to be introduced in the Department of Business Administration and Department of Commerce ie. School of Business and Commerce and recommended to be placed in FB for the approval.

Item IV: Board approved the course codes and syllabi of first-degree courses provided by SBC for BBALLB(H) and BALLB(H) programs, SHSS for BALLB(H) programs, and FOS for B.Sc.LLB(H) program and recommended to be placed in FB for the approval.

Item V: Board discussed the Vision and Mission of the Department of Law in line with the Vision and Mission of the University and recommended to be placed in FB for the approval.

Item VI: Board discussed and approved the CWS for the Odd semester i.e. August to December 2023.

Item VII: Board discussed and approved the Values Added courses to be introduced in AY 2023-24.

Item VIII: The Board deeply discussed and analysed the result of the Even Semester (Jan-May 2023) and its scopes for improvements.

Item IX: Thorough discussion was taken place on PO attainment, individual course attainment and consequent discussion on the scopes for improvement.

Item X: Board discussed and gave its approval for the constitution of Program Advisory Committee to be formed in the School of Law Department for course outcomes, Program outcomes preparations.

B. Ratification:

1. Board approved the Minutes of Meeting of 21st BoS meeting held on 25th January 2023 in the previous academic session

These points are deliberated, and suggestions given by the members are incorporated.

for [signature]

Dr. Sony Kulshrestha
Head, Department of Law

Enclosures: -
1. Signature sheet of the Members
2. All relevant documents

Manipal University Jaipur
Faculty of Law
Attendance Sheet
22nd BoS Meeting, Department of Law

208

Dated: May 17, 2023 (Wednesday),

Time: 1:30 PM Onwards

Venue: Room No. 208, 2nd Floor, 2AB.

The following Members are present: -

Sr. No.	Name	Signature
1	Dr. Sony Kulshrestha Head, Department of Law **Chairperson**	Sony Kulshrestha 17/5/2023
2	Prof. (Dr.) Jayaram E. R. Dean, Faculty of Law **Special Invitee**	[signature]
3	Prof. (Dr.) Vijaylaxmi Sharma Director, School of Law **Special Invitee**	Vijaylaxmi 17/05/23
4	Dr. Richa Arora Director, SHSS **Internal Member**	[signature] 17/5/23
5	Prof. (Dr.) Nitu Bhatnagar, Registrar, MUJ **Ex-Officio Member**	[signature]
6	Prof. Mridul Srivastava Consultant Law Courses, Dr. Bhimrao Ambedkar Law University, Jaipur Former Dean, FoA&L, MUJ **External Member**	Consent taken through mail
7	Mr. Abhay Jain (ADJ) Senior Advocate, Rajasthan High Court **Industry Member**	Consent taken through mail
8	Dr. Susruta Samanta Directorate of Academics **Member**	[signature] 17/5/23
9	Dr. Ashu Maharshi Associate Professor, Faculty of Law **Convener**	Ashu 17/5/23

Biodiversity Protection , Farmers And Breeders Rights

By Prof. Padmavati Manchikanti, Prof. Narendran Thiruthy | IIT Kharagpur

ABOUT THE COURSE:
Protecting biological diversity has traditionally been associated with the lives and cultures of communities living in any specified region. More than half of the world's medicines are derived from plants and as such humans have used biodiversity for many purposes. There has been tremendous overexploitation of genetic resources by industries etc., leading to their reduction and associated effects on the environment and the human life. Following the formation of WTO as well as introduction of TRIPS, biodiversity representing 'knowledge' has received a new definition under intellectual property. Initial discussions at the Earth summit at Rio culminating in the Convention on Biodiversity has led to the realization of greater protection of genetic resources and the need for access as well as benefit sharing. Biodiversity Governance is directly connected to the sustenance of all major industry sectors, livelihood of rural population and the survival of mankind. The international, regional and domestic laws in this area have undergone significant transition in the last two decades. As a well-crafted topic equally balanced between its theoretical and practical realms, this course intends not only to create an awareness and knowledgebase about the regime of biodiversity protection, but also to enlighten the learner about the scope and ambit in pursuing one's career options in the same spectrum. This course aims at touching base on the essential areas of compliance with domestic and global Biodiversity Governance Regulations, regulatory and approval mechanisms operating in this area, and the procedure and practice nuances which can help in crafting a career in compliance practice.

