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Chapter 8
Biological Control of Root-Knot and Cyst Nematodes Using Nematophagous Fungi

Geeta Saxena

8.1 Introduction

Plant-parasitic nematodes are important pests of crops which have a direct economic impact in reducing crop yield. They are non-segmented tiny eelworms usually measuring about 100–1000 μm in length. The plant-feeding nematodes are sustained by photosynthetic activity of plants and food supply from roots in the form of exudates and exfoliates. Along with other microorganisms, plant-parasitic nematodes are abundant in rhizosphere soil, as they are source of high-quality nutrients. Estimated annual crop loss caused by nematodes worldwide each year is over $100 billion (Chitwood 2003). On a worldwide basis, the ten most damaging genera of plant-parasitic nematodes are *Heterodera*, *Globodera*, *Meloidogyne*, *Tylenchulus*, *Pratylenchus*, *Ditylenchus*, *Rotylenchus*, *Helicotylenchus*, *Xiphinema* and *Radopholus* (Sasser and Freckman 1987). In general root symptoms vary widely but can include cysts, galls, lesions, stunting and decay. Aboveground symptoms include wilting, yellowing and loss of foliage. Majority of plant parasitic forms enter the root completely, feed, mature, and lay eggs within the root or attached to it.

Biological check mechanisms operate in the soil to control high population densities of plant-parasitic nematodes. Nematophagous fungi also known as nematode-destroying fungi or predaceous fungi are most fascinating soil organisms because of their spectacular predaceous ability to capture nematodes thus suppress the population of plant-parasitic nematodes. They are present throughout the world in all types of climate. Their habitats include soil, cultivated lands, decaying plant materials, decaying woods, dung, garden compost, leaf litter, moss cushions (Mittal et al. 1988, 1989; Saxena and Mukerji 1991; Saxena and Lysek 1993; Saxena 2008), and permanent pasture (Bailey and Gray 1989). They have also been reported to come from freshwater and marine habitats (Hao et al. 2005), brackish

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1

DNA barcoding: species identification *sans* physical presence

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Before we dwell on the technique that can be used to identify a species even if the organism (plant or animal) is not physically present, it is necessary to understand what is a species? In the taxonomic hierarchy, a species is the smallest taxonomic group (https://scientia and veritas.wordpress.com). A species is perceived differently by various individuals and consequently so many definitions are given to explain this grouping of individuals. According to biological species concept, a species is defined as a group of individuals whose members have the potential to interbreed in nature and produce viable, fertile offspring, but do not produce viable, fertile offspring with members of other such groups (Queiroz, 2005). Although appearance is helpful in identifying species, it does not define species. The phylogenetic species concept defined the population as the smallest group of individuals with a common ancestor, forming a single branch on the tree of life (Caracraft, 1987). In practice, individual(s) is/are identified as belonging to a species on the basis of a set of characters shared by all the individuals of a species and not with individuals of other species. However, it becomes difficult or sometimes impossible to ascertain the biological identity, if only a part, fragment, or a sample degraded upto the molecular level is available. In such a situation, DNA barcoding can be used because it makes possible to identify the sample even if only small amount of tissue or DNA of the organism is available.

DNA BARCODING

The DNA barcoding is a technology for species level identification and detection. It relies on DNA sequence variations in selected and small regions of nuclear and/or cytoplasmic genome(s) to provide unique molecular recognition tags to species. Thus, DNA barcodes are short sequences of DNA from standardized and globally agreed upon locus/loci of either nuclear or cytoplasmic genome or both. These can be from coding or non-coding regions. The concept of DNA barcoding was proposed by Paul Hebert of the University of

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Routing Protocol Analysis for Internet of Things

Umang and Akanksha Gupta

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16.1 Introduction

The number of Internet users and devices in the world is increasing day by day. It has been estimated that there will be 50 billion connected devices in the world by the year 2020. The Internet of Things (IoT) explores the concept of interconnection and communication between these devices in an intelligent manner.

