



# **P.G.D.A.V. College**

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. Rajni Jagota : Company Law

**[UGCF]** Undergraduate Curriculum Framework

TAXMANN<sup>®</sup>'S

# Company Law

Dr. Rajni Jagota



2nd Edition  
March 2023

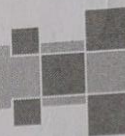
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## About the Book

A Comprehensive Textbook on "Company Law" for the B.Com. Hons. & B.Com. based on Undergraduate Curriculum Framework (UGCF) for University of Delhi, Non-collegiate Women's Education Board (NCWEB) and School of Open Learning (SOL) of the University of Delhi and Various Universities throughout India.

**Unique features of the book are:**

- ▶ Relevant Case Laws have been discussed in simple language.
- ▶ Figures and Tables have been used extensively.
- ▶ Latest amendments and developments have been incorporated at relevant places.
- ▶ Examination Questions have been incorporated.
- ▶ Annexure has been added for 'Practical Exercises' as per the requirements under NEP.

## About the Author

**Rajni Jagota** is an Associate Professor in the Department of Commerce at P.G.D.A.V. College, University of Delhi. She is M.Com., M. Phil and Ph.D all from University of Delhi. She has over two decades of teaching experience to her credit. She has been visiting faculty to M.Com., MBA (IB) and MBA (MHROD), University of Delhi. She has taught law papers to CA students. She has also presented papers in a number of national and international conferences. She has number of publications to her credit. Two students have been awarded Ph.D under her joint supervision and advice respectively. She has completed an Innovation Project 2015-16 on Jan Dhan Yojana and Financial Inclusion as one of the investigators and awarded Certificate of Best Research Poster.

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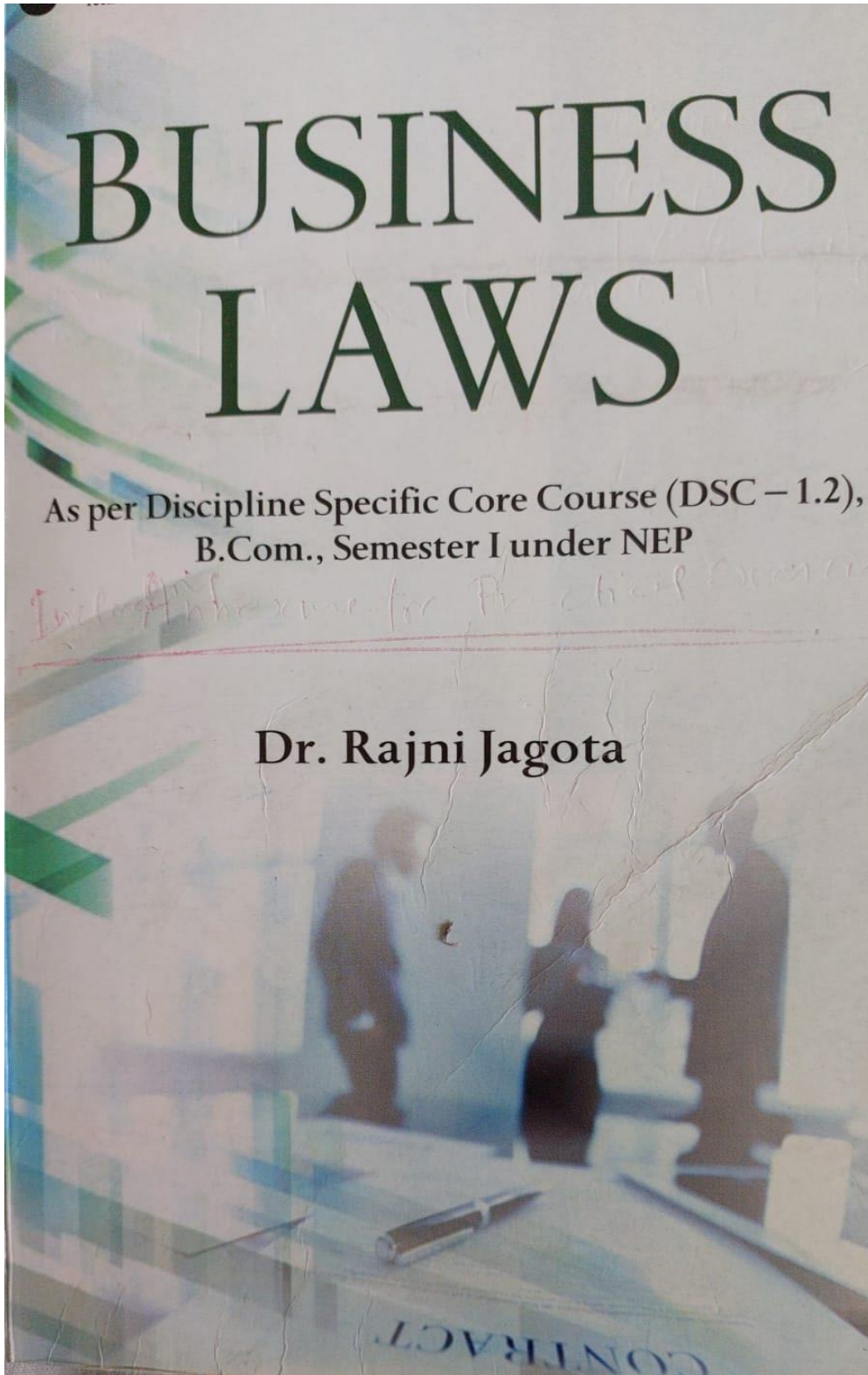
Dr Rajni Jagota: Business Law

# BUSINESS LAWS

As per Discipline Specific Core Course (DSC – 1.2),  
B.Com., Semester I under NEP

*Incl. Annexure for Practical Exam*

Dr. Rajni Jagota



#### About the Book

This book has been written as per revised syllabus specified by University of Delhi for students of **B.Com., Semester I under National Education Policy (NEP)**.

Unique features of book are:

- **Neutral citation** has been used in case studies for the sake of simplicity.
- **Latest Judgments** have been included.
- **Figures and Tables** have been used extensively.
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## Dr. Kiran yadav - Impact of Psychological Biases on Individual Investors Investment Decision Making: Mediation by Risk Perception

### **Impact of Psychological Biases on Individual Investors Investment Decision Making: Mediation by Risk Perception**

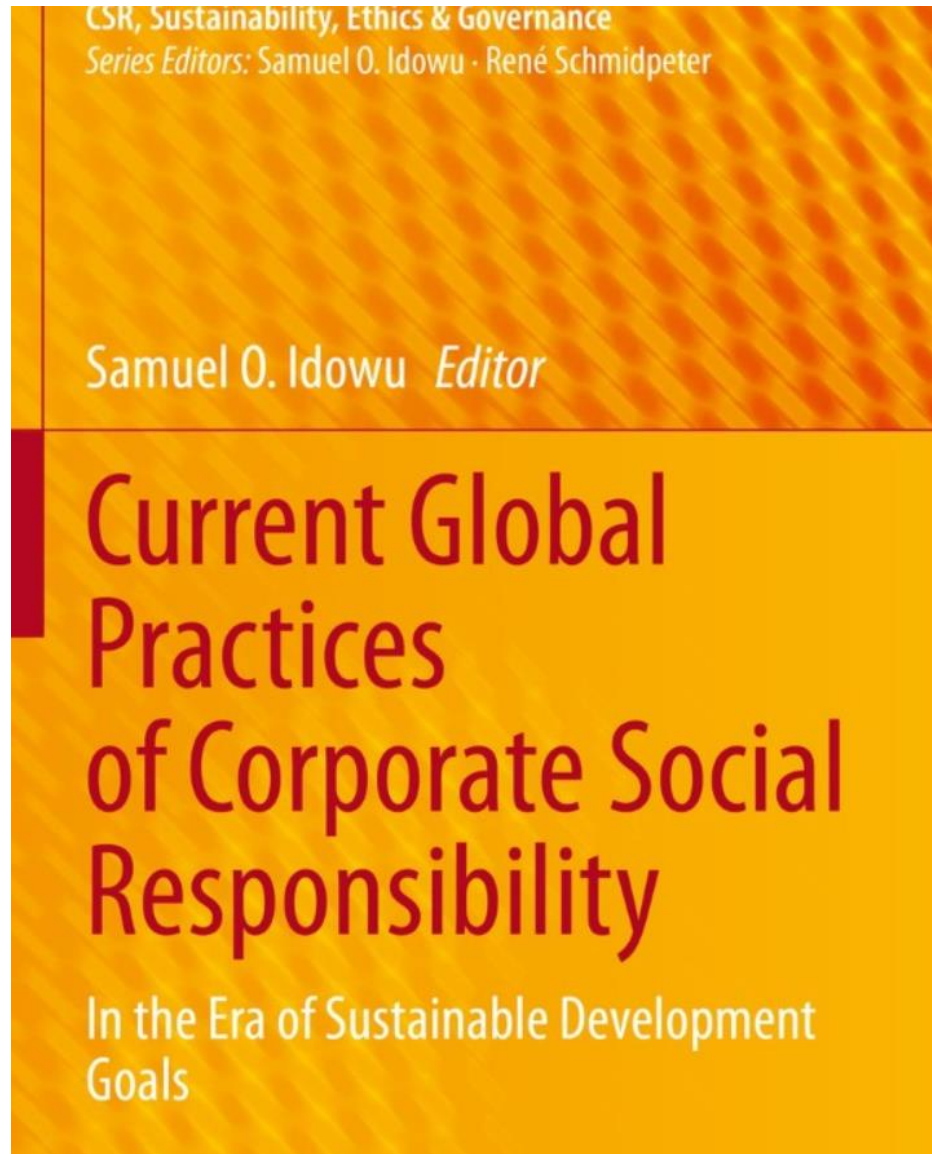
**Kiran Yadav  
Shikha Menani**  
*University of Delhi, India*

Psychologists found that investors do not behave as traditional finance economist says rationally instead investors' psychology influences their investment decision-making. This research aims to determine the impact of psychological biases on individual investors' investment decision-making in the Indian stock market. Also, attempt to examine the mediating role of risk perception of the individual investors. A cross-sectional study was done through the structured and closed-ended questionnaire. The five-point Likert scale had used to collect data from 704 individual investors. The content validity, reliability, and construct validity of survey instrument was checked through SPSS and AMOS graphics software under the pilot study. Under this study, higher-order measurement invariance analysis of psychological biases comprised two second-order factors and ten zero-order constructs used. The relationship of psychological biases, individual investment decisions measured through SEM, and the mediation effect of risk perception was checked by the Baron and Kenny method. This research provides empirical insight into how psychological biases impact the investment decision-making of individual investors in the Indian stock market. The results show the psychological biases have a positive and significant impact on the irrational investment decision-making of individual investors. Individual investors are susceptible to psychological biases, use mental shortcuts while making investment decisions, and make irrational investment decisions. Risk perception partially mediates the relationship between psychological biases and irrational investment decision-making. The stock market is highly volatile that creates an uncertain and risky situation. Due to uncertainty and risk, investors perceive risk and use mental shortcuts instead of analysing in-depth available information while making investment decisions and making poor decisions. The results of the research have relevant implications for investors, stock market regulators, and researchers. It encourages the investors to understand and avoid to susceptible to psychological biases while making an investment decision. Even this research also helps other financial practitioners like financial advisors to understand the psychological biases of their own and their clients. Furthermore, this study also helps stock market regulators and policymakers that investor's psychology plays a vital role in investment decision-making. This paper also provides insight to researchers on how to report and apply higher-order measurement invariance analysis in SEM.

