Educational Outreach on Land Management for Agriculture

Sustainable land management plays a crucial role in safeguarding essential natural resources, including soil, water, and biodiversity. It aims to preserve these resources for future generations while simultaneously addressing the current demands of agriculture and tourism. Manipal University Jaipur provides educational programs and outreach initiatives that emphasize sustainable land management practices relevant to both sectors. Implementing sustainable land practices can significantly alleviate the impacts of climate change. Techniques such as reforestation and organic farming contribute to carbon sequestration, lower greenhouse gas emissions, and bolster ecosystem resilience. Manipal University Jaipur possesses the expertise necessary to create educational programs that incorporate the latest research and best practices in sustainable land management. The university maintains a robust presence within local and national communities, utilizing its networks to engage with farmers, tourism operators, and policymakers, thereby promoting knowledge sharing and collaboration. Manipal University Jaipur conducts workshops and training sessions aimed at local farmers and tourism professionals, addressing subjects such as organic farming methods, agroforestry, sustainable tourism strategies, and waste management. Additionally, the university collaborates with local communities on research initiatives concerning sustainable land management, yielding valuable data and insights for both scholars and practitioners. With the rise of technology, Manipal University Jaipur also offers online courses, making sustainable land management education accessible to a wider audience, including individuals nationwide who are interested in this field. Manipal University Jaipur has established demonstration farms that exemplify sustainable agricultural practices. These farms act as practical models for local farmers, enabling them to observe the advantages of sustainable methods in a direct manner. Educational programs are designed to equip local farmers and tourism operators with the necessary knowledge and skills to improve their practices, potentially resulting in increased income and enhanced livelihoods.

Through its educational outreach initiatives, Manipal University Jaipur empowers both local and national communities by providing them with the knowledge and resources to make environmentally conscious decisions. By promoting a culture of sustainability, the university plays a significant role in supporting community well-being, conserving natural resources, and ensuring the long-term health of our planet.

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

Index

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.

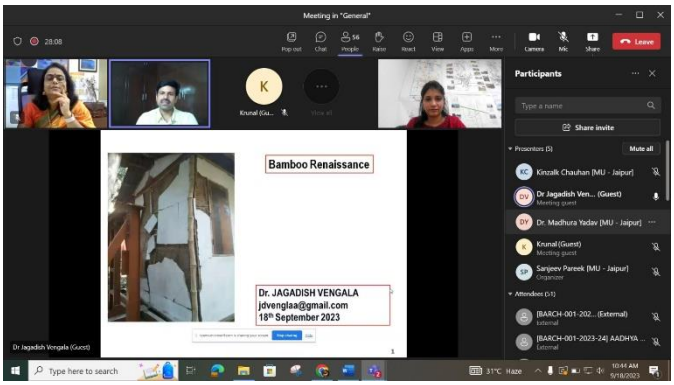
e) Mr. Amitava Sil, a Scientist at IWST (Indian Wood Science and Technology), Kolkata, renowned for his extensive knowledge and experience in the preservation treatment of bamboo species. Mr. Amitava Sil provided insights into preservative treatments and fire retardancy in structural bamboo. He elucidated 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 Molly [B.Des - ID - 2020]	22/9/23, 4:00:54 pm
9	Nikhitha Naresh Molly [B.Des - ID - 2020]	22/9/23, 4:01:23 pm
10	Nikhitha Naresh Molly [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, 5:55:53 pm
30	Guest	22/9/23, 4:11:20 pm
31	Guest	22/9/23, 5:53:48 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, 4:17:06 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, 4:21:13 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, 5:54:05 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, 4:25:35 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, 4:55:24 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	Amne Iqbal [B.Arch - 2020]	22/9/23, 4:30:35 pm
79	Amne 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, 5:53:54 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, 5:54:01 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, 4:56:09 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, 5:30:17 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, 5:43:21 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, 4:52:06 pm
137	Guest	22/9/23, 4:52:10 pm
138	Guest	22/9/23, 5:43:26 pm
139	Pranat Kothari [B.Arch - 2022]	22/9/23, 4:52:35 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, 4:52:48 pm
145	Guest	22/9/23, 5:06:36 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, 4:54:18 pm
152	Guest	22/9/23, 4:54:23 pm
153	Guest	22/9/23, 5:46:18 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, 5:28:59 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)

MANIPAL UNIVERSITY
JAIPUR

FACULTY OF ARTS

SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

COOMUNITY OUTREACH VISIT

Date of Event- October 31, 2023

Content of Report (index)

1. Introduction of the Event

The practical knowledge about the subject is of immense importance for the students of B.A, Economics (Hons.), M.A. Economics (Hons.), and as such apart from regular classroom teaching there is a strong case for exposing them to innovative and practical outdoor sessions/visits to the nearby areas & projects. Taking this pedagogy of teaching, a one day visit to the renowned Laporiya village and interaction with **Padma Shree Laxman Singh** was planned to closely to observe how the water stressed Laporiya village became self-sufficient in water with all the efforts of **Laxman Singh** Ji. He has been awarded the Padma Shree for his significant contribution to the field of saving water and the environment for the last 40 years. He changed the picture of more than 50 villages with the technique of saving water and the campaign launched for it. He recharged the ponds with the Chowka technique to save water and pastures.