Stating simply, IoT is basically connecting any kind of device—cell phones, televisions, coffee machines, cars, or any other physical world object—with the Internet, and/or to each other. IoT can be called a large network of connected "things," wherein the network can consist of connections between people and people, people and things or things and things (Figure 16.1).

Conceptualization of this approach with appropriate implementation in the real world is also an important aspect. The devices and objects to be interconnected are provided with built-in sensors (connected to an IoT platform) that integrate the data collected from these devices, analyzed, and then share the useful information extracted (ignoring any unrequired information in the process) with various applications that address specific needs. This information can be used to identify patterns, make recommendations, and detect potential problems before they occur.

Today, there are various real-life applications like smart alarm clocks, smart vehicular systems, smart homes, smart cities, and consequently, a smart world. A few applications along with appropriate processes are mentioned below:

> Case Example 1: A smart alarm clock integrates with IoT, and collects data about the metro schedule, the weather outside, traffic conditions, and so on. It analyzes this data

to recommend the right time and mode of transport to take in order to reach the office in time and wake you up accordingly. It could also be connected to the toaster and the water heater in order to get everything ready even before you wake up.

Processes used in the smart clock in real-life scenarios are as follows:

1. Scan all sensors present in connected devices
2. Data collection from connected devices
3. Set time (select HH:MM:SS format)
4. Get time
5. Set alarm
6. Off alarm
7. Initiate service
8. Select service
9. Get service
10. Off service

Case Example 2: There are various online vehicular systems such as the UberGoogle system. This system provides automatic dispatch service to the customer that will match a trip request with respect to the requested source and destination generated by the customer. This service will take a request and match a trip request to the best available automatic transport unit. If any driver is not willing to process and execute the request, then the request may be cancelled by the driver and will be automatically allocated to the next driver. Research by Google is successfully trying to implement driverless cars, however, research is still ongoing.

Case Example 3: The Health Care System in the "Missing Towel Problem" (Towel Tracking Module):

Scenario Explanation: As a patient enters the hospital, either the patient will take treatment from the outpatient department (OPD) or the patient will go to the emergency room. Accordingly, the patient may be moved to a general ward, an intensive care unit, or operating theatre based on the health status. Initially, a radio frequency identification (RFID) tag will be assigned to each new patient: "RFID ID ISSUED." There is need to monitor the status of patient health, which can be compared as well as evaluated in order to get health improvement based on an hourly, daily, and weekly basis. Thereafter, Generate Alarm Status will be set to OK. A Yellow Alarm

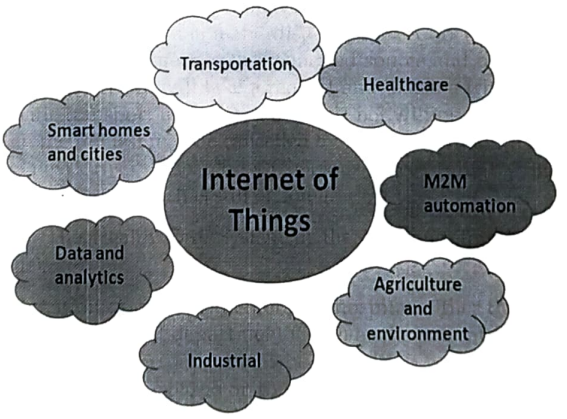

FIGURE 16.1
IoT applications in different areas.

will be generated at the instrument table (Count Towel: Status_1). And a Orange Alarm will be generated as the operation starts and it will calculate Towel Status_2 with Towel Status_1. It will generate a Yellow Alarm during the operation time at intervals of every five seconds and compare Status_3 with Status_2 and Status_1. In case of any mismatch or inconsistency, a Red Alarm will be generated. A Green Alarm will be generated at the end of the operation if all counting status are ok, otherwise it will be a Red Alarm. Then Immediate Take Action On. Check towel status before stitching of the patient, if any inconsistencies are found, then put it in Alarm Container and the doctor and the team should receive a penalty. If a number of such happenings from the team increases, then their certification of practice should be cancelled by the health organization. After successful completion of the operation, at the time of discharge, the RFID Tag will be returned "RFID TAG RETURNED" by the patient.