*Keywords: Behavioral Finance, Herding, Heuristic Bias, Higher-Order, Prospect Theory*



Dr.Suchi Pahuja :Current Global Practices of Corporate Social Responsibility.  
CSR, sustainability , Ethics & Governance



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## Part IV

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**Current Global Practices of Corporate Social Responsibility** pp 689–709 | [Cite as](#)

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## Corporate Social Responsibility in India

The Impact of Mandated CSR: Evidence from India

[Shuchi Pahuja](#)

Chapter | [First Online: 08 July 2021](#)

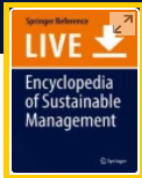
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Part of the [CSR, Sustainability, Ethics & Governance](#) book series (CSEG)

### Abstract

The concept of CSR is not new for India. It has its footprints in ancient India when CSR was known as social duty or charity. The concept got a more formal prominence during nineties when companies started integrating sustainability concerns into their business goals. This was also a period when Government of India initiated many reforms to liberalize and de-regulate

# Dr.Suchi Pahuja   Kyoto Protocol



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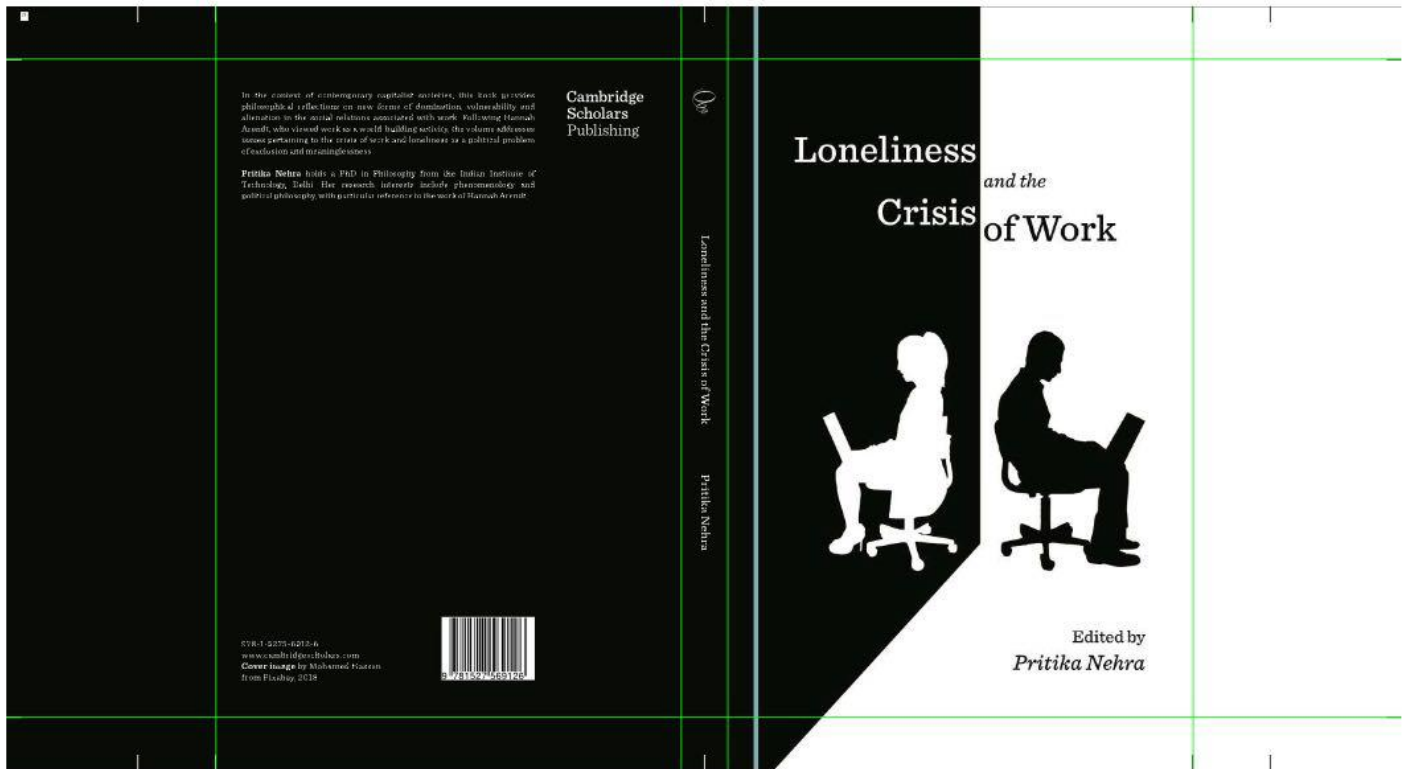
[International treaty under the UNFCCC](#)

### Definition

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The Kyoto Protocol is an international agreement under the United Nations Framework Convention on Climate Change (UNFCCC) designed with the aim of reducing global

# Dr. Pritika Nehra: Loneliness and the Crisis of Work



# Loneliness and the Crisis of Work

Edited by Pritika Nehra

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Loneliness and the Crisis of Work

Edited by Pritika Nehra

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**Dr. Pritika Nehra: Chapter ‘The Political Concerns of Loneliness’, In -  
Loneliness and the Crisis of Work**

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# THE POLITICAL CONCERNS OF LONELINESS

PRITIKA NEHRA

'No man is an island,  
Entire of itself,  
Every man is a piece of Continent,  
A part of the main.'  
—John Donne<sup>1</sup>

'You'd be surprised how quickly the mind goes soggy in the absence of other people. One person alone is not a full person. We exist in relation to others. I was one person: I risked becoming no person.'  
—Margaret Atwood<sup>2</sup>

'It isn't running away they're afraid of. We wouldn't get far. It's those other escapes, the ones that you can open in yourself, given a cutting edge.'  
—Margaret Atwood<sup>3</sup>

Loneliness brings into question the dualism of the external world and the internal reality of human beings (subjectivity and the world) more sharply. It makes us think about our bodily embeddedness in the world. Loneliness is not merely a subjective response but more importantly, it is a response to the intersubjectivity of the world. Through the lens of Hannah Arendt's views, first I develop a phenomenology of various lonely states viz., isolation, solitude, loneliness, superfluousness, and virtuality to demarcate them from each other. Then, I proceed to establish how each of them connect with intersubjectivity within a common, shared world and the political conse-

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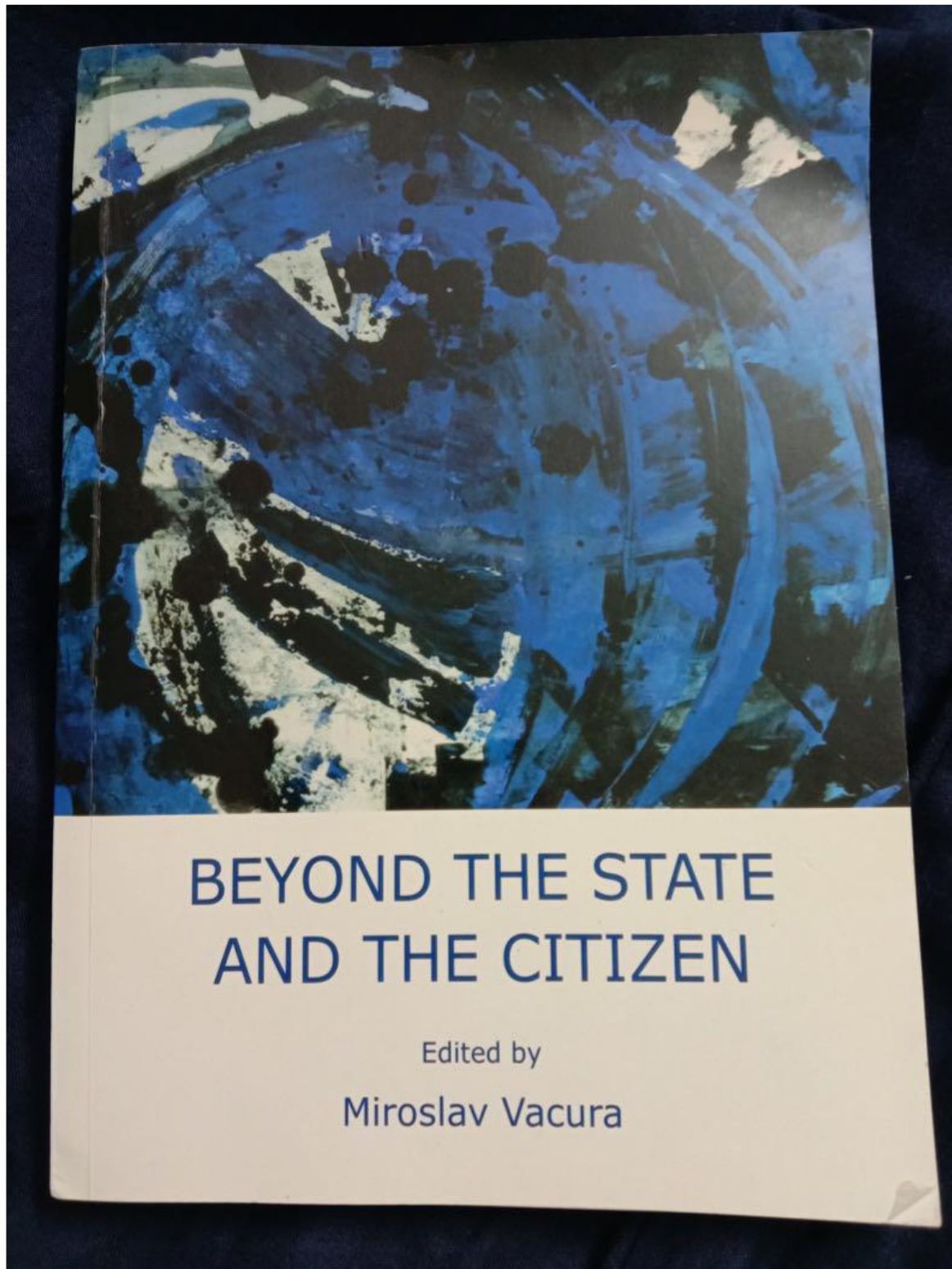
<sup>1</sup> Donne, John (1624). 'Devotions Upon Emergent Occasions, Meditations XVII' in *Donne's Devotions*. Cambridge University Press: 98.

<sup>2</sup> Atwood, Margaret (2020). *The Testaments*. Vintage: 132.

<sup>3</sup> Atwood, Margaret (1996). *The Handmaid's Tale*. Vintage: 18.



Pritika Nehra: Chapter Truth and Political Judgment in the book Beyond the State and the Citizen'



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## Truth and Political Judgment

Pritika Nehra<sup>85</sup>  
Delhi University, India

**Abstract:** In light of the two sides of criticism of truth talk in politics namely, truth as unnecessary remnant of metaphysical foundationalism and an insecure start for democratic politics as it risks promoting authoritarianism, I shall focus on Kant's views on involuntary assent with regard to political judgment. Reflecting on the tension between objective and subjective sufficiency of assent, I propose the consideration of unaddressed remainders of subjectivity (both individual and collective/social) along with objective sufficiency within Kant's model of assent. I argue that instead of challenging correctness, we need to preserve it by considering human fallibility and the social dimension of truths to open it for contestation within a publicly communicable sphere of disagreements and plurality.