To take insights into his dedication, efforts, and commitments, this visit was planned for students to interact with him so that the **environmental sustainability** thought will sustain forever with **Gen-Z** and they will transfer the same to **Gen-Alpha.**

2. Objective of the Event

Water is a finite and shared resource. As well as being a basic human right and fundamental to healthy ecosystems, water is vital to the functioning of the global economy. However, increasing demand and competition, climate change and pollution are putting pressure on global water resources, creating risks for business and society. To experience the outstanding achievements and gain practical knowledge about environmental economics, an academic visit to "Laporiya village, near Dudu" is organized for the betterment and knowledge enhancement of the students.

3. Beneficiaries of the Event

Students and faculty members of Manipal University Jaipur.

4. Details of the Guests

The President of India has awarded Shri Laxman Singh Ji Padma Shree for his commendable work of reviving the Chowka system, a traditional water harvesting method in Rajasthan. He has founded the NGO Gram Vikas Navyuvak Mandal Laporiya (GVNML). The efforts of Sh. Laxman Singh Ji has borne fruits in a drought-ridden small village (Lapodiya), 80 km from Jaipur.

5. Brief Description of the event

It was an expert lecture on Syllogism of knowledge of economics, entrepreneurial and data skills: Unpack the Why? by Mr. Abhishek Jain, EY, Senior project consultant E & Y. The aim of the lecture is to provide economic knowledge, entrepreneurial skill with basic data analytics knowledge and skills when it comes to leveraging data while growing their businesses, regardless of their respective industries. Student's always be in prisoners dilemma of Why?

Photographs

3 to 5 geotagged photographs of the event or screenshots of the event (if online) with captions

Mr Laxaman Singh Ji discussing the importance of ecosystem

Mr Laxaman Singh Ji Addressing the students

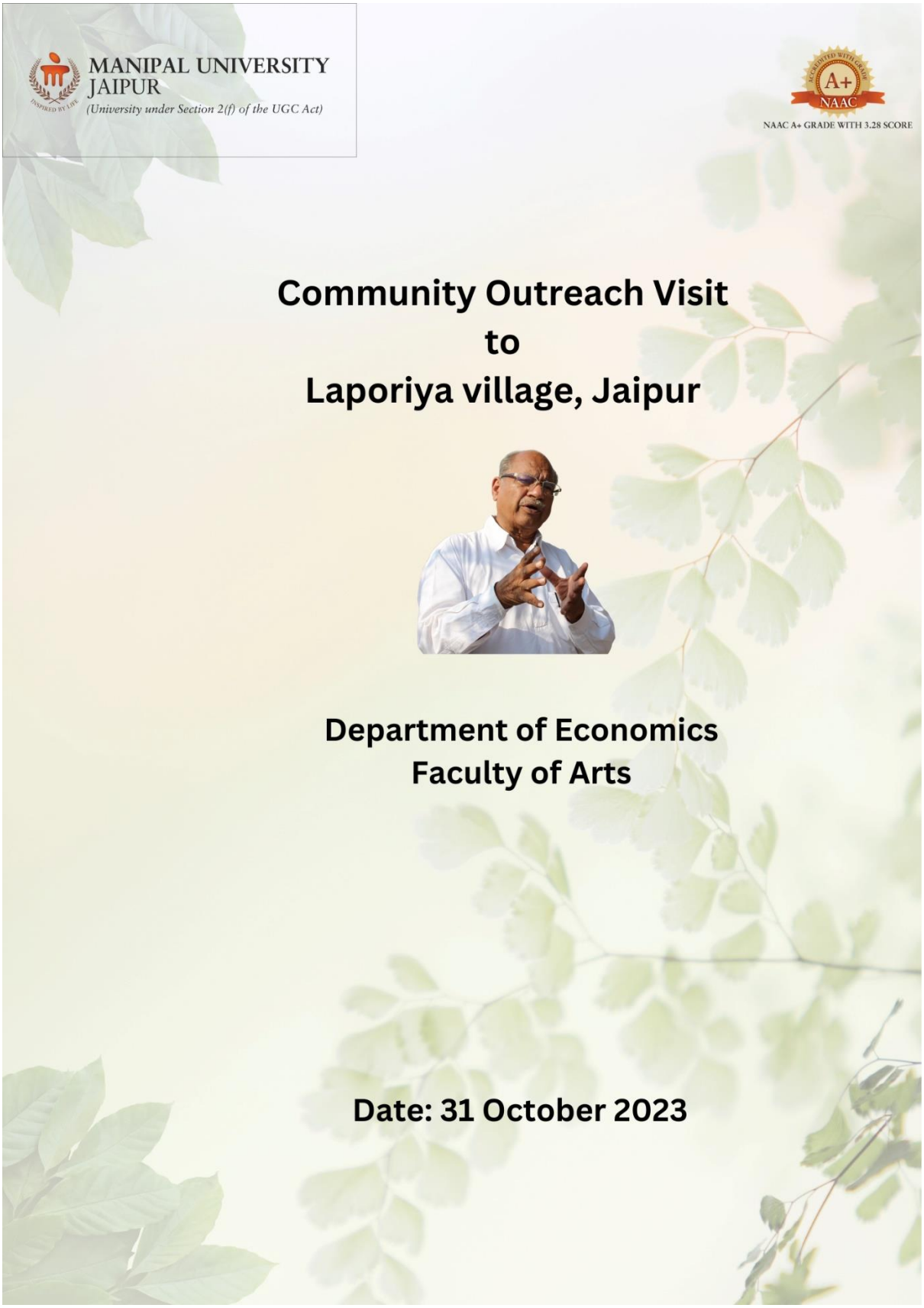
The Village well

Taking a short break, Mr Lakshman Singh Ji, faculties and students

Mr Singh (centre) discussing the young mind's learnings and impressions in his house at the end of the visit.