Step-by-Step Process:

1. Source of stimulus: Towel as a component that has been integrated by the RFID sensor tag (which is composed of a digital device called tag including an antenna and an IC-chip with a unique identification code, and a radio scanner device) will extract physical information along with connectivity and send to the server) allotted to the patient.
2. Stimulus: A component towel will send the signal and share its status as it is used, in use, or not used.
3. Environment: Normal operation.
4. Artifact: Database (cloud server).
5. Response: Track the towels issued to patient and in case of missing status "GENERATE ALARM."
6. Response measure: The system must be available and give a response at every 30 second interval. To maintain consistency in towel status, check the number of towels at the instrument table in the operating theatre and check the number of towels before operation "START" at regular 2-minute periods. Check the number of towels "In Operation Progress" every 1 minute and calculate status every 30 seconds and calculate status in case of comparative evaluation based on monotonically decreasing time analysis of the number of towels. RFID data will send the information from the cloud server and connectivity needs to be maintained with the operating theater. The updated information received from sensors must be checked with the alarm status periodically in intervals of 30 seconds so that data can be tracked.

The issue related to security and privacy of personal data in the above discussed system may degrade the performance of the system. In addition to this, automation of devices also makes it difficult to secure private information on the IoT platform. Data management also plays an important role in managing communications between devices, as an enormous amount of data is being constantly produced, which needs to be transmitted and/or analyzed from time to time in order to keep the applications working at the right pace. Storing this data efficiently so that it is readily available and easily accessible is also a concern. Delayed request response by the underlying server also raises potential concerns. Such IoT devices require a higher amount of power supply and hence they can be expensive and more difficult to realize. Portable devices require batteries, which might be needed to be replaced from time to time. Even though various mobile devices have now been optimized for lower power consumption, the cost of running enormous amounts of such devices, in terms of energy requirements, remains high.

16.2 Routing Protocols in IoT

Routing protocols such as Ad Hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR), and Optimized Link State Routing (OLSR) can be deployed with IoT, but before that, let us consider the IoT network stack and how it differs from the traditional network stack of the TCP/IP protocol suite and the Internet. Figure 16.2 illustrates the stated comparison. In the IoT smart devices stack, the IEEE 802.15.4 data link and physical layers have been optimized for energy efficiency and the ability to be deployed on cheap devices. In the network layer, the size of the maximum transmission unit (MTU) has been kept at a mere 127 bytes, conflicting with the minimal MTU of 1280 bytes of the IPv6. This limitation has led to the demand for an adaptation layer: 6LoWPAN—"IPv6 over Low Power Wireless Personal Area Networks" operating in the 2.4 GHz frequency range with 250 kbps transfer rate. Here, IPv6 headers are compressed and the packets exceeding the new 127-byte MTU are fragmented.

The fragments thus produced can be reassembled by all border routers that connect a 6LoWPAN network to the Internet (Figure 16.3).

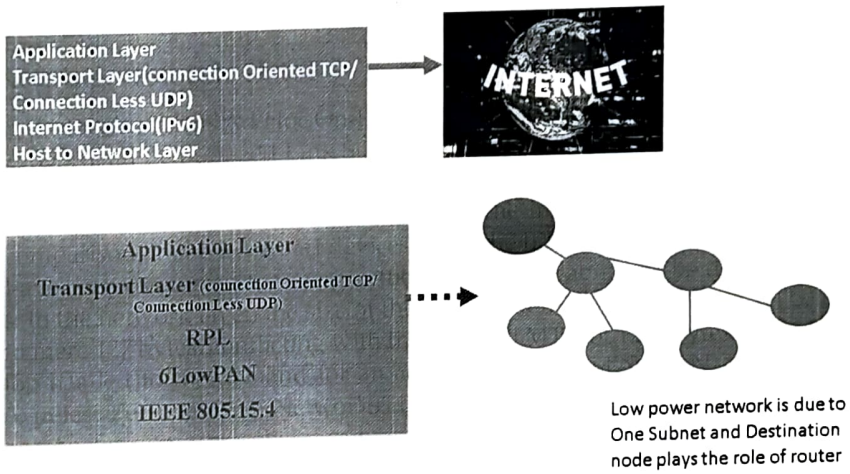

FIGURE 16.2
IPv6 on low power and lossy networks.