**Keywords:** Truth, opinion, social epistemology, authority, conviction, objectivity, politics, judgment, Kant

In light of the contemporary political events like the *Black Lives Matter*, *the standing rock*, and such, there is a growing emphasis on the importance of the right to unmanipulated factual information in preserving the freedom of the political sphere. We should be particularly concerned about beliefs that influence our political and moral judgments. False beliefs that sketch a racist, anti-semitic, misogynist, fascist and such biased views of the world as truth claims illustrate the moral and political risks involved in communicating them. If truth is

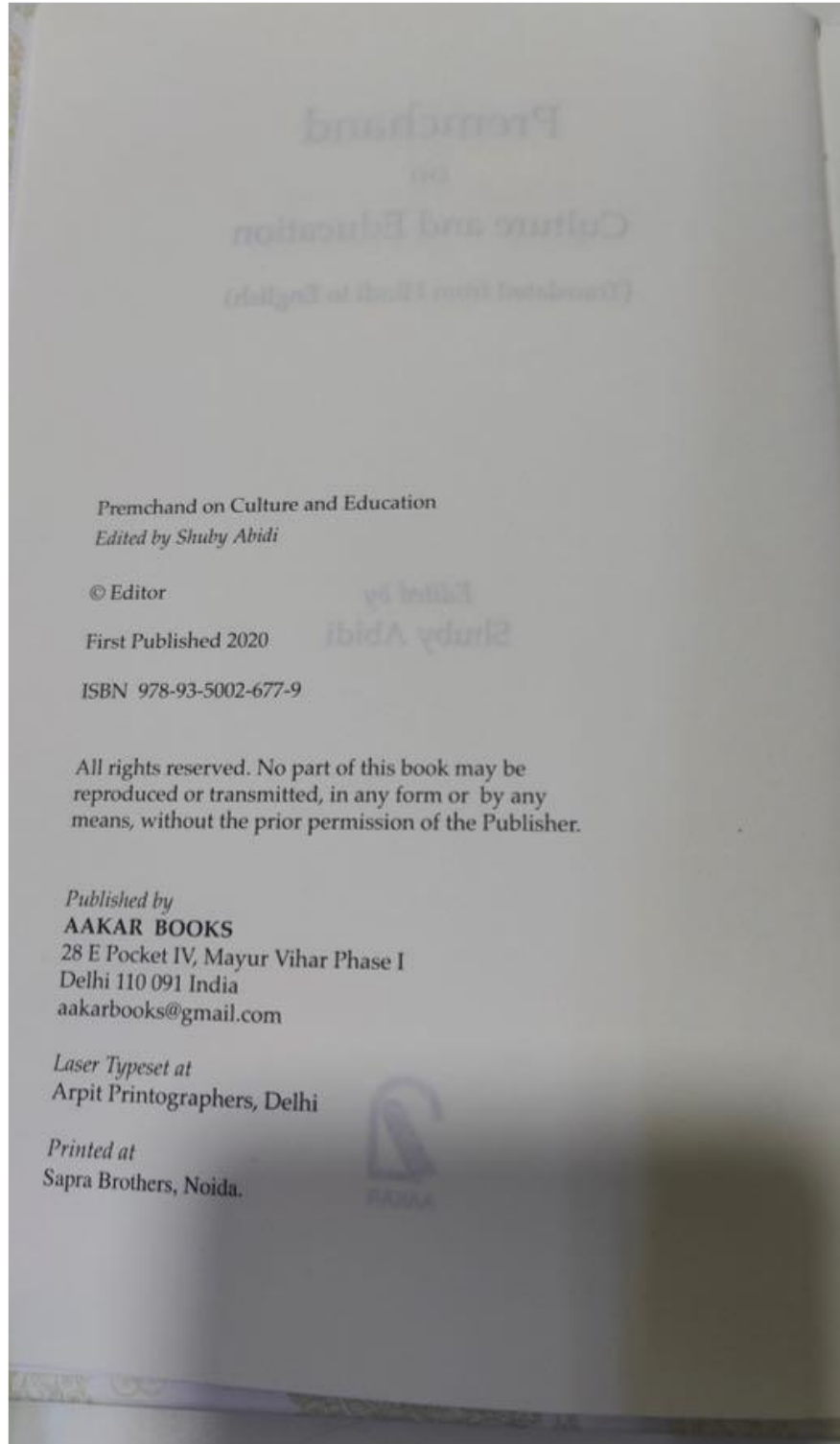
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**Dr. Urvashi Sabu: Translation of two non-fiction prose pieces of Munshi Premchand in Premchand on Culture and Education**

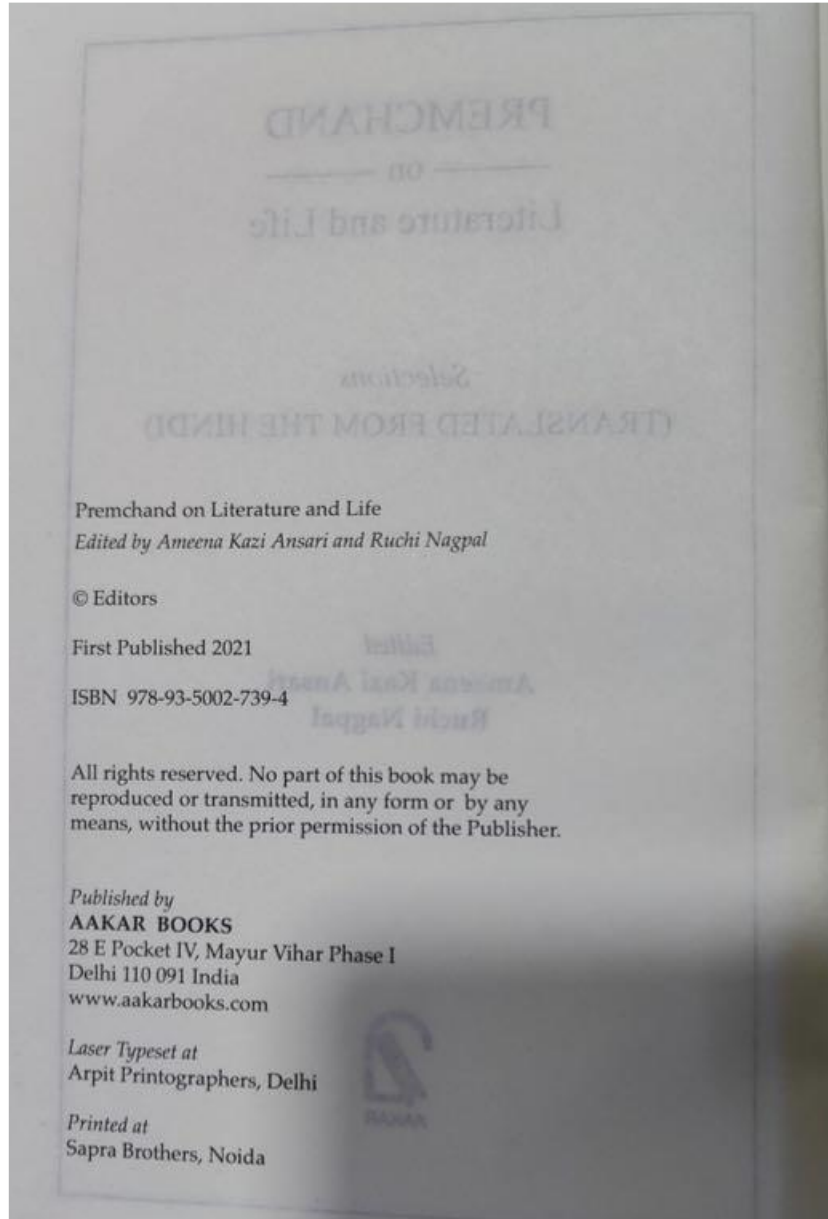


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Dr. Urvashi Sabu Translation of six non-fiction prose pieces of Munshi  
Premchand in Premchand on Literature and Life





## The Objectionable Conduct of Periodical Subscribers

*Patron ke Grahakon ka Aapattijanak Vyavhar*

Everyone is well aware of the condition of magazines and journals in India. In the case of Hindi, barring a few such publications, all the others are running into losses. The question is—if all publications are incurring losses, why do they not shut down? If there are no buyers for a product, why produce it? But then, are our schools, colleges and other educational institutions being run for profit? Their main job is to disseminate education, and they are doing this. Incurring losses for a noble cause is not a bad thing. It also holds true for magazines and journals, which should be prepared to disseminate ideas even at the cost of incurring minor losses. Schools and colleges might suffer losses when some students do not pay the monthly fees but they are not shut down in the face of this. Similarly, magazines and journals are dependent on subscribers for the dissemination of their ideas. By paying four or six rupees for a magazine, subscribers are not just customers; they deserve credit for being partners in publicizing the publication's viewpoints. This relationship is not merely one of seller and buyer. It makes one sad to see readers failing to give a thought to their duty and responsibility towards publications.

To be a subscriber is entirely your prerogative. Founders of magazines and journals always wish for a large number of subscribers as this reduces their financial burden. So they grovel before subscribers, who have the freedom to renew or discontinue their subscription. It would, however, be very nice if subscribers would simply decline renewal of their subscriptions on a postcard or through VP<sup>1</sup>, soon after receiving advance notice of the expiry of their membership. Experience tells me that, despite repeated reminders and requests for renewal three months prior to expiry, we have got no responses. When this silence is taken as assent for renewal of subscription and the publication is mailed as VP post, it is immediately returned without giving a thought to the expense incurred in postage and printing their copy of the magazine or journal, not to mention the office overheads. The sad part is that there are well educated gentlemen amongst such 'kind' readers. Is it any courtesy or kindness to avoid spending one's own coins but get others to pay many times more? What else can one say other than it being the sign of fallen character which has also brought about the enslavement our country! God help a land in which the educated classes lack integrity, and where the quantum of selfishness has multiplied many times over.

*Translated by Urvashi Sabu*

## Publications in Japan

*Japan Mein Patron ka Prachar*

Japan has a population of around six and a half crores. About 1137 dailies and 225 weekly and monthly magazines are published there. Some of these dailies have a subscribership of around ten to twenty lakhs. The financial condition of these publications can be gauged from the fact that the office of the *Osaka Mainichi* was constructed at a cost of Rs. 33 lakhs. Almost the same amount was spent on the *Tokyo Nichi* building. The *Asahi* has constructed a huge building in Tokyo at a cost of Rs. 32 lakhs. Each of these organizations employs around two to three thousand people. The editorial department alone has a staff of about four to five hundred. There is not much difference in the per capita income of India and Japan but the latter's population is just one-fifth of India's. Japanese publishing is in an advanced state. There is hardly a publication in India that has more than fifty thousand subscribers. One reason for this could be that every province in India has its own *bhasha* or language. Though the population of Hindi-speaking provinces is one and a half times more than the entire population of Japan, I believe that no Hindi daily prints more than twenty thousand copies. Most are limited to just four or five thousand copies a day. In such a situation, can publishing ever prosper in India?

*Translated by Urvashi Sabu*

## Religion in Ancient Egypt

*Pracheen Misr ke Dharma Tatva*

The ancient Egyptians were very religious and beliefs formed an integral part of their daily lives. They worshipped idols and also images of objects useful in everyday existence. Their invocations included water, earth, and foodgrains; the sky, sun, and moon; the Nile, celestial bodies and the spirits of the dead. The entire populace did not worship the same gods as each region had its own special deities who reigned supreme. Though their important gods had different forms, they were all really one in the eyes of the Egyptians. The city of Heliopolis, for example, worshipped the sun as the god Ra but his name in Thebes was Amun. In the two cities, the image of this god was also different.

It was believed that these gods were living beings who resembled humans but in terms of intelligence, knowledge, might, and valour they were far superior to man. They were also believed to possess desires and feelings like human beings and, therefore, had families. Their wives and children were also worshipped. Some cities worshipped female deities rather than male ones. Scholars, however, believe that the Egyptian elite were largely monotheistic.

The most splendid of the Egyptian gods was the Sun. His appearance and ornaments were like those of kings.

destroyed any canals. I am innocent. In fact, I have fed the hungry, served water to the thirsty, given clothes to the naked, assisted wayfarers across the river, made offerings at the altar of gods, and served food to the dead. O judges, exonerate me and speak no evil of me before Osiris because my face and my two hands are pure.

Such were the soul's entreaties inscribed on the walls of tombs and, at times, even on the faces of the dead.

*Translated by Urvashi Sabu*

to the world than English. It does not play that great a role as we tend to think.