The students, Mr Lakshman Singh (towards right in white) and Dr Shilpi Gupta, outside his house.

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



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

Date of the event –October 31, 2023 7:30 AM

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

Registration No.	Name of the Students	Column1	Column2
211101046	Akshay	P	
211101035	Anubhav	p	
211101003	Dakshita	P	
211101043	Gaurav basniwal	P	
211101050	Gaurav kumar	P	
211101013	Saarthak tiwari	P	
211101042	Praseeda	P	
211101004	Rishita	P	
211101006	Shivangi	P	
211101015	Sumriddhi	P	
211101040	Yash	P	
211101041	Yashi	P	
211101039	Anushka	P	
211101007	Utkarsh	P	
211101044	Riti	P	
211101021	Paritosh	P	
211101028	Divya surana	P	
211101025	Atharv	P	
23FA20MEA00004	Santanu Bhowmick	P	
23FA20MEA00007	Anubhav Joshi	P	
23FA20MEA00005	Bhumita Yadav	P	
23FA20MEA00006	Shweta Choudhary	P	
23FA20MEA00003	Medini Choudhary	A	Unwell
23FA20MEA00002	Nisha Choudhary	A	Unwell
231151001	Devanshi Kapoor	P	
Dr. Shilpi Gupta	Associate professor - Department of Economics	P	
Mr. Apoorva Saxena	Head, community Radio Station	P	
Mr. Parul Kanwar	Jr. Assistant SHSS	P	

News Publication- News printed in newspaper or online links (if any) for news – insert images)
NA

9. Feedback report of the Event

Students experienced Padam Shree Laxman Singh Ji's dedication, efforts, and commitments, and take away from him the **environmental sustainability** thought which will sustain forever with **Gen-Z** and they will transfer the same to **Gen-Alpha.**

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

Dr. Monika Mathur
Head, Department of Economics
Manipal University Jaipur

Seal and Signature of Head with date

MANIPAL UNIVERSITY JAIPUR

FACULTY OF ENGINEERING

SCHOOL OF COMPUTER SCIENCE & ENGINEERING

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

"Social Outreach Program for Local Communities"

Type of Event – NCC/NSS/Redcross

Date of Event – 24 July 2023

Content of Report (index)

1. Introduction of the Event

A. Purpose of the proposal: To organize a community outreach program involving Universities various departments and community radio station.

B. Overview of the partnership between the Community Radio Station and the University's multi-disciplinary departments like Department of Psychology, Department of Management & Commerce, Department of Law, Department of Science (Biotechnology), Department of Sports and Yoga & Department of Languages

C. Importance of community outreach programs for local development

2. Objective of the Event

A **Overall goal of the program:** To empower and improve the well-being of local communities.

B. **Specific objectives:**

1. To provide one day psychological support and mental health services to community members
2. To promote sustainable agricultural practices and create awareness schemes floated by the government.
3. To offer legal aid services and increase legal awareness within the community.
4. To educate and empower individuals on microfinance and investment opportunities
5. To encourage sports participation, promote physical well-being and scout young talents and facilitate them the training facilities.
6. To inculcate English teaching among the school going children of the Dehmi Kalan.

3. Beneficiaries of the Event

The event was conducted for all the students at Government Senior Secondary School, Begas and the people who lived nearby.

4. Details of the Guests

NA

5. Brief Description of the event

III. Program Components

A. Psychology Outreach – Department of Psychology

1. Establish a counselling session/s through the Community Radio Station for individuals seeking psychological support.
2. Organize workshops and seminars on stress management, mental health, and well-being.
3. Collaborate with local mental health organizations for referrals and specialized support.

B. Agriculture Outreach – Department of Science - Biotechnology

1. Conduct training sessions on sustainable farming techniques, organic farming, and crop diversification.
2. Provide agricultural advisory services through radio programs and interactive sessions
3. Facilitate visits of government officials to elaborate further on various Agriculture related schemes

C. Legal Aid Outreach – Department of Law

1. Set up a legal helpline for community members to access legal advice and information
2. Organize legal awareness campaigns through radio broadcasts and community workshops
3. Coordinate with local legal aid organizations to provide pro bono legal assistance

D. Microfinance and Investing Outreach – Department of Management & Commerce

1. Conduct financial literacy workshops on basic banking, savings, and investment strategies
2. Offer training sessions on entrepreneurship, business planning, and access to microfinance opportunities
3. Facilitate collaborations with local financial institutions to provide small loans and seed funding.

E. Sports Outreach – Department of Sports and Yoga

1. Organize sports events and tournaments to promote physical fitness and Community engagement.
2. Provide sports equipment and training to local schools and community centres
3. Collaborate with local sports clubs and coaches to offer coaching and mentoring Programs, facilitated by the University.