INTENDED AUDIENCE: Undergraduate and postgraduate students of Biotechnology, Life science subjects & law, Legal practitioners at various courts of law, corporate legal professionals, Legal professionals working in various governmental/ regulatory services, IPR enthusiasts who want expand their horizons of knowledge.

PREREQUISITES: Preferably Graduate/Post Graduate Student of Biotechnology, Life science, Public Policy and Law. PhD Students also can take this who research on environmental and biodiversity matters

INDUSTRY SUPPORT: All Bio-based Industry Sectors – Agriculture / Biotechnology/ Pharma / Fertilizers & Pesticides / Cosmetics & Fragrances/ Foods& Beverages and AYUSH Industry.

Summary

Course Status :	Completed
Course Type :	Core
Duration :	8 weeks

Category :	○ Law
Credit Points :	2
Level :	Undergraduate/Postgraduate
Start Date :	24 Jul 2023
End Date :	15 Sep 2023
Enrollment Ends :	07 Aug 2023
Exam Registration Ends :	21 Aug 2023
Exam Date :	24 Sep 2023 IST

Note: This exam date is subjected to change based on seat availability. You can check final exam date on your hall ticket.

This is an AICTE approved FDP course

FacebookTwitterEmailLinkedInWhatsAppShare

Course layout

Week 1: Concept and Scope of biodiversity protection

1. Concept and Scope of biodiversity protection

2. Types of biodiversity, mega-biodiverse centers,

3. Type of bio-resources, conservation mechanisms

4. International resources/centers of conservation

5. Traditional Resource rights, ecosystem measures

Week 2: Protection of Biological diversity: International mandate

1. Overview of International framework

2. Convention on Biodiversity - Objectives and Articles

3. International Regime on ABS

4. Biodiversity and Climate Change

5. Biobanks – Governance issues

Week 3: Protection of Biological Diversity -Indian position

1. The Biological Diversity Act, 2002

2. Regulatory authorities in India – NBA & SBB

3. Biodiversity Management Committees

4. People Biodiversity Registers

5. ABS Regulation and Benefit Sharing Procedures in India

Week 4: CBD, TRIPS and other treaties relevant to biodiversity protection – Interrelationship and Developments

1. Trade regime and Biodiversity

2. Comparison of Biodiversity Laws of countries

3. TRIPS-CBD relation

4. CBD and relation to other international treaties related to environment and organization of related bodies

5. Interrelationship and new Developments

Week 5: Biodiversity and Intellectual Property Rights

1. Biodiversity and Interface with IPR

2. Challenges related to Bio piracy - Case Studies

3. Patenting Biodiversity – Recent trends and Developments

4. Disclosure Requirements in Patent – Comparative Perspective

5. Regulatory Law – Comparative Perspective

Week 6: Plant Breeding and breeders' right v the farmers' right

1. Concept, Definitions and Criteria for Plant Variety Protection.

2. Protection of Plant Varieties and Farmers' Right 2001 - Major provisions of the Act

3. Plant Variety protection in US, EU, Japan, China etc.,

4. International Union for protection of new plant varieties (UPOV)

5. Farmers' Rights – other country models

Week 7: Biodiversity Governance and Compliance Procedures – Comparative Perspective

1. Principles of Biodiversity Governance

2. Compliance Procedures and Linkage with IPR

3. Compliance Procedures under International Framework

4. Compliance Procedures in India

5. Compliance Procedures in EU

Week 8: Biodiversity and Human Wellbeing

1. Biodiversity and Interrelationship with Life

2. Sustainable Development Agenda

3. Biodiversity, ecosystem functioning, ecosystem services

4. Biodiversity and Human Happiness

5. Nature Protects if She is Protected

Books and references

1.Genetic resources, traditional knowledge and the law. Eds. Evanson.C. Kamau, Gerd Winter
2.The governance of genetic information. Who decides? Eds. Heather Widdows and Caroline Mullen
3.Plant Variety and Farmer Rights Act 2001, India
4.Intellectual Property Rights in Agricultural biotechnology. 2nd Edition. F. H. Erbisch and K. M. Maredia. CABI Publishing.
(This is only an indicative list. Instructors will share specific course material)