Nehruji also accepts that it is difficult for many of us to learn the various languages of Europe when he writes:

It would be appropriate that famous books written in foreign languages be translated into Hindi. I believe this is extremely necessary for us to understand the flow of thoughts in the world.

The works which we translate from English these days find few takers because most people know English and prefer to read the originals rather than their Hindi translations. But this would not hold true for works in other European languages because there are very few of us who can read these languages in the original.

My hope is that our readers will ponder over this issue. I also hope that those who have the misconception that Hindi as the national language will damage the other languages of the land will understand the true nature of the relationship between Hindi and the languages of the provinces. It will be the responsibility of our national literary association to identify which works written in the provincial languages should be brought out in Hindi and the best ways in which these texts can then be placed before forums of world literature. Considering Hindi a separate language, and turning indifferent to it, will not be beneficial for the languages and literatures of our provinces but it will certainly be damaging for national literature.

*Translated by Urvashi Sabu*

## My Humble Submission to Triveni

*Triveni se Hamara Namra Nivedan*

*Triveni*, a publication in English from Madras, has welcomed my proposal seeking the formation of an Indian literary association, the *Bharatiya Sahitya Sangathan*, and also brought out a brief note<sup>1</sup> warmly acknowledging

<sup>1</sup> This note is in English and reads:

A Commonwealth of Literatures

We welcome the efforts that are being made by Mr. K. M. Munshi to give an All-India status to our provincial literatures. *Hansa*, the Hindi magazine till now conducted by Sri Premchandji, will hereafter be edited co-jointly by Sriyuts Munshi and Premchandji. It will publish articles about the different literatures, with personal sketches of writers and poets, and translations into Hindi of the more valuable literary pieces. *Triveni* has similar aims, and since 1928, it has bestowed a great deal of attention on the literary and cultural movements in Andhra, Maharashtra, Karnataka, and other linguistic units of India. In fact, this has been a prominent feature of *Triveni*, and it is not quite accurate today to say that we know the latest literary and cultural activity in England, but not that of our neighbouring province.

While we readily recognize that it is useful to conduct a magazine in Hindi for the benefit of all Indian provinces, we believe that it is not less important that Indian literature should keep in touch with the literature of the world by the publication of articles on the Indian literatures and translations of poems, plays and stories, in an international language like English. There are so many ways in which *Triveni* and *Hansa* can cooperate with advantage. There is however, a widespread feeling in South India that, in their zeal for the promotion of

## Pandit Jawaharlal Nehru and Indian Literature

*Bharatiya Sahitya aur Pandit Jawaharlal Nehru*

At the same time that *Hans* carried views on the necessity of establishing an association of Indian literature to bring together the country's various literatures, Pandit Jawaharlal Nehru was also ruminating on the same issue sitting faraway in Almora jail. Though entirely unaware of what the *Hans* issue had to say, Nehru's recent article has an uncannily similar orientation in *Pratap*, a collaborative publication of *Hans*. Such coinciding views prove that the nation's stream of thought is deliberating on culture and literature with singularity of purpose. Nehruji is the life and heart of this nation, and centred in him are the aspirations and feelings of its people. Cultural and literary harmony is a vital factor in any nation's development, and it is an auspicious sign for the nation's future to have these concerns catch the attention of its citizens.

At the beginning of his essay, Nehruji has rightly spoken about the mediocrity of the new literary writing emerging in Hindi while pointing out the historical and geographical reasons for Bengal and then Gujarat absorbing Western literary influence and getting ahead of other provinces. But for us in Hindi-speaking provinces, political consciousness



desiring to appear for the examinations of the Hindi Sahitya Sammelan. Provisions have also been made for the study of subjects like English, Sanskrit, and skills in arts and crafts. A hostel is also available for students and they can get good meals here for a mere Rs. 5 per month. Arrangements have been made for their physical exercise. The founder of this institution is an enthusiastic gentleman from Calcutta—the honourable Shri Madanlalji Kaiyyan. The management of the school is in very capable hands, some of whom like Shri Janardhan Jha 'Dwij' (MA) and Shri Lakshminarayan Singh 'Sudhanshu' (MA, LLB) are very well known in the world of Hindi. I am particularly pleased to know that this institution also trains students in creative writing and editing.

It has been just three years since the Khopapur Hindi Sahitya Vidyalaya opened its doors to students. Here, too, special attention is paid to imparting skills in Hindi and preparing students for examinations in higher courses of study. This year, arrangements have been made for awarding twenty-five scholarships to students from non-Hindi speaking provinces like Andhra, Assam, Utkal, Maharashtra, Gujarat, and Punjab. Along with this, preparations are also underway to teach English as well as two regional languages. In making such arrangements, the administrators have displayed a liberal outlook. Cultural evolution does not only mean giving our own language to others; it also means receiving theirs. Only then can mutual exchange have permanence. Queries and any other correspondence may be addressed to:

The Hindi Sahitya Vidyalaya

Khopapur

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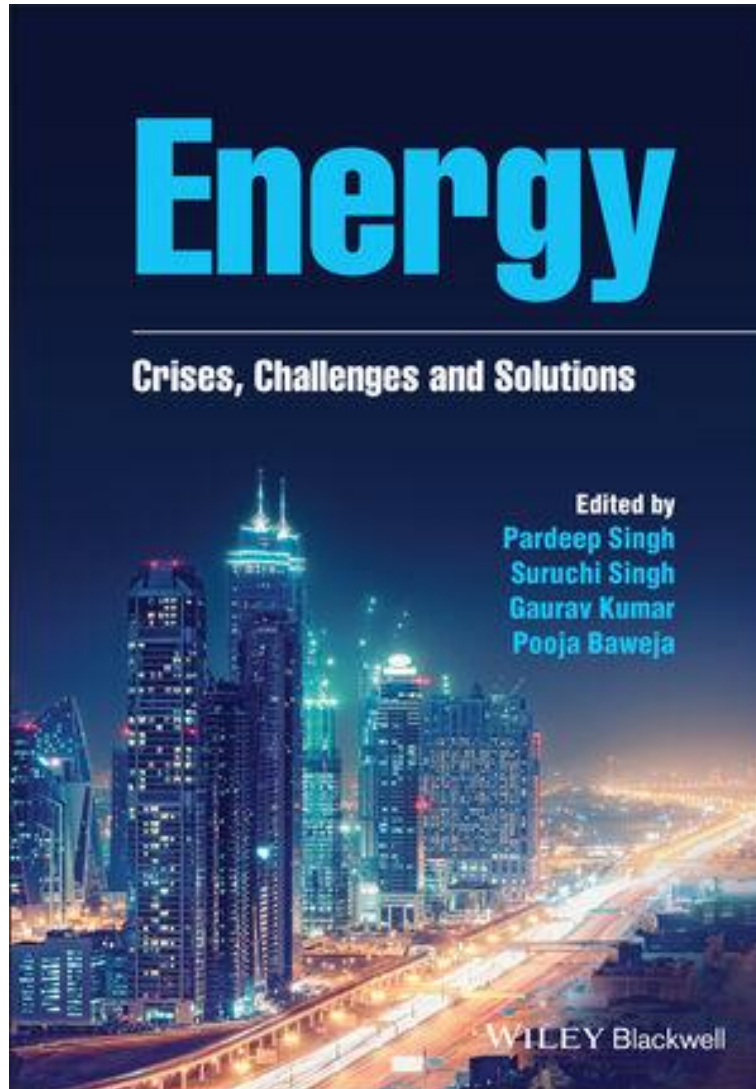
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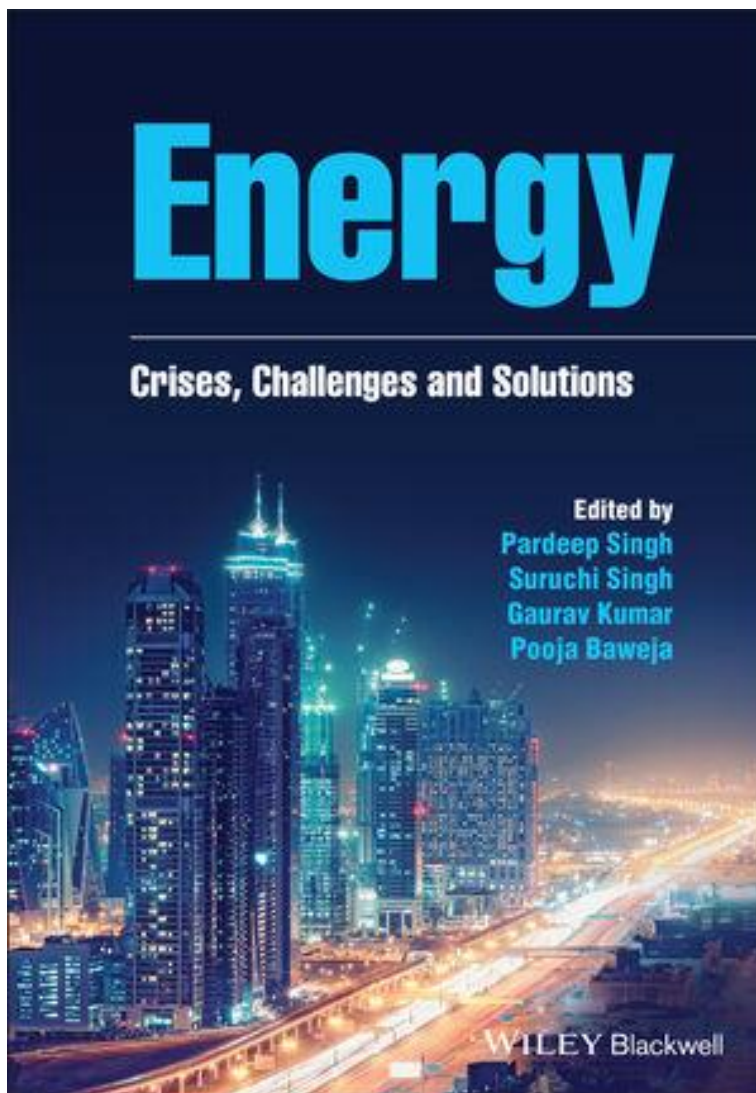
literatures—is this also harmful for us? If it is not harmful then can familiarity with our country's various literatures be harmful, or is it harmful simply because this familiarity comes through a destitute language like Hindi rather than English? If our endeavours were in English, would it be more gratifying for *Triveni*? Can our literary concord be achieved through any other language? If not, then is Hindi committing a great crime by undertaking this endeavour? For international transactions, we certainly need English; the vernaculars are there for communication between provinces. But for communication at the national level, the knowledge of Hindi has become essential. We may neglect Hindi today, but perhaps a time will come in the future when it cannot be ignored.

*Translated by Urvashi Sabu*

Dr. Gaurav Kumar & Dr. Pardeep Singh: Energy, Challenges, Crisis and Solutions.  
(Book)



Dr. Kiran & Dr. Shikha: Chapter named “Energy and Development in the Twenty-First Century –A Road Towards a Sustainable Future: An Indian Perspective” in the book Energy, Challenges, Crisis and Solutions.