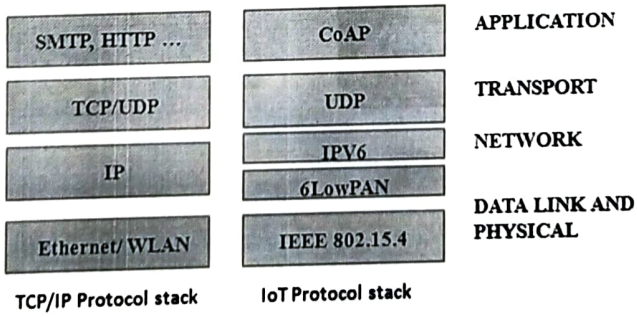

FIGURE 16.3
Comparison between traditional and IoT protocol stacks.

Figure 16.2 presents a comparison between the TCP/IP protocol stack and the IoT protocol stack. Further, there is need to consider and understand the concept of a few protocols that are deployed with IoT in today's scenario.

16.2.1 RPL

RPL stands for the routing protocol for low power and lossy networks. It is a distance-vector routing protocol developed by the IETF "Routing Over Low power and Lossy (ROLL) networks" working group. It works on the principle that the network has a *sink node* having more computing power and resources than the other nodes of the network. The protocol operates by constructing a destination oriented acyclic graph (DODAG) with its root as the sink node. All traffic is routed toward this sink node from all other leaf nodes. A DODAG information object (DIO) message is emitted by each node in the DODAG, containing information about its identity and rank in the DODAG proactively making RPL a proactive protocol. RPL can provide support for potentially constrained and lossy link layers, and is usually used with devices with limited resources, like home, industries, and transportation applications. Its ability to build network routes in a quick manner and an effective adaptation of the network topology makes it an ideal choice for 6LowPAN devices.

16.2.2 CORPL

Cognitive Routing Protocol for Low-Power and Lossy Networks (CORPL) is a protocol used for cognitive networks. The cognitive RPL is an extension of the RPL designed for cognitive networks and uses the RPL DODAG topology generation with two modifications. DODAG is built in the same way as RPL but here, instead of forwarding the packet to only one pre-decided node, each node maintains a forwarding set. This protocol forwards the concerned packet by using opportunistic forwarding, that is, it chooses multiple nodes from the forwarder set and then analyzes the network and routes toward the selected nodes for the best way to forward to the next hop. The node then updates its neighbor with the changes using DIO messages. Based on the updated information, each node then dynamically updates its neighbor priorities in order to construct the forwarder set [1].

16.2.3 CARP

Channel aware routing protocol (CARP) is used for underwater communication and so can be used in conjunction with IoT as it supports light weight packets. Link quality is calculated using historical information about the successful data transmissions gathered from neighboring sensors, which is then used to select the forwarding nodes. In CARP, the network is first initialized and then data is forwarded. For initialization, the sink node broadcasts a HELLO packet to all other nodes in the network. After the broadcast, the packet is routed from the sensor node to the sink node in a hop-by-hop fashion. The route toward each hop is determined independently.

This protocol does not support reusing historic data. Therefore, the CARP data forwarding technique is not beneficial to an application that requires sensor data only when it changes significantly. Energy-efficient common address redundancy protocol (E-CARP) is an enhancement to CARP and it allows the sink node to save historic information in terms of previously received sensor data. When new data is needed, a ping packet is sent to the sensor nodes by E-CARP, which is replied with the data from the sensor nodes. Thus, E-CARP is able to reduce the communication overhead drastically [2].