Instructor bio

Prof. Padmavati Manchikanti

IIT Kharagpur

Prof. Padmavati Manchikanti With more than sixteen years of teaching and research experience, Prof. M. Padmavati teaches the subjects of Patent Law, Patent Procedure and Drafting, Biodiversity Law and TK protectionto undergraduate and master students of law at IIT Kharagpur. Her primary area of research includes Intellectual Property and Commercialization of recombinant and herbal drugs and Drug Regulation, Biodiversity Law, studies on implementation of IP. Prior to joining IIT Kharagpur, she was a Senior Scientist at Monsanto Research Center, Bangalore where she coordinated invention disclosure activities. She has many research as well as consultancy projects, from Ministry of Human Resource Development, DST etc,. She has been awarded the Microsoft–Young Faculty Scholarship in Intellectual Property. She is an Advisor to the IPR Cell, IIT Kharagpur. She is the Course Coordinator of the KIRAN-IPR Program at IIT Kharagpur. She has guided research of masters as well as doctoral students in the area of biodiversity implementation in India and works on the protection of TK in India. She has been an Observer to the 2018 COP meeting of the Convention on Biological Diversity and is a regular contributor for the CBD report for the Year Book of International Environmental Law. She is also an Editorial Board member of Journal of Intellectual Property Rights (JIPR) and Journal of Integrative Medicine. She has been an invited speaker at various international as well as national conferences.

Prof. Narendran Thiruthy

Prof. Narendran Thiruthy is Assistant Professor in Rajiv Gandhi School of Intellectual Property Law, Indian Institute of Technology, Kharagpur. Before joining the faculty of IIT Kharagpur, he served as the head for IPR Section in National Biodiversity Authority, Government of India. He has both theoretical expertise and administrative experience in the field of IPR and Biodiversity governance. Dr.Narendran coordinated the 'Module on Biodiversity Governance' for IFS Probationers in Indira Gandhi National Forest Academy, Dehradun for the years 2018, 2019, 2020 & 2021. He was the officer in-charge of coordinating the India Biodiversity Awards for IBA 2018 & IBA 2021 cycles and the NBA-UNDP Biodiversity Samrakshan Internship Program in 2019-20 & 2020-21. He has delivered many lectures on Intellectual Property Rights and Biodiversity Law in various forums including in United Nations CBD events. He has also represented the government in many bilateral and multilateral meetings. Narendran's research explores the intersection of law, technology and environment. His research areas include IP Philosophy, Protection of Cultural Property, IP procedure, IP Business models, New Technology Developments and IP, Theories of Creativity, Biodiversity Governance etc. He is currently exploring the challenges of DSI for biodiversity governance and Business models for open collaborative research

Course certificate

The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.

The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).

Date and Time of Exams: **24 September 2023** Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.

Registration url: Announcements will be made when the registration form is open for registrations.

The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.

Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 6 assignments out of the total 8 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Kharagpur .It will be e-verifiable at nptel.ac.in/noc.

Only the e-certificate will be made available. Hard copies will not be dispatched.

Once again, thanks for your interest in our online courses and certification. Happy learning.

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

ADITYA VIDYARTHI

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **57 %**

Online Assignments	19.17/25	Proctored Exam	38.27/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

swayam

Roll No: NPTEL23LW06S45290071 To verify the certificate No. of credits recommended: 2 or 3

Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

DAMINI CHAUHAN

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **60** %

Online Assignments	17.25/25	Proctored Exam	42.33/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

Roll No: NPTEL23LW06S45262839 To verify the certificate No. of credits recommended: 2 or 3

Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

KHUSHBOO RATHORE

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **69** %

Online Assignments	20.25/25	Proctored Exam	48.98/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

Roll No: NPTEL23LW06S45260404 To verify the certificate No. of credits recommended: 2 or 3

Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

RASHI GOYAL

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **71** %

Online Assignments	17.46/25	Proctored Exam	53.57/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