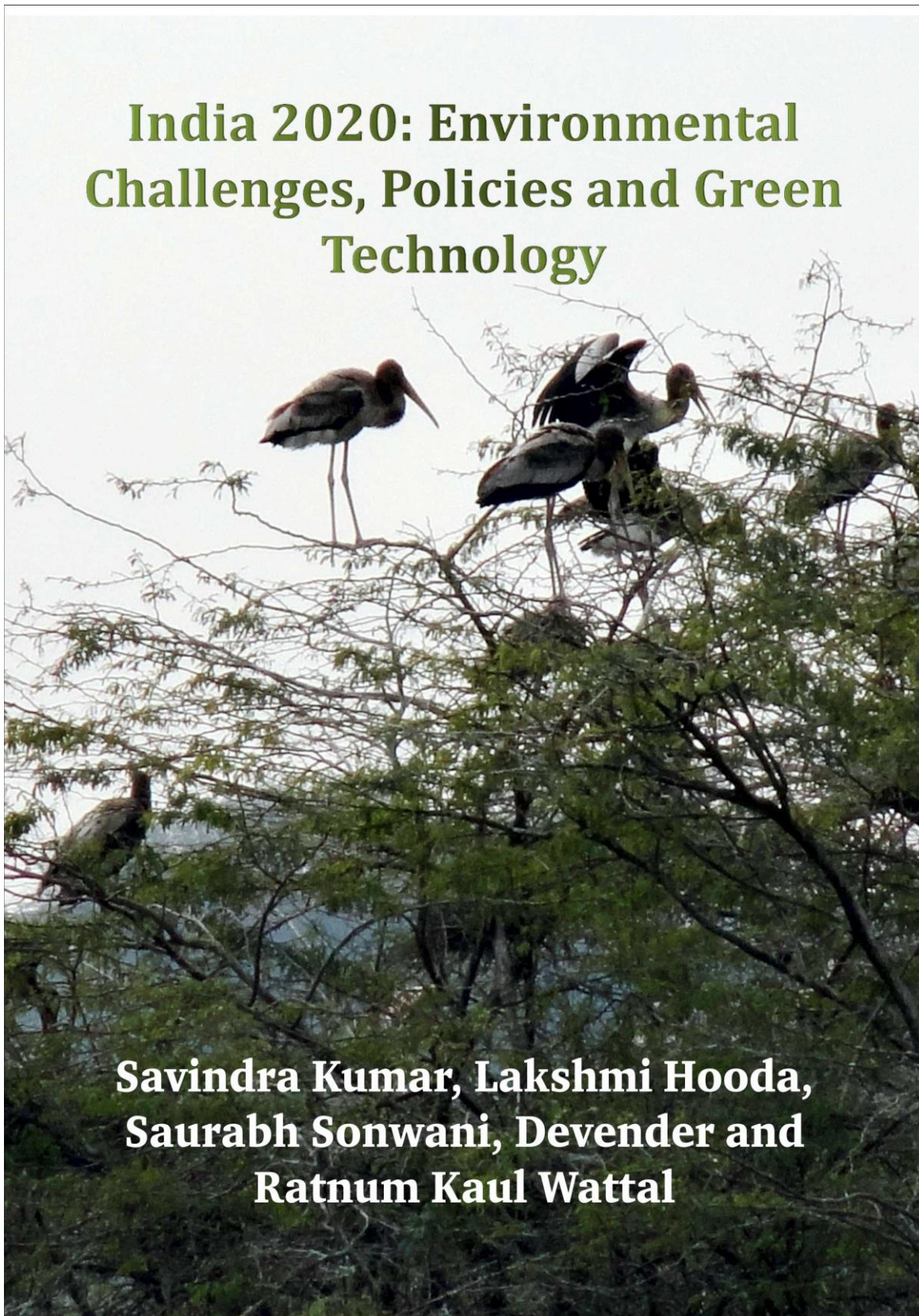


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Dr. Gaurav Kumar & Dr Pardeep Singh: Chapter “Water Pollution: Causes, Impact, Solutions and Treatment Technologies” in Book--India 2020: Environmental Challenges, Policies and Green Technology)

## **India 2020: Environmental Challenges, Policies and Green Technology**

**Savindra Kumar, Lakshmi Hooda,  
Saurabh Sonwani, Devender and  
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## WATER POLLUTION: CAUSES, IMPACTS, SOLUTIONS AND TREATMENT TECHNOLOGIES

Gaurav Kumar<sup>1</sup>, Pardeep Singh<sup>1</sup>, Amar Singh Kashyap<sup>2</sup> and Pooja Baweja<sup>3\*</sup>

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### Abstract

Water pollution is the condition when harmful and toxic substances like chemicals, heavy metals, microorganisms contaminate water or water resources, degrade water quality and make it toxic. Due to booming population, urbanization and rapid industrialization, there is scarcity of clean water and water contamination is rising up. Wastewater is generally the used water being released from homes or from commercial, industrial, and agricultural activities (i.e. metals, solvents, and toxic sludge). The wastewater which is being released from homes remains untreated and although there is provision of treatment of wastewater coming out from various industries it is limited with primary treatment process only and is capable of polluting nearby water bodies. Agricultural runoff causes soil degradation and depletion of aquatic flora and fauna in water bodies, and there is no preventive measure. Due to the consumption of contaminated water, every year, more than one billion people worldwide get infected through water borne diseases such as cholera, dysentery and typhoid. As water pollution is rising on an alarming scale, it is important to control it at the primary source of contamination and hence, there is a need to emphasize on possible solutions through treatment technologies.

**Keywords:** Chemicals, Diseases, Environment, Toxic, Water pollution, Wastewater treatment

### 1. Introduction

Water is elixir of life which covers around 71% of the total earth's surface mainly, the water exists on earth in Sea and Oceans (97%) and only a little amount (3%) is fresh water. Most of the fresh water (about 2.7%) exists in the form of ice, groundwater and soil moisture, with only 0.3% in liquid form on the earth surface (Gleick, 1993a, 1993b, 1996). Out of this 0.3% liquid fresh water, mostly (around 87%) is contained in lakes, 11% in swamps, and only a little amount (2%) in rivers (<http://www.blueplanet.nsw.edu.au/mi--water--distribution-of-water/.aspx>). Water plays a significant role in the world economy, as it acts as a universal solvent and facilitates industrial cooling and transportation. Animal farming and agriculture are responsible for about 70% of



freshwater utilization, whereas only 22% of fresh water is used by industry and about 8% is used for domestic purposes (World Watch Institute, 2004; Baroni, et al., 2007).

Water pollution occurs when harmful substances like chemicals, heavy metals and microorganisms etc. contaminate any lake, river, stream, ocean, aquifer, ground water or any other water body, degrading water quality and rendering it toxic to human consumption or the environment (Schweitzer and Noblet 2018). After contamination this polluted water is termed as waste water as it can't be used without further treatment. Based on its origin the wastewater can be categorized as commercial, industrial, sanitary, agricultural or surface runoff (Sanamdikar and Harne, 2012). Sewage water is contaminated with faeces or urine, the sewage generates from domestic residence, hospitals, industries and offices etc. Sewage includes domestic, municipal, and industrial liquid waste products. Domestic sewage contains a wide variety of dissolved and suspended impurities and is the primary source of various pathogens, potentially creating a direct threat to public health and water quality. As the water pollution is increasing alarmingly, in recent years, the awareness and concern about water conservation has increased at global level, and new approaches to conserve and protect water resources are considered worldwide (Sanamdikar and Harne, 2012; Shrirang and Chatterjee, 2014).

India and most of the other developing and underdeveloped nations are facing major problems with water pollution, predominantly due to untreated sewage. In India, rivers like Ganges, Yamuna and other major rivers flow through densely populated areas, and industrial belts, which pollute the rivers. Although governments have made some regulatory policies, however due to lack of stringent measures to check these norms, there is no success in controlling the water pollution (Shrirang and Chatterjee, 2014). The industrial and household effluents are directly released in the nearby water bodies which make them polluted and unfit for use. The present chapter emphasizes on possible solutions through treatment technologies for sewage and polluted water and its reuse that is the need of the hour.

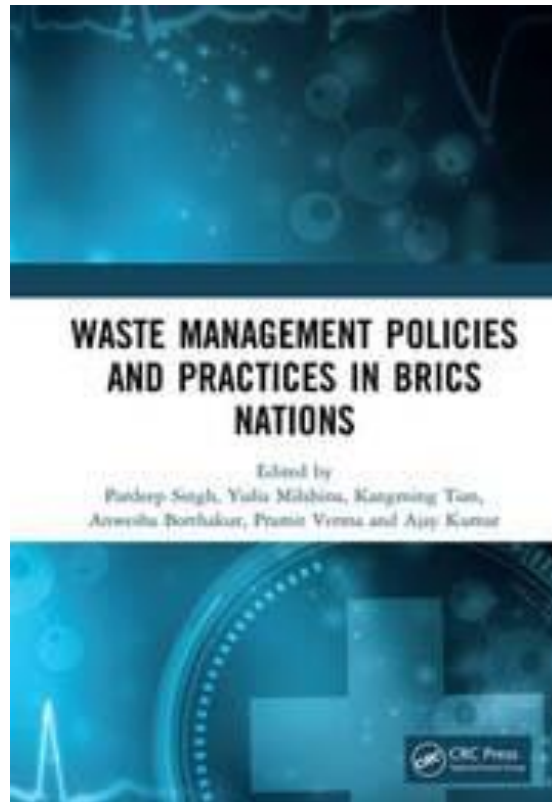
## 2. Causes of water pollution

Water is known as a universal solvent therefore, it's able to dissolve more substances than any other liquid present on planet earth. That is why water is so easily polluted. Toxic substances from factories, farms and towns readily dissolve and mix with water, causing water pollution, the substances which pollute water are known as water pollutants or water polluting agents and may be of the following types Table. 1.

Table- 1. Major water polluting agents

S. No.	Polluting Agents	Examples
1.	Organic Pollutants	Detergents, Sewage, Insecticides, Pesticides, Herbicides and Petroleum etc.
2.	Inorganic Pollutants	Heavy metals, Chemical wastes, Ammonia etc
3.	Macroscopic Solid waste	Plastic, Paper, Glass pieces, Food waste etc
4.	Pathogens	Bacteria, Protozoans, Viruses etc.
5.	Others	Hot water discharge into various water bodies

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Book

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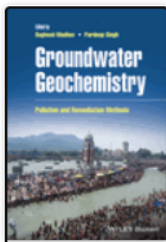
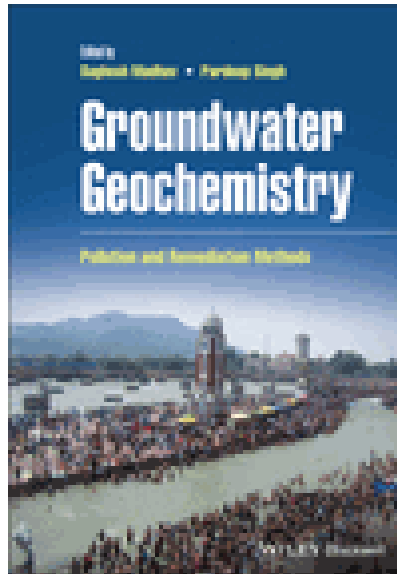
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**Dr. Pardeep Singh : Groundwater Geochemistry: Pollution and Remediation Methods**



## **Groundwater Geochemistry: Pollution and Remediation Methods**

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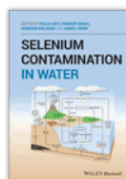
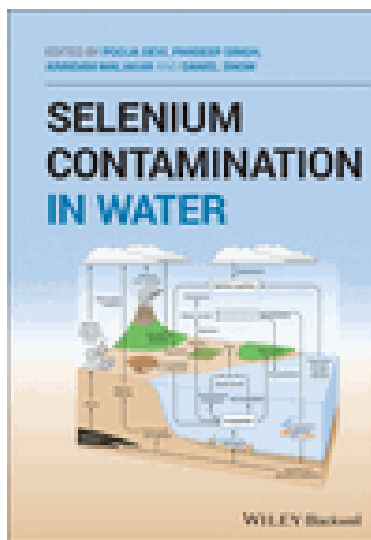
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## Dr. Pardeep Singh: Book "Selenium Contamination in Water"



### Selenium Contamination in Water

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### About this book


The contamination of environment and water resources by Selenium (Se) and its oxyanions from various sources are emerging contaminants of significant health and environmental concern. The primary sources include agricultural drainage water, mine drainage, residues from fossil fuels, thermoelectric power plants, oil refineries, and metal ores. Various methods and technologies have been developed which focus on the treatment of selenium-containing waters and ... [Show all](#) ▾