F. English for the Development of School Students – Department of Languages

1. To provide comprehensive English language instruction to students in the community, enabling them to develop strong language skills and enhance their opportunities for academic and professional success.
2. Conduct conversational activities, role-plays, and group discussions to improve oral communication skills.
3. Teach fundamental grammar rules and structures.

IV. Implementation Plan

A. Form a coordinating committee comprising representatives from the Community Radio Station and relevant university departments.
B. Develop detailed action plans for each program component, including timelines, resource requirements, and responsibilities
C. Establish partnerships with local organizations, NGOs, and community leaders to enhance program reach and effectiveness
D. Allocate appropriate funding for program implementation and sustainability
E. Monitor and evaluate the program's impact through regular assessments and feedback mechanisms

V. Conclusion

A. Reiterate the importance of the proposed social outreach program for local community development
B. Emphasize the potential long-term benefits of the program in terms of empowerment, well-being, and sustainable growth
C. Encourage support and collaboration from stakeholders, including the local community, government, and funding agencies.

6. Photographs

Image1. NCC air wing cadets with the faculties of different departments at Manipal University Jaipur.

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

NA

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

Date: June-July,2023

Time: 10:00 AM to 2:00 PM

Mode: Offline

9. Attendance of the Event

Total attendee: 1

S.No.	Name	Regimental Number	Department	Registeration Number
1.	Cdt. Sgt. Anirudh Singh	RJ/21/SDF/278487	B.Tech CSE AIML	219310037

10. News Publication- News printed in newspaper or online links

NA

11. Feedback report of the Event

The event's program components, including psychology outreach, agriculture outreach, legal aid outreach, microfinance and investing outreach, sports outreach, and English language development, received positive feedback. Attendees found these initiatives to be informative, valuable, and community-enhancing.

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

NA

Seal and Signature of Head with date

HOD
Department of AIML
Manipal University Jaipur

MANIPAL UNIVERSITY JAIPUR

Community Outreach Program 24th to 28th July 2023

Post Event Report

A five-day Community Outreach Program was conducted by Faculty of Arts and 90.8 FM Radio Manipal Jaipur under the aegis of Manipal University Jaipur. The Community Outreach Program took place for the school going children of class 9 to 12, at the Mahatma Gandhi English Medium Government School Dehmi Kalan, Farmer community at Dabar Dera and village folks of Gram Panchayat Dehmi Kalan.

The overall objective being to empower and improve the well-being of local communities by fulfilling specific areas like the: -

- Conversational English of the school children on Day 1 (24th July 2023)
- Physical Fitness and self-defense through sporting activities and Stress Management, Mental health, and well-being of the school children on Day 2 (25th July 2023)
- Best Agricultural practices by farmers to safeguard cultivation of Pearl Millet on Day 3 (26th July 2023)
- Legal awareness, gender laws was targeted towards the women community on Day 4 (27th July 2023)
- Tips on Micro Investment, Government schemes were given to village folks especially women on Day 5 (28th July 2023)

Various department faculties from Psychology, Languages, Sports and Yoga, Law, Bio Sciences and Economics took part actively and engaged the village folks.

Resource Persons

1) Prof. Neha Jain, Department of Languages
2) Dr Keshav Nath, Department of Languages
3) Dr Arun Dev Pareek, Department of Languages
4) Dr Deepak Bangari, Department of Sports and Yoga
5) Mr Sanjeev Kumar, Department of Sports and Yoga
6) Dr Kirti Shekhawat, Department of Psychology
7) Dr Rahul Kumar Singh, Department of Psychology
8) Dr Rohit Jain, Department of Sciences – Bioscience
9) Dr Maryam Ishrat Beg, Department of Law
10) Dr Namrata Bharadwaj, Department of Economics
11) Dr Naseeb Singh, Department of Economics

Organizing Team

1) Prof. (Dr) Komal Audichya, Dean – Faculty of Arts and Chairperson – Radio Cell
2) Dr Ashish Sharma – Deputy Registrar and Member – Radio Cell
3) Mr Radhakrishna Samaga – Manager – Finance and Member – Radio Cell
4) Dr Amit Sharma - Assistant Professor – Dept. of J&MC and Member – Radio Cell
5) Dr Dinesh Yadav – Associate Professor – Dept. of Electronics and Member – Radio Cell
6) Dr Amit Verma - Assistant Professor – J&MC - DOE and Member – Radio Cell
7) Appoorv Saxena – Member Secretary, Radio Cell

On Ground Support

1) Mr Vinod Daslaniya – 90.8 FM Radio Manipal Jaipur
2) Mr Ramkishan Gurjar - 90.8 FM Radio Manipal Jaipur
3) Ms Krishna Kanwar - 90.8 FM Radio Manipal Jaipur
4) Ms Avni Gaur - 90.8 FM Radio Manipal Jaipur
5) Mr Rajeev Jangid - 90.8 FM Radio Manipal Jaipur

This Community Outreach Program would not have been possible with kind support of Registrar's office, office of the Director GS&A, Quess Corp, Purchase, Transport, COW and Terrier and our vendors for Branding.