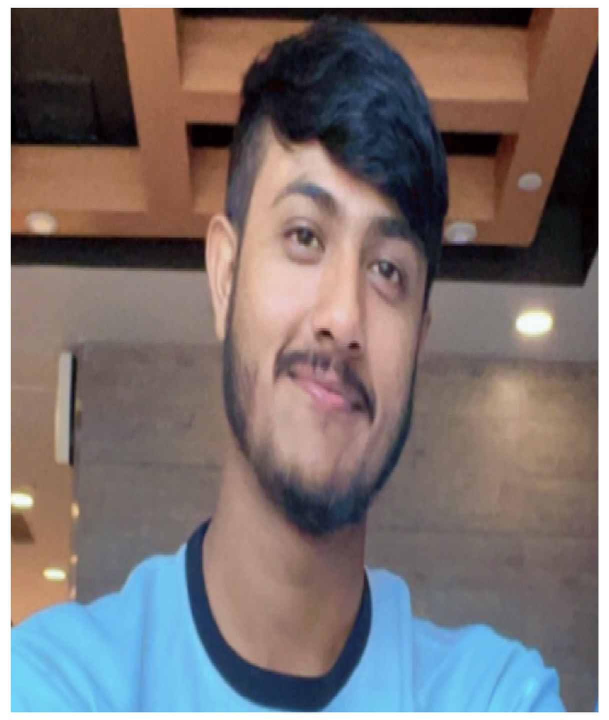
Roll No: NPTEL23LW06S45260179

To verify the certificate

No. of credits recommended: 2 or 3

NPTEL Online Certification

(Funded by the MoE, Govt. of India)



This certificate is awarded to

RAVI DUBEY

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **44** %

Online Assignments	13.38/25	Proctored Exam	30.62/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam
शिक्षित भारत, उन्नत भारत

Roll No: NPTEL23LW06S35260806

To verify the certificate

No. of credits recommended: 2 or 3

Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

ROHINI

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **66** %

Online Assignments	17.25/25	Proctored Exam	48.98/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

Roll No: NPTEL23LW06S35290128 To verify the certificate No. of credits recommended: 2 or 3

Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

SHASHANK FAUZDAR

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **60** %

Online Assignments	17.54/25	Proctored Exam	42.33/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam
शिक्षित भारत, उन्नत भारत

Roll No: NPTEL23LW06S35263407   To verify the certificate   No. of credits recommended: 2 or 3

Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

SHEETAL SHARMA

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **73** %

Online Assignments	17.75/25	Proctored Exam	55.1/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

Roll No: NPTEL23LW06S35290190 To verify the certificate No. of credits recommended: 2 or 3

Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

VATSAL PAREEK

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **67** %

Online Assignments	15.29/25	Proctored Exam	52.04/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

Roll No: NPTEL23LW06S45290022

To verify the certificate

No. of credits recommended: 2 or 3

Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

SHREYSEE OJHA

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **75** %

Online Assignments	17.79/25	Proctored Exam	57.64/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

Roll No: NPTEL23LW06S35261894 To verify the certificate No. of credits recommended: 2 or 3

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

SIDDHI JAIN

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **47** %

Online Assignments	13.38/25	Proctored Exam	33.68/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

Roll No: NPTEL23LW06S35262036 To verify the certificate No. of credits recommended: 2 or 3

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

MAMTA BHINCHAR

for successfully completing the course

Biodiversity Protection, Farmers and Breeders Rights

with a consolidated score of **52** %

Online Assignments	17.83/25	Proctored Exam	33.68/75

Total number of candidates certified in this course: **286**

Jul-Sep 2023

(8 week course)

Prof. Haimanti Banerji
Coordinator, NPTEL
IIT Kharagpur

Indian Institute of Technology Kharagpur

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

Roll No: NPTEL23LW06S35261892 | To verify the certificate | No. of credits recommended: 2 or 3

MANIPAL UNIVERSITY JAIPUR

Dehmi Kalan, Near GVK Toll Plaza,Jaipur-Ajmer Expressway, Jaipur,Rajasthan 303007

Faculty of Art & Low (FOA&L)
External Marks Award List (LA3105)

ACADEMIC YEAR : 23-24 **ACADEMIC SESSION** : JUL-NOV 2023

PROGRAM CODE : INT-001 **BRANCH/SPECIALIZATION** : BA LLB (HONS)

COURSE CODE : LA3105 **COURSE NAME** : INTERNATIONAL LAW

SECTION : A **SEMESTER** : V

FACULTY NAME : AYUSHI RAGHUWANSHI (MUJ1493)