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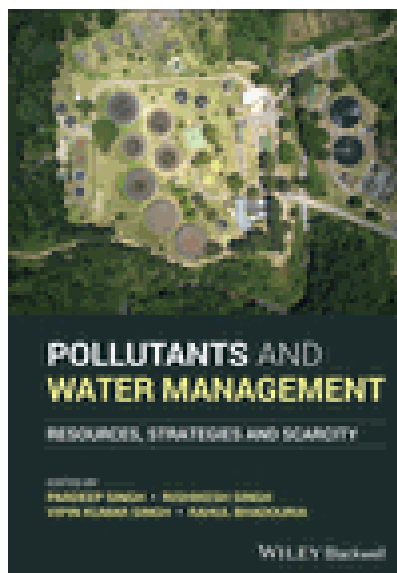
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# Dr. Pardeep Singh: Pollutants and Water Management: Resources, Strategies and Scarcity



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## Pollutants and Water Management: Resources, Strategies and Scarcity

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#### POLLUTANTS AND WATER MANAGEMENT

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Chapter

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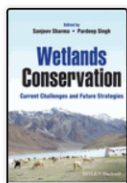
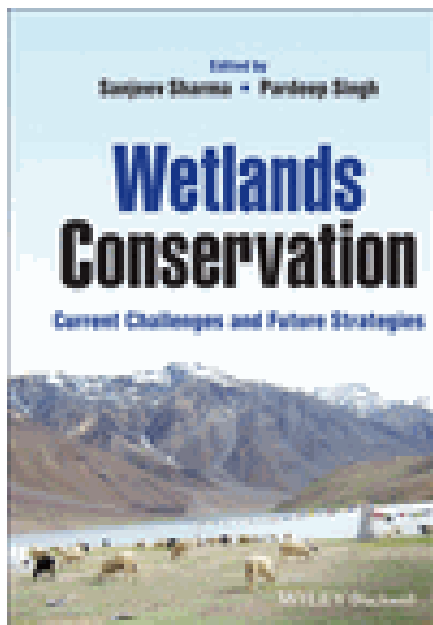


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# Wetlands Conservation

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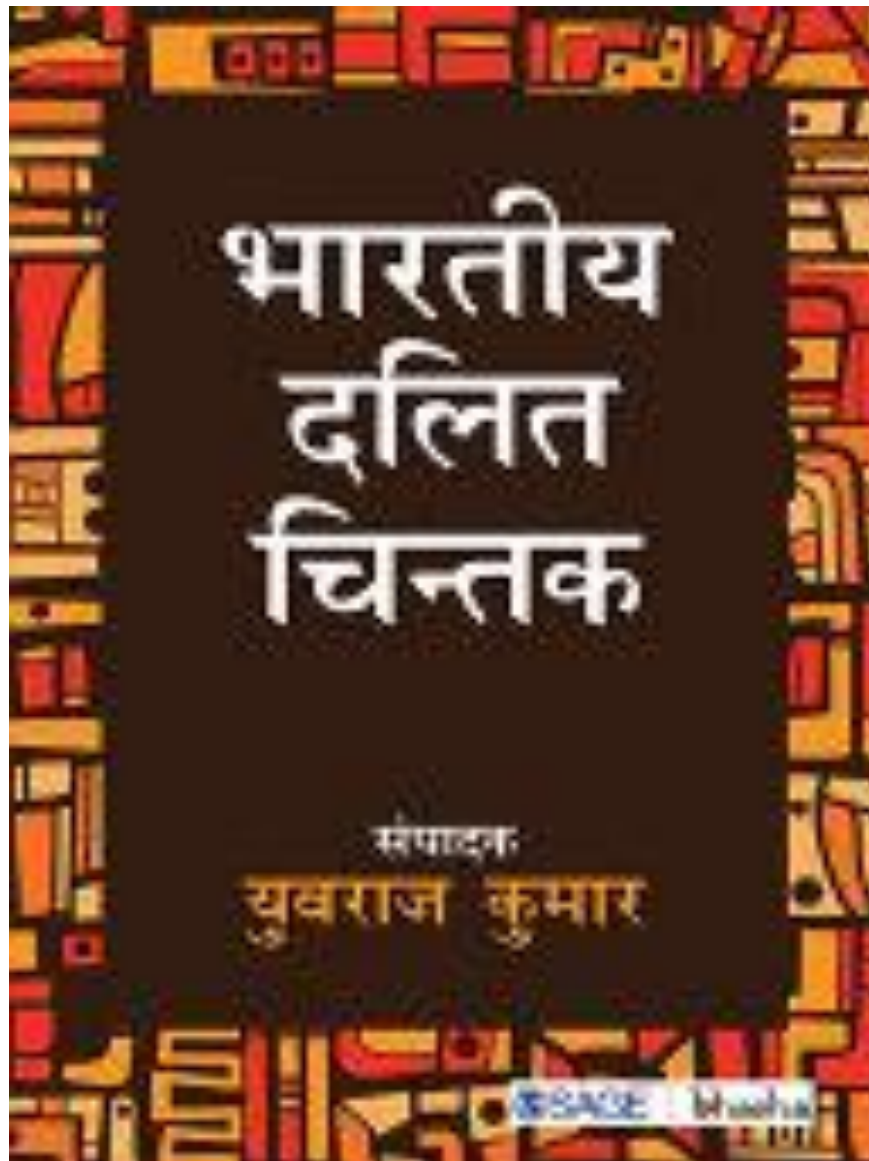
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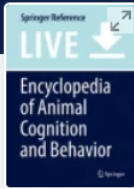
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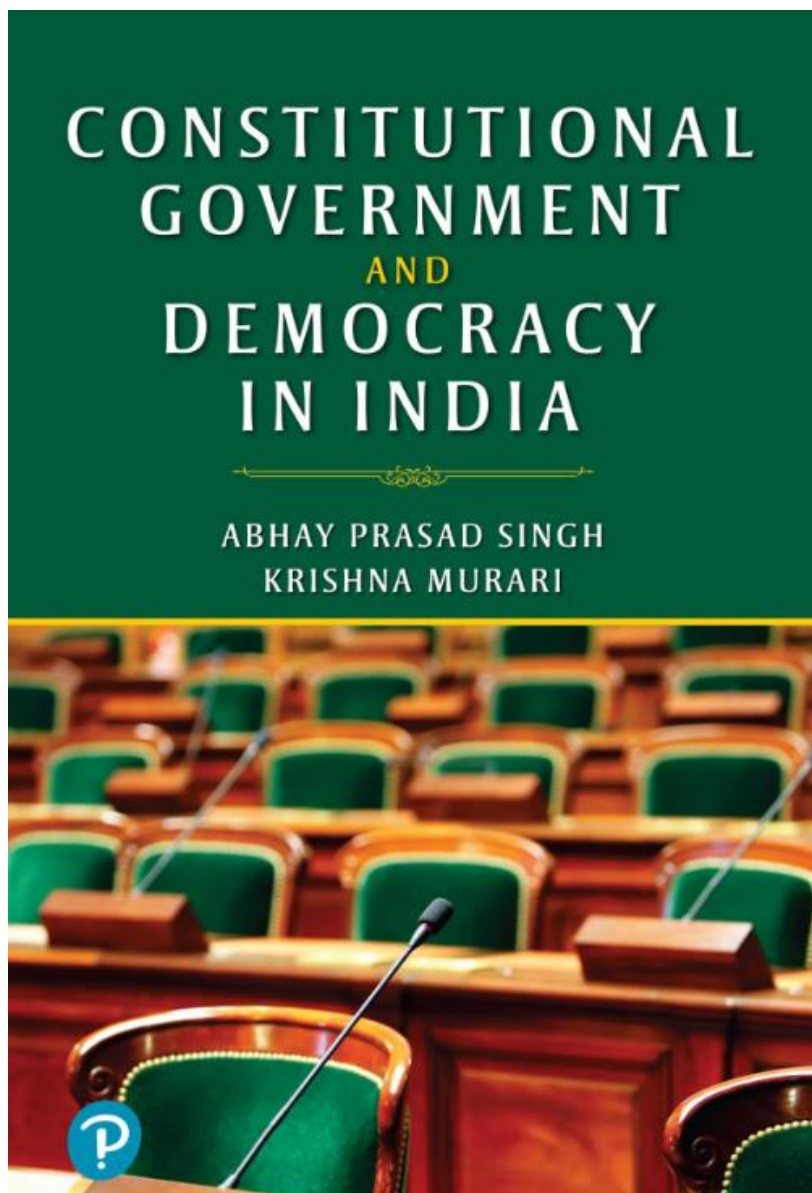
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Tapetum is structurally and functionally diverse unistrata layer of universal occurrence in the microsporangia of all land plants that chiefly serves as a nutritive tissue for developing male gametophytes (Dickinson and Bell [1972](#), [1976](#); Sporne [1973](#); Pacini [1997](#); Pacini et al. [1985](#); Huysmans et al. [1998](#)). The tapetum is better known in higher plants (gymnosperms and angiosperms) than in lower plants (bryophytes and pteridophytes) as its activities are less frequent in lower plants than in higher plants (Dickinson and Bell [1972](#), [1976](#); Pacini et al. [1985](#); Parkinson and Pacini [1995](#)). On the other hand, compared to their aquatic ancestors, early land plants had well-protected reproductive structure, the loculus – a liquid-filled cavity that occurs





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Book



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## Climate Change and Soil Interactions

2020, Pages 453-471

## Chapter 17 - Sustainability science—below and above the ground as per the United Nation's sustainable development goals

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### Abstract

With the emerging global socioeconomic and environmental apprehensions appear the significance of “sustainability science” in terms of a comprehensive and interdisciplinary approach toward addressing major present-day concerns. The United Nation's 17 sustainable development goals (SDGs) under Agenda 2030 are an attempt to promote and ensure such holistic advancements. Soil, as a central component of the environment, is connected directly or indirectly to a number of SDGs. For instance, soil health and functions have substantial implications in SDG 2 (Zero hunger), SDG 3 (Good health and well-being for people), SDG 6 (Clean water and sanitation), SDG 11 (Sustainable cities and communities), SDG 14 (Life below water), and SDG 15 (Life on land). In this chapter, we attempt to explore the attributes of each of these SDG in connection with the soil and how soil sustainability could influence or aid in achieving sustainable development. We argue that soil conservation is one of the most vital and essential ways toward realizing the objectives of SDGs both effectively and adequately.

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[Prमित Verma](#)<sup>1</sup>, [Rishikesh Singh](#)<sup>1</sup>, [Pardeep Singh](#)<sup>2</sup>, [A.S. Raghubanshi](#)<sup>1</sup>

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## Abstract

Urban ecology is a cross-cutting theme across the social, economic and environmental dimensions of sustainable development. As such, different aspects of urban ecology are dealt with by different experts. Urbanization in developing countries is driven by economic benefits while developed countries, having large ecological footprints, can focus on efficiency reducing the impact of urban growth on the ecosystem. The society is losing its appreciation for the ecosystem services, thereby diminishing resilience in terms of mitigating problems arising out of urbanization such as air quality deterioration, restricted living space, urban heat island (UHI) effect, urban health, groundwater scarcity, loss of water bodies and so on. While urbanization has many detrimental effects on the ecosystem, it has also led to innovations aimed at reducing these effects, such as water harvesting systems, energy-efficient homes, landscape planning, sustainable commuting and green space accessibility. Due to these advances, the perspective towards urban ecology has changed from a theoretical and empirical study to an applied and transdisciplinary field.