Images of Community Outreach Program

Day 1 – Mahatma Gandhi English Medium School, Dehmi Kalan – Communicative English – Department of English

Day 2 – Mahatma Gandhi English Medium School, Dehmi Kalan – Communicative English – Department of Psychology and Department of Sports and Yoga

Day 3 – Daabar Dera Village – Best Agricultural Practices of Baajra – Department of Sciences

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RESEARCH ARTICLE

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

Jabbar Khan[1] · Govind Gupta[1] · Naveen Kumar Singh[1] · Vivek Narayan Bhave[2] · Vinay Bhardwaj[2] · Pallavi Upreti[3] · Rani Singh[4] · Amarendra Kumar Sinha[5]

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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

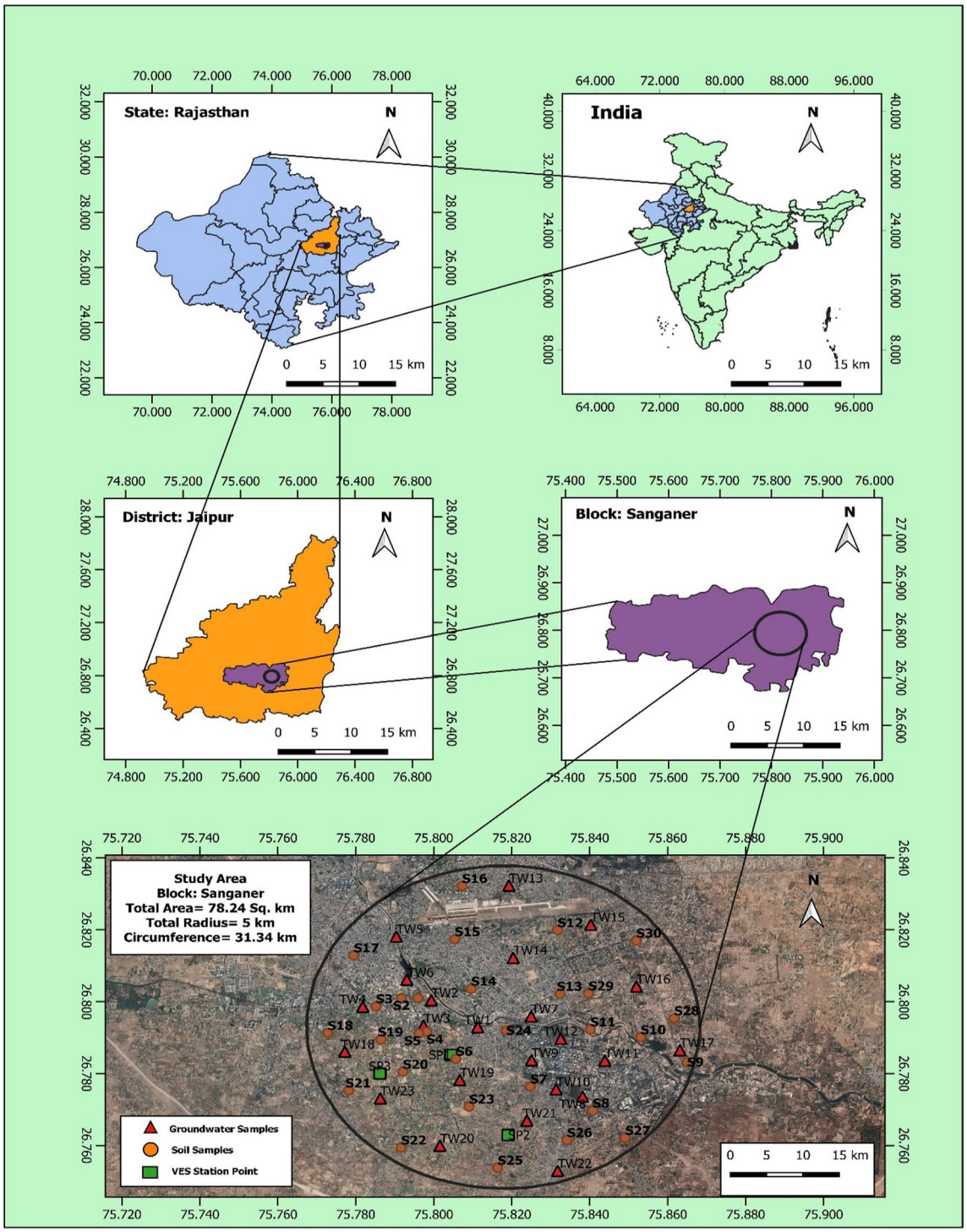


Fig. 1 Sampling sites of soil and ground water selected in the study area, Sanganer, Jaipur, Rajasthan, India

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.