S.No	Reg. No	Student Name	Internal Marks (Max - 60)	External Marks (Max - 40)	Total Marks (Max - 100)	Rev Grade
1	211301003	APRAJITA DALAL	41	21	62	C
2	211301005	HITESHI VYAS	56	37	93	A+
3	211301008	MAHENSHI MAHENDRASINGH CHAUHAN	56	28	84	B
4	211301009	GEETIKA TYAGI TYAGI	0	0	0	F
5	211301011	AMEYA BAKSHI	21	14	35	E
6	211301012	PRACHI SINHA	46	19	65	C
7	211301014	NEHAL AGARWAL	47	22	69	C
8	211301015	PARAS SINGH RAO	48	31	79	B
9	211301016	GRACY SINGH GEHLOT	53	34	87	B
10	211301017	SYED MOHAMMAD ASIM ABBAS	41	15	56	D
11	211301018	RIYA SINGH	59	36	95	A+
12	211301019	PRIYAL MALVIYA	45	33	78	B
13	211301020	NISHCHAY	22	15	37	E
14	211301021	KUSHAL SHARMA	15	0	15	F
15	211301022	KAMAYANI SHARMA	49	34	83	B
16	211301023	ALINA ALI	52	35	87	B
17	211301024	PRAYANSH GARHWAL	45	28	73	C
18	211301025	DHRUV PRATAP SINGH	11	2	13	F
19	211301026	UJJWAL SHARMA	56	0	56	F
20	211301027	PRANJAL LEGHA	52	33	85	B
21	211301028	SHUBHAM JHORAR	32	0	32	F
22	211301029	ROYAL RAJPUROHIT	50	25	75	C
23	211301030	HIMANSHI SHARMA	53	31	84	B
24	211301031	SATYENDRA SINGH SHEKHAWAT	33	15	48	D
25	211301032	PEARL SINGH	53	30	83	B
26	211301033	KHYATI RAGHAV	43	22	65	C

27	211301034	RAJNANDANI KHANGAROT	49	30	79	B
28	211301035	YASH CHATURVEDI	55	33	88	A
29	211301036	EISHA SURANA	57	36	93	A+
30	211301037	ANUREET KAUR	59	39	98	A+
31	211301038	NAVYA SHARMA	56	31	87	B
32	211301039	DEEPESH SHARMA	40	23	63	C
33	211301040	SHIVANSHI SHARMA	49	25	74	C
34	211301041	ANSHIKA GARG	57	36	93	A+
35	211301042	MANOJ KUMAWAT	50	19	69	C
36	211301043	DEWANG ARHA	44	16	60	C
37	211301044	HARSHITA	0	0	0	F
38	211301045	MUKUND MAHESHWARI	52	35	87	B
39	211301046	DEEPANSHU SINGH	45	26	71	C
40	211301047	SHASHWATI SOMYA	44	14	58	C
41	211301048	LAKSHIT KASWAN	22	15	37	E
42	211301050	MEGHA TANWAR	49	24	73	C
43	211301051	UNEZA KHAN	52	31	83	B
44	211301052	RISHIKA SWAMI	45	22	67	C
45	211301053	SHIVANSH SRIVASTAVA	34	15	49	D
46	211301055	AYUSHI MAHESHWARI	58	38	96	A+
47	211301056	YUVRAJ SINGH	45	18	63	C
48	211301057	NIKHIL BANA	41	11	52	F
49	211301058	VINEET MAHARSHI	50	20	70	C
50	211301060	AKSHITA PRADHAN	54	35	89	A
51	211301061	GAYATRI VIJAYKUMAR JOSHI	53	35	88	A
52	211301124	GAURVI PALIWAL	43	21	64	C
53	211301126	VARSHITA PALSANIA	53	36	89	A
54	211301127	CHAHAT AGGARWAL	54	34	88	A
55	211301128	KHUSHBOO MAHLA	42	23	65	C
56	211301129	MADHVI JANGIR	48	24	72	C

No of Student present : 51

No of Student absent : 4

FACULTY SIGNATURE

AYUSHI RAGHUWANSHI (MUJ1493)

HOD SIGNATURE

Sony Kulshrestha (MUJ0351)

MANIPAL UNIVERSITY JAIPUR

Dehmi Kalan, Near GVK Toll Plaza,Jaipur-Ajmer Expressway, Jaipur,Rajasthan 303007

Faculty of Art & Low (FOA&L)
External Marks Award List (LA3105)