In this book, advances in urban ecology have been integrated with emerging fields from ecological and environmental as well as from human-centric perspective, particularly governance, economics, social-ecological systems, urban boundary, the impact of urbanization on climate change and human health, and sustainable cities. This chapter gives a brief background of urban ecology, need for considering cities as social-ecological systems, the current state of research and major concepts described in this book.





## Keywords

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## Wetlands Conservation: Current Challenges and Future Strategies

### Chapter 1

# Global Wetlands

## Categorization, Distribution and Global Scenario

Sanjeev Sharma, Mahika Phartiyal, Sugghosh Madhav, Pardeep Singh

Book Editor(s): Sanjeev Sharma, Pardeep Singh

First published: 24 September 2021

<https://doi.org/10.1002/9781119692621.ch1>

## Summary

The Wetlands are a crucial part of the ecological system and the storehouse of numerous ecosystem services that provide humanity's well-being and preserve the natural ecological system. Wetlands manage the hydrological process and track the ecological environment. These wetland systems are classified differently at the global level based on their origin, use, hydrology, composition, water level, and wetland physical and chemical characteristics. These wetland systems are important for the survival and environmental stability of humans. Since the beginning of human civilization on this planet Earth, wetlands have become the lifeline of civilizations. Often along and in the outskirts of wetlands, cultures have grown. This precious wetland environment's economic interests are not yet recognized at the global and regional levels by policymakers and decision-makers. These wetlands are distributed in all climate zones in the geographical and climatic setting, from the tropics to the tundra regions. It is the world's most efficient and important ecosystem. As recorded by Davidson et al., the largest wetland areas in 2018 are Asia (32% of the global area), North America (27%), Latin America and the Caribbean (16%), Europe's wetland areas (13%), Africa (10%), and Oceania (10%). At present, 2414 wetland sites of international significance covering 254 543 972 ha are internationally important at the country and humanity levels. Many wetlands have been destroyed and impaired by rapid agriculture and urbanization in North America and Europe, including the extinction of most floodplain areas. Increasing pressure on water supplies is also a very dominant factor responsible for wetland destruction in various regions at the global and local levels due to population pressure, land use cover changes, global warming and climate change, and lack of legislation and governance. The current section of the book highlights global wetlands, categorization, and status. Threats and mitigation initiatives are also proposed for wetland habitat conservation in this chapter.

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Jyoti Kushawaha<sup>1</sup>, Sivaiah Borra<sup>2</sup>, Abhishek Kumar Kushawaha<sup>3</sup>, Gurudatta Singh<sup>4</sup> and Pardeep Singh<sup>5</sup>

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## **14.1 Introduction**

Climate change was the natural phenomenon occurring even before. Still, since a few decades ago, its outbreak becomes severe and shows adverse effects on nature and life. Increasing population and industrialization releases toxic greenhouse gases into the atmosphere and changes hydrological and weather pattern throughout the world. At some places, drought persists for a longer time, and at some places, massive flooding occurs due to precipitation (IPCC, 2007b). The disappearance of glaciers, valleys, and snowcaps affects the downstream habitats adversely. These changes possess severe stress on natural resources like less availability of water resources for agriculture, energy production, domestic uses and ecosystems all around the world. Climate change is one of the biggest threats for the environmental, social, and economic perspective, which is a major challenge for sustainable development, mainly in developing countries. Climate change often results in water scarcity, land degradation, deforestation, and several health issues (Oeumg et al., 2019). The variability of climate change, government policies, and their responses which are linked with socioeconomic development affect the country's sustainable growth (Dhar and Mazumdar, 2009).

Climate change increases global warming and considered as one of the most discussed topics of political controversy worldwide. The world has gone with several debates in the past to confirm whether global warming is real or just a hypothetical thought, but now the effects are quite visible. The significant change in earth's climate brings a massive disruption on every segment of the world's activity as well as a natural phenomenon. Some of the scientific theories suggest adverse repercussion of climate change enhanced by global warming. Some of them are inundation of coastal cities, drying of agricultural fields, melting of glaciers, increasing diseases,

sea-level rise, change of pattern in ocean currents, and other disasters. Some of the crucial indicators of ongoing climate change are:

- temperature,
- the sea-level growth and submergence of the coastal villages and lands,
- the retreat of the major and minor glacial layer,
- extinction of the biodiversity, and
- frequent forest fire, etc.

In the present scenario, the consequences can be seen in the form of heatwaves and associated droughts, extreme and frequent floods, tropical storms, cyclones, sea-level rise, etc. have already affected livelihood across the world.

Global warming increases the average temperature of the earth such as its surface, ocean, and atmosphere. This phenomenon started years ago at a controlled rate. In the past, small climate changes had significant impacts on human activities like agricultural practices, traceroutes for new markets, etc. In the case of spreading human civilization, warming has been proved as a favorable point. After industrial revolutions, the rate of global warming becomes very high due to climate change. According to the World Meteorological Organization (WMO), the past two decades were the warmest years.

The rate of earth's climate change has increased rapidly in an unprecedented manner in recent past years, making the world much warmer. According to the temperature analysis report of WMO, the state of global change in 2019 has ended with the average global temperature of  $1.1^{\circ}\text{C}$  more than the estimated preindustrial average (WMO, 2020). In the previous decade, 2019 was the warmest year without El-Nino effect after 2016, representing as an indicator of the increased global temperature phenomenon. Since 1880, the average global temperature has risen by more than 1 degree. Another alarming point is, the two-third of total warming has occurred after 1975 by the rate of around  $0.15^{\circ}\text{C}$ – $0.20^{\circ}\text{C}$  per decade. This can be termed as a worrisome situation because the one-degree increase of average temperature has enough heat to warm all oceans, atmosphere, and earth's surface significantly. The average temperature data is based on two factors, that is, how much energy the planet receive through sun and how much energy it radiates back to space. As we all know, that second factor is directly proportional to the availability of greenhouse gases in the atmosphere that is heat-trapping in nature and affects the change in temperature. Greenhouse gases are most important for life on earth because they trap the heat radiated back to the space from earth's surface in the atmosphere and keep the earth warmer and much comfortable for survival. In the last few decades, the chemical composition of greenhouse gases of the atmosphere has been disturbed due to anthropogenic activities. According to the report of WMO (2020), in comparison to the preindustrial era, the level of  $\text{CO}_2$ ,  $\text{CH}_4$ , and  $\text{N}_2\text{O}$  has increased by 147%, 259%, and 123%, respectively.

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# Impact of climate change on wetlands, concerning Son Beel, the largest wetland of North East, India

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Moharana Choudhury<sup>1</sup>, Anu Sharma<sup>2</sup>, Pardeep Singh<sup>3</sup>, Deepak Kumar<sup>4</sup>

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## 1. Introduction

Water is a vital source of life for the planet Earth, not only to perform the necessary metabolic cycle but also to run and regulate all the functions of day-to-day life. Stable economic growth and development for every nation or country are powered by water, as its availability impacts agriculture, manufacturing, environment, sustainable development, etc. The availability of water directly linked to the amount of precipitation, which is well-taken care by the hydrological cycle. The changing climate followed by enhanced levels of temperature leads to disturbance in this cycle. The observation of the world's wetland day on February 2 every year highlights the significance of wetlands as ecosystems. This observance began in 1971 when the Ramsar convention was convened at Ramsar in Iran. Wetlands play a substantial role in pollution control and detoxification. Because of their exceptional performance as the filters, the absorption of pesticides and chemicals, and removing harmful waste from the water, they are given the Earth's kidneys' status. Nature plans its natural systems to enhance or even replace historically gray infrastructure functionalities (WBCSD, 2017). Wetlands cover around 6% of shares in the global surface they play a unique role in the biogeochemical and water cycle. They are home to a large part of global biodiversity—tremendous pressure on the ecosystem in the form of land reclamation, extreme exploitation of the resources. Alteration in hydrology, pollution threats are accruing from many sources on the wetlands on almost every continent.

Further stress to wetlands is expected by climate models, primarily due to changes in hydrology, rising temperatures, and increasing sea level (Junk et al., 2013). Twentieth-century climate data show that the United States is in a wetter, warmer climate pattern. Even other climate forecasts indicate that over the next 100 years, this phenomenon will continue and potentially worsen. Wetlands are likely to be affected by the rising sea level trend because of elevated carbon dioxide levels.

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# Exploring soil responses to various organic amendments under dry tropical agroecosystems

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## 21.1 INTRODUCTION

Agriculture is the principal livelihood option for most people residing in rural areas in developing countries (FAO, 2015). In these countries, cereals (mostly rice–wheat cropping) cultivation shares a major part of cultivable land (RWC, 2005) and are the potential source of per capita energy as compared to other food sources (Brevik, 2013). Thus improving cereal production for achieving the dietary demand of the growing population has been a basic need. With the irrational increase in the human population, this need gained urgency for achieving global food productivity (Singh et al., 2019a). In this regard, the green revolution was introduced globally during the latter half of the 20th century (Singh et al., 2019a). As the green revolution was introduced to achieve the global food security, it was mainly based on yield maximization strategies, such as people need to eat and land resources are limited, thereby increasing the yield through external inputs such as chemical fertilizers and pesticides (Lobell et al., 2014). The externalization of agriculture after the green revolution resulted in a significant increase in cereal production per unit area (Ramakrishna and Rao 2008). However, in the later phases of the green revolution, a yield stagnancy and even a decline in cereal yield were reported worldwide (Dhillon et al., 2010), particularly in the Philippines, India, Indonesia, and Pakistan, especially in the last two decades (Srivastava et al., 2016a; Singh et al., 2019b,c).

Fourteen elements are considered as essential for plant growth and are further classified as macro- and micronutrients depending on their requirements to the plant (Sathya et al., 2016). Among these elements, three macronutrients, viz. nitrogen (N), phosphorus (P), and potassium (K), are the major building blocks in several plant growth-related processes, and thus, are required in large quantities to improve the crop growth (Sathya et al., 2016). These elements are naturally present in the environment; however, their availability to the plants is limited due to their natural forms. Therefore to increase the crop yield, a high dose of chemical fertilizers has been applied in the soils. It can be understood by the estimate that the demand for nitrogen fertilizer is increasing globally at an annual growth rate of 1.7% (FAO, 2011). Asian countries are the major producers of cereals, and therefore, consume two-third of total fertilizer application for cereal crop production (FAO, 2011). The impact of excessive fertilizer application on crop production remains fugitive, and it has resulted in a chronic impact on soil quality and microbial population. On the other hand, excessive supply of macronutrients leads to a deficiency of micronutrients such as copper (Cu), manganese (Mn), iron (Fe), and zinc (Zn), which act as a cofactor for several enzymes involved

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## *Phytoremediation: A Sustainable Technology for Pollution Control and Environmental Cleanup*

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### 12.1 Introduction

Industrialisation and rapid urbanisation have resulted in the release of large amounts of heavy metal(oids) in our surroundings, along with other life-threatening pollutants in the environment. That has reached an alarming situation and is of serious concerns among the scientific community throughout the world (Kanwar et al., 2020). These heavy metal(oids) come into the environment from natural and anthropogenic sources, such as the use of fertilisers and pesticides in agriculture (Hamzah et al., 2016; Rani et al., 2020); sewage discharge, mining, and smelting processes (Chen et al., 2016); fossil fuel burning and electroplating, etc. Hence, they concentrate in soil and water, and pose a great threat to the environment because heavy metals are non-degradable. Therefore, they are persistent in the environment and can reside in the soil for prolonged periods. They make their way from the roots of plants to our food chain via accumulation in crops. Thus, they accumulate in our body through the process of biomagnification and affect our health, leading to some serious illnesses (Rehman et al., 2017). So, it is becoming necessary to decontaminate the soil and water, and



stop the entry of the contaminants into our environment and food chain (Gerhardt et al., 2017). The extraction of these toxic pollutants from contaminated soil and water by various physical, chemical, and biological methods is the current interest. So far, many remediation and decontamination approaches have been proposed that have also evolved with time due to continued research and advanced techniques. Traditional methods of remediation such as incineration, flushing, electrokinetics, landfilling, and vitrification are very expensive and result in damage to the soil properties. One of the most popular, attractive, and sustainable techniques is phytoremediation of contaminated soil or water (Kanwar et al., 2020).