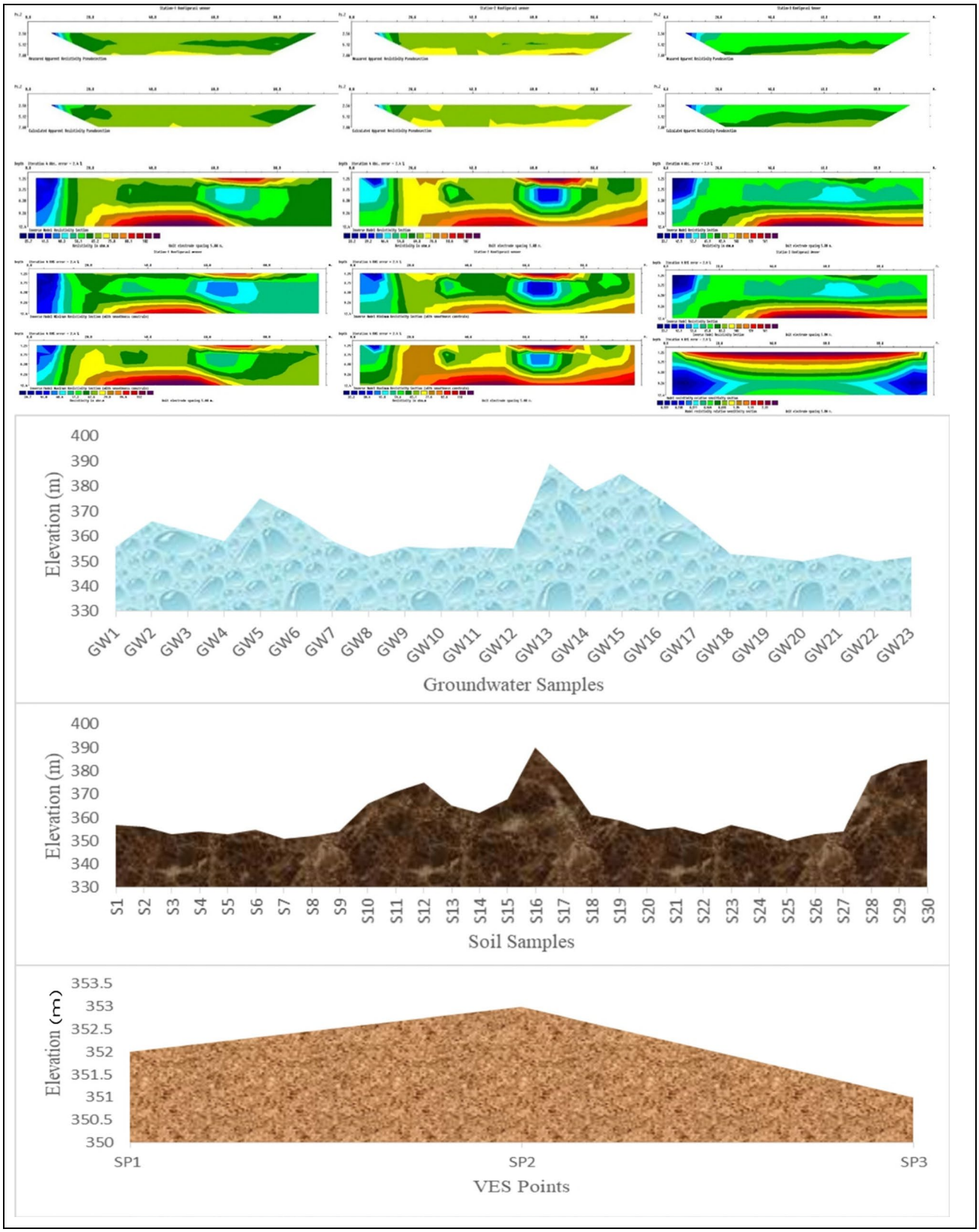


Fig. 2 Geoelectrical layers and elevation point of different sampling sites at the study area, Sanganer, Jaipur, Rajasthan, India

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).

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

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

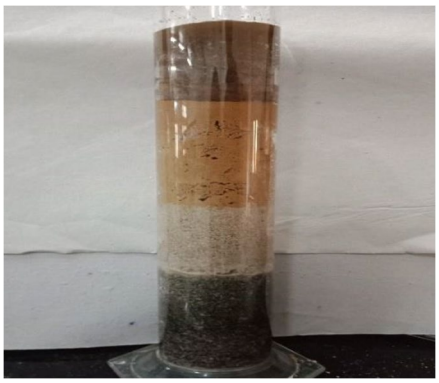
where Wi is the unit weight of each parameter, qi is the 0–100 subindex rating for each variable, and n is the number