The three protocols, although based on similar grounds, have a few differences in the supported technologies. The RPL and CORPL protocols support different server technologies; there is no support by the CARP protocol. Also, storage management is performed by the RPL and CARP protocol only. Data management is supported by all three, whereas no security is provided by any of the three protocols.

16.2.3.1 Working of the RPL

This section undergoes the detailed analysis of the working of the RPL protocol for IoT. But before that, the working of a low power lossy network on which the RPL protocol works on needs to be understood.

According to RFC 7228:

> *A low power and lossy network is composed of many embedded devices with limited power, memory, and processing resources interconnected by a variety of links, such as IEEE 802.15.4 or low-power Wi-Fi. There is a wide scope of application areas for LLNs, including industrial monitoring, building automation (heating, ventilation, and air conditioning (HVAC), lighting, access control, fire), connected home, health care, environmental monitoring, urban sensor networks, energy management, assets tracking, and refrigeration.*

RPL is a distance routing protocol because it works upon calculating distances from each node in the network to the other nodes in the network. It is an intra-domain routing protocol, which time to time indicates changes in the topology of the neighbors of the network routers. Distance-vector protocols calculate the direction, that is, the next hop address and the exit interface, as well as the distance, which is the measure of the cost to reach a certain node. Between any two nodes, the route that comes out to have the least cost is said to have the minimum distance. Hence, each node in the network maintains a vector of minimum distance calculated to each and every other node of the network, and using this table, the cost of reaching any destination in the network can be found out using the various route metrics available.

RPL also supports source routing by allowing a packet sender to partially or fully specify the route of the packet in the network. It enables a network node to obtain all the possible routes towards a host.

RPL organizes a topology as a DODAG, which is a directed acyclic graph, having a single root node with no outgoing edges. All other nodes are directed toward the root node. The rank of a node defines the node's individual position relative to other nodes with respect to the DODAG root (Figure 16.4).

An objective function (OF) in the RPL (OF) defines how the RPL nodes select and optimize routes within an RPL instance. The OF also helps in translating one or more metrics into a rank for each node and also aids in selecting parents for each child node.

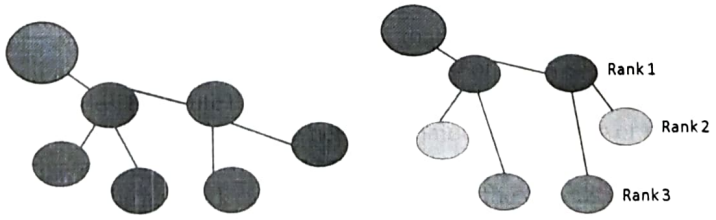

FIGURE 16.4
Rank of nodes in DODAG.

An RPL instance is a set of one or more DODAGs that share an RPLInstanceID. An RPLInstanceID is a unique identifier within a network. DODAGs with the same RPLInstanceID share the same OF used to compute the position of node in the DODAG (Figure 16.5).

The RPL has a self-monitoring capability using triple timer mechanisms. Hence, as soon as the network becomes stable, the frequency of control packets is reduced, further reducing the control overhead.

The traffic flows supported by RPL are:

- Multipoint to point (MP2P)
- Point to multipoint (P2MP)
- Point to point (P2P—non-storing) (Figure 16.6)

The network topology is constructed and thereby controlled by three types of control messages;

- DODAG information object (DIO)
- DODAG information solicitation (DIS)
- Destination advertisement object (DAO)

This set of messages belongs to a type of ICMP message control group. First, the leaf nodes construct the DIO message for upward routing construction toward the sink node. This scenario depicts a MP2P communication, which is dominant in most of the RPL applications. The sink node broadcasts the DIOs and the nodes that receive the DIO

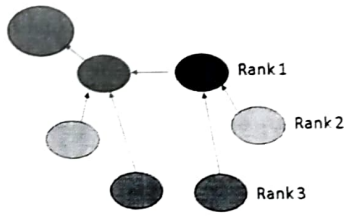

FIGURE 16.5
An RPL instance.