Phytoremediation is a technology that makes use of plants (hence the name “phyto”) and microbial flora associated with it to accumulate or degrade pollutants of organic and inorganic origin present in the system. This is a novel and efficient cleanup strategy that utilises biological entities (Pilon-Smits, 2005). So, phytoremediation is the utilisation of living plants for degradation, accumulation (assimilation in plants’ tissue), and containment of pollutants from water, soil, and other sources within its tissues (Iori et al., 2015) and rendering toxic environmental pollutants harmless. It can also be described by its potential for immobilisation, sequestration, extraction, removal, destruction, remediation, uptake, and stabilisation of soil/water contaminants (Kanwar et al., 2020).

Green plant-based remediation and management of contaminated soil or water is not a new concept. Floating and submerged plant systems, reed beds, and constructed wetlands have been in common use for the management of some wastewaters for many years. But, with time, the concept has evolved and developed. In literature, many plant species have been reported as hyper-accumulators, i.e., accumulation beyond a certain threshold limit. There are a large number of diverse sets of plants available (terrestrial and aquatic both) that have been reported to show hyper-accumulation potential for different metal (loids); for example, Ni, Zn, As, Cd, etc. *Alyssum lesbiacum*, *Alyssum bertolonii*, and *Thlaspi goesingense* are known to hyper-accumulate Ni from contaminated sources (Küpper et al., 2001); *Pteris vitata* is known for As hyper-accumulation (Ma et al., 2001); and *Arabidopsis halleri* is reported for Zn hyper-accumulation (Zhao et al., 2000). There are other plants species also, like alpine pennycress, hemp, mustard plants, and pigweed, that have proven to be good and result-oriented hyper-accumulators for toxic contaminants at waste sites. Some of the aquatic macrophytes, free-floating, submerged, and rooted emergent plants, are also found to have very effective phytoremediation potential; for example, *Hydrilla verticillata*, *Lemna minor*, *Ceratophyllum*, *Typha latifolia*, *Pistia* sp., *Spirodela* sp., and *Eichornia crassipes* (Valipour and Ahn, 2017; Poonam et al., 2017; Srivastava et al., 2007; Yadav and Srivastava, 2020). Other hyper-accumulator plants, highly studied and reported by the scientific community, are *Sedum alfredii* sp., *Thlaspi* sp., *Arabidopsis* sp., and *Thlaspi* species were found to hyper-accumulate many metals (*T. caerulescens* for Pb, Ni, Cd, and Zn; *T. ochroleucum* and *T. goesingense* for Ni and Zn; and *T. rotundifolium* for Ni, Pb, and Zn) (Vara Prasad and de Oliveira Freitas, 2003). *Thlaspi caerulescens* is the most studied plant and has received much attention as a potential candidate for phytoremediation of soils rich in Cd and Zn. The desired condition for phytoremediation is that plants used should be native, tolerant, and adaptive to change. They should have high biomass production, easy propagation, high accumulation potential for the contaminant, and easily facilitate the breakdown of pollutants in the soil (Freitas et al., 2004). One major criterium for deciding on a plant as a hyper-accumulator is that it should accumulate the minimum threshold concentration in its tissues (for example, 0.1% for arsenic in dry weight of plants) (Wang et al., 2007). Here, it can be noted that every phytoremediation plant is specific to a particular metal(loids) in terms of response and tolerance. A single plant species cannot be used for all the contaminants, organic or inorganic. Thus, the selection of plant species for dominating contaminants present in the source is a crucial step that decides the success of the process.

Plants that produce high-biomass and high-valued products are also economically feasible for phytoremediation (Jiang et al., 2015). Some of the commercial flowering plants like marigolds and sunflowers can be proposed as ameliorating plants for contaminated soil, such as arsenic-contaminated soils. It will help in the management of contaminated soil and provide financial support to the local farmers as well (Poonam and Srivastava, 2019). The phytoremediation technique is an easy and applicable method, ex-situ and in-situ both, depending upon the contaminated media. Static water is required for the application of phytoremediation techniques (phyto-filtration), whereas any type of soil can be remediated using suitable plant species. Further, for the contaminated groundwater in some specific areas, rooted plants or trees with the capability to tap groundwater can be used to remediate the

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# Engineered Nanoparticles in Smart Agricultural Revolution: An Enticing Domain to Move Carefully

Pratap Srivastava, Rishikesh Singh, Rahul Bhadouria, Dan Bahadur Pal, Pardeep Singh, and Sachchidanand Tripathi

## Abstract

Nanotechnology may potentially benefit our agro-ecosystems in multiple ways, primarily via reduction in agricultural inputs without yield penalty and enhanced absorption of nutrients by the plants. In this regard, nano-fertilizers (such as engineered metal oxide or carbon-based nano-materials, nano-coated fertilizers, and nano-sized nutrients), and nano-pesticides (inorganic nano-materials or nano-formulations of active ingredients), might bring targeted as well as controlled release of agrochemicals in order to tap the fullest biological efficacy in already stressed agro-ecosystems, without over-dosages and leach-outs. Therefore, such nano-tools may multiply the agricultural yield, providing protection against various pests and diseases, without polluting our soil and water ecosystems at the same time. Though nanotechnology may provide potential solutions on such critical and persistent issues in agricultural management and activities; however, new environmental and human health hazards from their applications itself may pose

unforeseen challenges to the humankind. For example, the biosafety, adversity, unknown fate, and acquired biological reactivity/toxicity of these nano-materials once dispersed in environment after application are still an unknown and threatening area, which needs to be investigated carefully and scientifically, before its open field use in our agro-ecosystems. Among other potential benefits, nano-tools may also be utilized for the rapid disease diagnostic in field crops and monitoring of the packaged food quality and contaminations. Similarly, the quality and health of soils and plants can be regularly monitored in real-time manner with the help of sensors based on highly sensitive nano-materials. However, a responsible regulatory consensus on nanotechnology application in agriculture needs to be developed, based upon profound scientific foundations. This chapter explores the area of nanotechnology in revolutionizing agriculture in a smart way via its known interactions with plants and soil microorganisms so far in the literature.

## Keywords

Agrochemicals • Carbon nanotubes • Nano-fertilizers • Nano-pesticides • Nanopolymer • Quantum dots • Sustainable agriculture

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## 1 Introduction

Agriculture is fundamental to human civilization, which, therefore, also primarily associates with the sustainability of our system and human health (Srivastava et al. 2016; Mishra et al. 2018). The primary objective of nano-materials, for which they are being explored in agriculture domain, is economy and efficiency (i.e., to reduce agrochemicals, minimize nutrient leach-out with an increase in yield it provides, in a cost- and time-effective manner) (Marchiol et al. 2020; Pirzadah et al. 2020). Agriculture produces and

provides raw materials as human food as well as feed for various industries (Srivastava et al. 2016). The constantly growing human population with limited land, water, and soil availability prompts the agricultural development to keep pace with it and become increasingly more viable economically as well as efficient with time, but safe environmentally for sure. This alteration in agriculture would also be vital for bringing people back in the agricultural business, to opt them out of poverty and hunger (for socio-economic improvement), which is prevalent in most parts of the developing world (Mukhopadhyay 2014). In this regard, new and innovative technology providing better agricultural production in cost- and time-effective manner is need of the hour, and nanotechnology holds a great promise to fill up that space and produce qualitatively and quantitatively better food with lower cost, energy, and waste production in a smart manner (Hossain et al. 2020; Marchiol et al. 2020).

In recent years, a diverse spectrum of potential applications of nanotechnology has been observed in the agriculture, prompting intensive researches across the globe (Chen and Yada 2011; Dasgupta et al. 2015; Parisi et al. 2015). Initially, the term nanotechnology was first coined by Professor Norio Taniguchi in 1974 (Bulovic et al. 2004), for a domain wherein unique changes in physicochemical properties of materials happen in their nano-size, in sharp contrast to their bulk counterpart (Burman and Kumar 2018). However, it was Eric Drexler who formally introduced the term nanotechnology in his book “Engines of Creation” to the world. Nanotechnology holds a great promise in providing efficiency and economy to the system, particularly in agro-ecosystems. This area of nano-size world (termed as nano-science), with magical properties, evolved gradually, but greatly in last decade, as can be observed by the growing scientific publications and higher captured market size in short time, which also enabled us today to develop cutting-edge applications in most of the important sectors/domains of human life, along with improved instrumental ability to synthesize and isolate engineered nano-materials (ENMs), precisely (Gibney 2015).

Though, nanotechnology in material sciences and electronics has relatively higher dynamics, its potential use in agriculture and food supply chain segment has evolved quite recently. Many engineered nanoparticles (ENPs) have also been synthesized in recent years for a large number of nano-materials based products. Particularly in agriculture, nano-materials are being specially tailored as nanopesticide, nanofertilizer, and nano-biosensor for improving agriculture. However, in-depth scientific studies are being done to understand the impact of ENPs on plant growth, metabolism and physiological processes, and agro-ecosystems productivity/management in order to develop smart nanotechnology applications for revolutionizing agriculture to a next level in a smart manner.

Products that are synthesized via nanotechnology using specialized techniques are known as nano-materials (NMs). It is estimated that over 800 nano-material products are currently available in the market, worldwide. Generally, NMs refer to colloidal particulates with size range lying between 1 and 100 nm, in at least one of their dimension. These NMs reveals size-dependent characteristics, including large surface area/volume ratio and unique optical properties specifically, which lies somewhere intermediate to individual molecule and bulk material. The main categories of NMs include metal oxides, zero-valent metals, quantum dots, carbonaceous, semiconductor, lipids, nanopolymer and dendrimers featuring distinct and diverse characteristics. Additionally, fullerenes and carbon nanotubes are defined as most widely used organic NMs. The change in property of NMs, in sharp contrast to their bulk counterparts and distinct magnetic property in nano-size, owes to the alteration in atoms and larger surface area (due to smaller size of NMs), resulting in high reactivity (Burman and Kumar 2018). The altered property of NMs is specifically related with the change in electronic energy level, specifically due to the alteration in surface area/volume ratio (Prasad et al. 2016). Chemically synthesized nano-materials, being toxic and mostly costly in nature, are now being synthesized alternatively from plant as well in a domain called green nanotechnology. The later is a safe process and is cost- and energy-efficient, but with reduced waste (also because it is mostly produced from waste) and greenhouse gaseous production (Prasad 2014). The recent shift toward the green nanotechnology is at a faster pace, as it is environmentally sustainable. In spite of this green transition, various issues with NMs use in the agricultural field remain open ended, which hopefully would resolve with scientific advancement in the concerned field (Kandasamy and Prema 2015). Quite recently, the biocompatibility, cost-effective synthesis, and enhanced sensitivity to external stimuli have accentuated interest of scientific communities in polymeric NMs, as compared to chemically synthesized counterparts (Baskar et al. 2018).

In modern agriculture, it is quite difficult task to produce crops without pesticides, fertilizers, despite knowing the potential hazardous implications these chemicals unleash upon organisms, not intentioned to affect (including plants, mesofauna, macrofauna, and soil microbiota), human health and environment (Kah 2015; Abbas et al. 2019; Pérez-Hernández et al. 2020). Researches reveal that the primary mechanism through which ENPs cause toxicity is reactive oxygen species (ROS)-mediated oxidative stress, either via physical direct damage or release of toxic ions after nanoparticle dissolution process (Abbas et al. 2019). However, the impact of ENPs on soil microorganisms and plants differs considerably depending upon NMs and soil used. Moreover, the species of microorganism and plant used in