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	

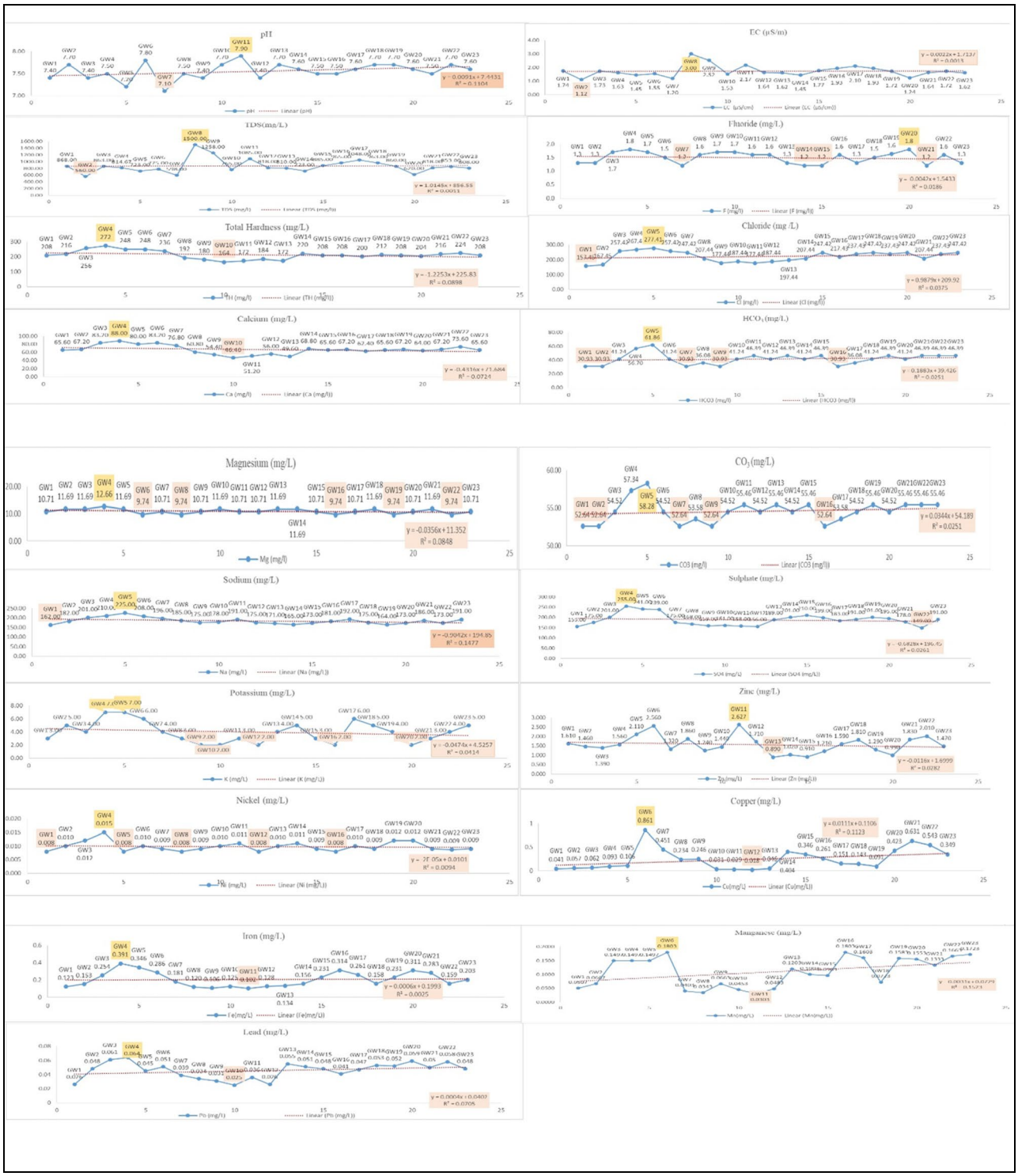


Fig. 3 Variations in water quality parameters of ground water samples collected from in different sites at the study area, Sanganer, Jaipur, Rajasthan, India