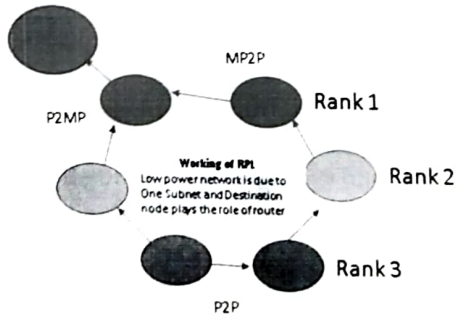

FIGURE 16.6
Traffic flows in RPL.

message directly from the sink node become its neighbors. These neighbor nodes then set the sink node as their parent, and then rebroadcast the DIOs to further nodes in the network. Repetition of this step by all the subsequent nodes will lead to the construction of the DODAG by handling these DIOs and building parent sets for each node. Next, the DIS message solicits the DIO message for immediate response to any kind of inconsistency in the network.

There are two ways in which the RPL works, that is, storing LLN and non-storing LLN. Storing is fully stateful, wherein each non-root and each non-leaf node has to maintain all its routing information and so traffic is directed as far as the common parent. In comparison to this, the non-storing LLN uses source routing, that is, it sends all traffic toward the root. Thereby, the root uses its available routing information to further divert the traffic toward other nodes. The DAO message can be used for P2P and P2MP route construction. If it is a storing LLN, the selected parent receives the DAO message from the selected node. Whereas, in case of a non-storing LLN, the DODAG root receives the DAO message from the node. A destination acknowledgement message (DAO-ACK) could be sent back to the node (if requested) that generated the DAO message by the destination node.

However, RPL has a few limitations as cited by [3], including diversification of OFs, high energy consumption, and proximity to attacks that could lead to failures in authentication, maintenance of routing information, and attacks on the integrity or availability of the network operations [4].

16.3 Analysis of the Greenhouse Environment System

Greenhouse environment systems are places used for plant growth and monitoring by constant surveillance of temperature, light, humidity, carbon dioxide level, and so on. It avoids crop damage due to changing weather and seasonal changes and hence creates a safe and sound environment for budding of crops and plants, which increases economic efficiency [5]. The factors affecting the crop growth need constant analysis and monitoring in order to increase plant quality, time taken for growth, and financial effectiveness. Such a system is complex to handle and requires optimized control, real-time monitoring, and information processing. It also poses convenience problems and is quite high maintenance. A number of developed countries have had high growth and progress in greenhouse management systems and control by adopting the developments in the field of IoT.

As greenhouse monitoring requires manual intervention for keeping track of the irrigation process, temperature, light, and humidity, IoT technology could be deployed for automating the majority of processes. The greenhouse environment monitoring system, based on wireless sensor networks (WSNs), deploys sensor nodes at the monitoring center that collect essential information and transmit the same for control purposes [6]. This data, when analyzed, helps in making the environment control decisions that are further transmitted to the controlling equipment inside the greenhouse. Regulating the environment based on the analyzed information makes up for the best growth environment for plants and crops (Figures 16.7 and 16.8).

As visible in Figure 16.7, the greenhouse is divided into multiple measurement and control areas, each managed respectively by a base station. Many sensor nodes are placed in each of the measurement areas (also called a virtual grid) and hence from a cluster of nodes, having a sink node serving as the root (selected through an algorithm)