ACADEMIC YEAR	: 23-24	**ACADEMIC SESSION**	: JUL-NOV 2023
PROGRAM CODE	: INT-001	**BRANCH/SPECIALIZATION**	: BA LLB (HONS)
COURSE CODE	: LA3105	**COURSE NAME**	: INTERNATIONAL LAW
SECTION	: B	**SEMESTER**	: V
FACULTY NAME	: AYUSHI RAGHUWANSHI (MUJ1493)		

S.No	Reg. No	Student Name	Internal Marks (Max - 60)	External Marks (Max - 40)	Total Marks (Max - 100)	Rev Grade
1	211301063	AJITA RATHOD	48	33	81	B
2	211301064	TEJASWARDHAN NARUKA	9	4	13	F
3	211301065	SHUBHAM CHOUDHARY	48	25	73	C
4	211301066	RIYA SINGH	18	16	34	F
5	211301067	PAAVNI CHADHA	52	36	88	A
6	211301069	SANYA MATHUR	53	37	90	A
7	211301070	SANJAY KUMAR	40	21	61	C
8	211301071	HARSHIT SAXENA	48	28	76	B
9	211301072	DHIRGHAYU SHARMA	54	37	91	A+
10	211301073	SHREYA SHARMA	46	16	62	C
11	211301074	VISHAKHA KANWAR	51	25	76	B
12	211301075	UDDHAVRAJ SINGH SHAKTAWAT	44	0	44	F
13	211301076	ABHISHEK SINGH NARUKA	48	7	55	F
14	211301077	KAUSHIK BAROLIYA	55	34	89	A
15	211301078	ANANT RAJ SINGH	53	34	87	B
16	211301080	DIVISHA YADAV	56	36	92	A+
17	211301084	BHARAT SOGARWAL	39	9	48	F
18	211301085	ANANYA DWIVEDI	55	37	92	A+
19	211301086	SHREE BANSAL	51	31	82	B
20	211301088	TANVI LAKHLAN	55	37	92	A+
21	211301089	MANAV DHABHAI	13	15	28	F
22	211301091	ASAD ALI KHAN	22	18	40	D
23	211301092	ABHISHEK SINGH SHEKHAWAT	37	14	51	D
24	211301093	ARYAN KUMAWAT	42	20	62	C
25	211301094	ANMOL BALI	55	36	91	A+
26	211301095	SRISHTI PARNAMI	53	35	88	A

27	211301096	ARCHI SARWGI	33	23	56	D
28	211301097	AYUSH RAO	30	18	48	D
29	211301098	ASHAY APURV	30	10	40	F
30	211301099	MEHWISH KHAN	49	0	49	F
31	211301100	AMAN PRAKASH	44	25	69	C
32	211301101	VIVEK RAJ SINGH	40	24	64	C
33	211301102	PUNJIKA SHEKHAWAT	47	22	69	C
34	211301103	SUNIL MEHRIYA	32	8	40	F
35	211301104	PRANAV MATHUR	53	36	89	A
36	211301105	TITHI GUPTA	53	36	89	A
37	211301106	PRATIBHA KARNOT	42	29	71	C
38	211301107	DEEPANKAR SINGH	56	32	88	A
39	211301109	MAHAK MAHAJAN	47	29	76	B
40	211301110	MANAN SHARMA	15	14	29	F
41	211301111	ABHAY SINGH SHEKHAWAT	19	16	35	E
42	211301112	LAKSHYA PAL MANDA	46	29	75	C
43	211301113	YUVRAJ SINGH RAJPUROHIT	29	17	46	D
44	211301114	MANASVINI TIWARI	48	0	48	F
45	211301115	SHRUTI MANTRI	36	15	51	D
46	211301116	AKSHITA CHOUDHARY	44	6	50	F
47	211301117	KHALID SHEIKH	12	8	20	F
48	211301118	SHIVANGI NANDWANA	56	33	89	A
49	211301119	DEEPAK CHOUDHARY	47	34	81	B
50	211301120	ASHUTOSH SINGH	55	37	92	A+
51	211301121	TANISHKA SINGH	40	17	57	D
52	211301122	RAKESH KUMAR	12	0	12	F
53	211301123	VINEET JAKHAR	15	14	29	F
54	211301125	TANMAY GOKULKA	23	0	23	F

No of Student present : 49

No of Student absent : 4

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AYUSHI RAGHUWANSHI (MUJ1493)

HOD SIGNATURE

Sony Kulshrestha (MUJ0351)