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

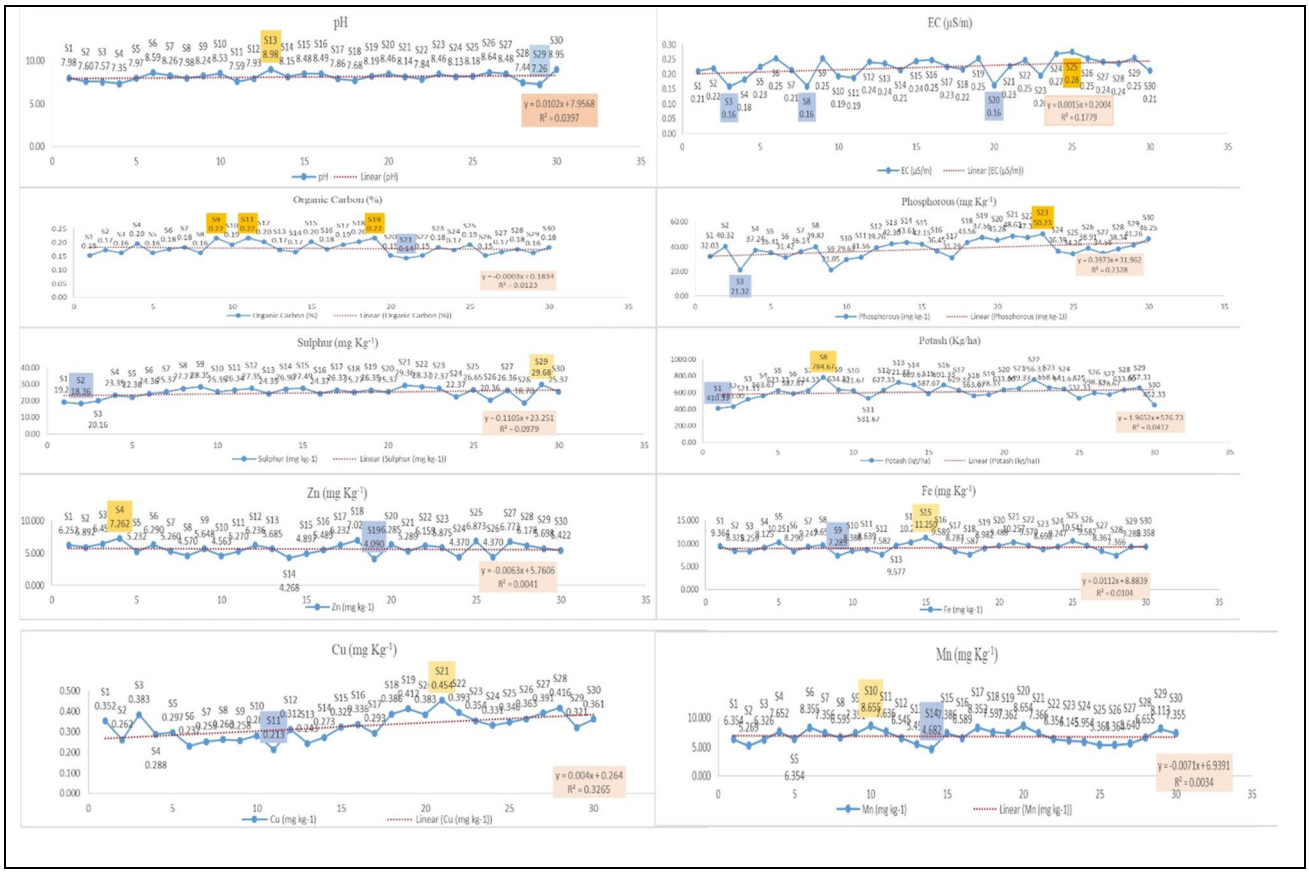


Fig. 4 Variations in soil quality parameters of soil samples collected from different sites at the study area, Sanganer, Jaipur, Rajasthan, India

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

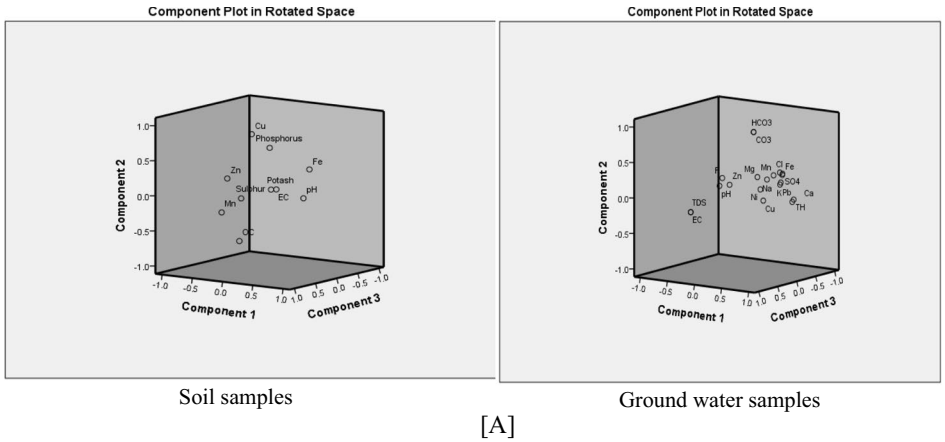
Table 4. Water quality and soil quality Index

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

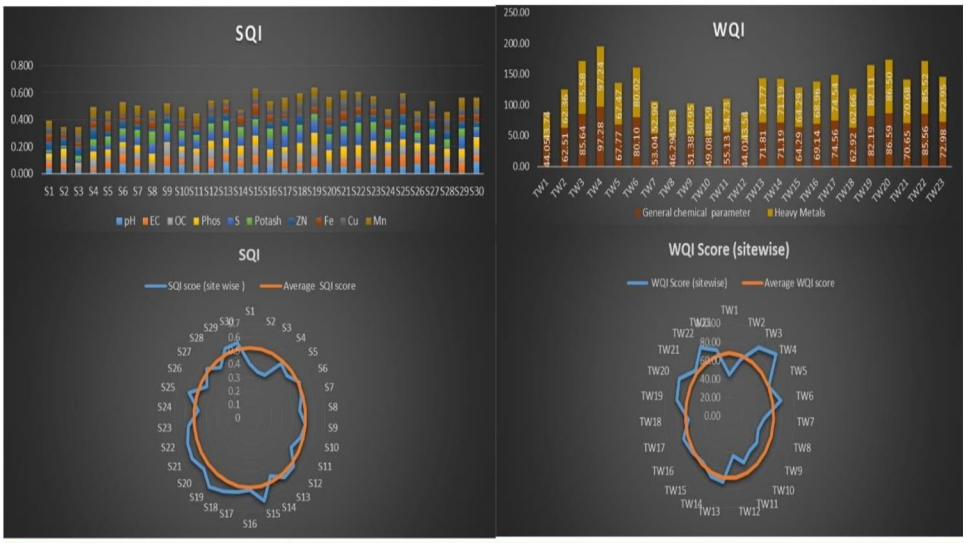
Collected samples from the selected study area, Jaipur regions of Rajasthan, Western India, evaluated for water and soil quality parameters which indicate slightly basic in nature as pH varied within the ranged of 7.0 to 8.0 in the samples. pH is one of the essentially functional parameters for evaluating 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



Soil samples

Ground water samples

[A]



Category-A	0-25	Excellent
Category-B	26-50	Good
Category-C	51-75	Poor
Category-D	76-100	Very Poor

[B]

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.

Data availability This is not applicable.

Declarations

Ethical approval This is not applicable.

Consent to participate The authors mutually agreed to submit the manuscript in the esteemed journal ESPR.

Consent to publish All authors are mutually agreed to publish the manuscript in the journal ESPR.

Competing interests The authors declare no competing interests.

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