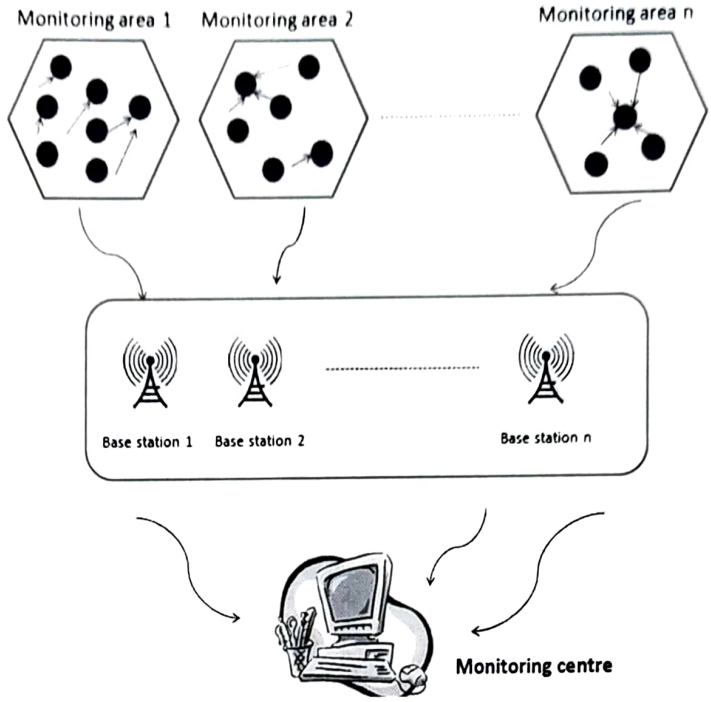

FIGURE 16.7
Block diagram of a greenhouse monitoring system.

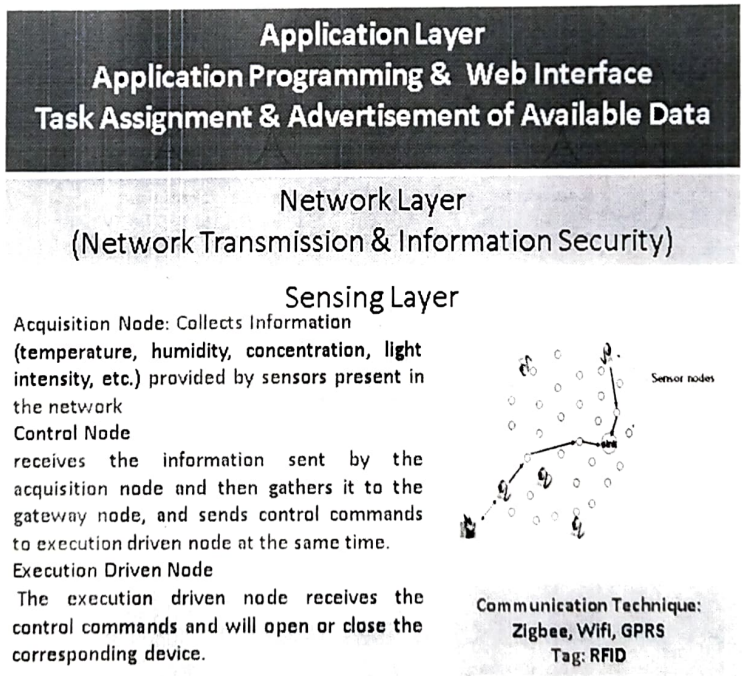

FIGURE 16.8
Layer design of main components of a greenhouse system.

and other sensor/control nodes as members of the grid. The sensor nodes of the grid collect relevant information for analysis and the control nodes are capable of altering the in-house environment based on the information provided by the base station. The information is relayed onto the base stations, which further transmits it to and from the monitoring center. The monitoring center is responsible for collecting all sensor data, analyzing the factors, and then transmitting the control parameters back to the virtual grids through the base stations. Figure 16.8 presents layer design of the main components of the system. For implementation of IoT over such an environment involving WSN, the RPL routing protocol can be deployed. RPL, being a proactive, distance routing protocol over low power and lossy networks, can provide a flexible and easily to deploy mechanism over various WSN applications, such as the one discussed above. To overcome the resource constraints in terms of sensor nodes and unreliable wireless links, in the case of single-path RPL protocol, Quynh [3] has proposed a multipath RPL protocol for the greenhouse environment monitoring system [7][8]. According to Quynh:

> RPL is designed based on a single route strategy. Especially in case of RPL, we develop RPL-based multipath protocols for overcome the disadvantages of single-path approach and the results show that our approaches achieve better energy efficiency, load balance, end-to-end delay and packet delivery rate compared to traditional solution of single-path RPL.

Hence, it can be observed that based on the real-life deployment and scale of the greenhouse network grids, IoT in conjunction with the multipath RPL protocol can be used for better performance in terms of the rate of delivery of the packets, time delay, and errors [9] as compared with the traditional single route strategy.

16.4 Conclusion

In this chapter, we have seen how IoT concepts can be utilized for automating various applications. We have seen the contrast between the traditional networking protocol stack and the IoT protocol stack. We have also studied the problems associated with deployment of IoT in different kinds of work areas. There are a number of routing protocols available with this stack and we have seen how the RPL protocol can be the best fit for the application of automating a greenhouse environment by adopting a multipath routing approach.

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ORGANIC SPECTROSCOPY

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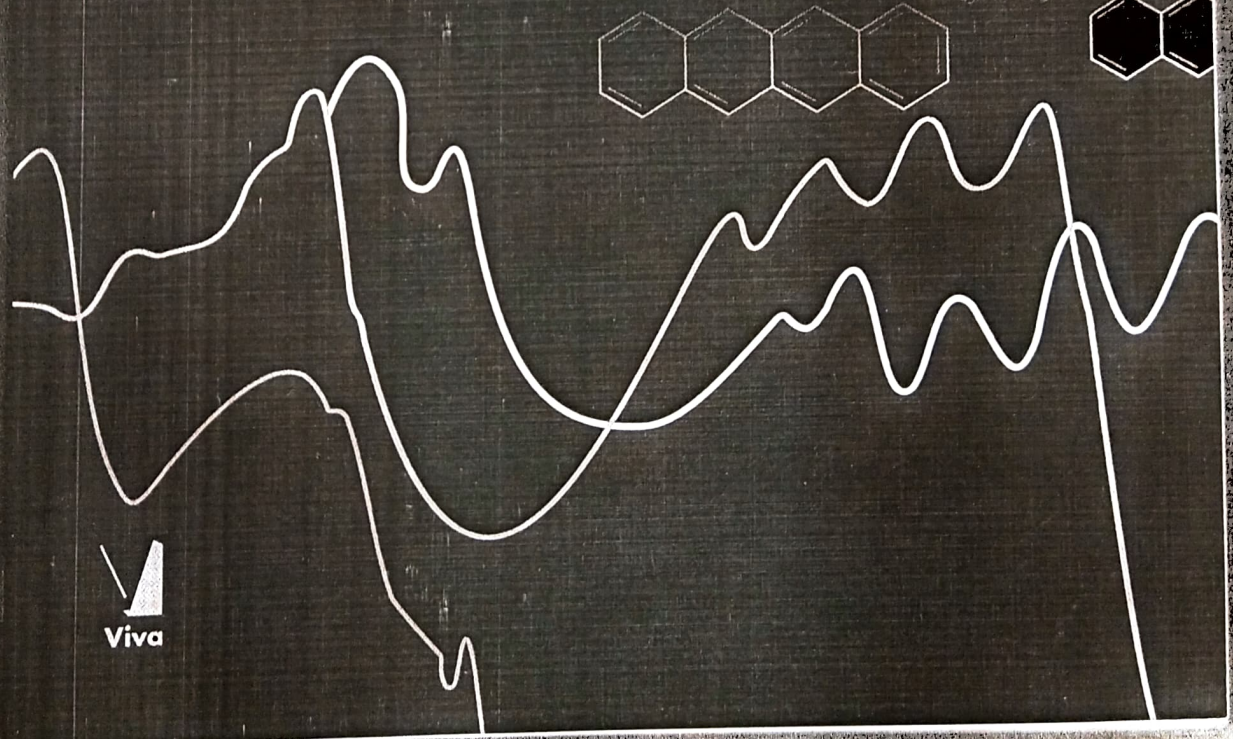

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Ruthenium Chemistry

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Chapter 4

Ruthenium Compounds: A New Approach in Nanochemistry

Pradeep Pratap Singh[a] and Ambika[b]

[a]*Department of Chemistry, Swami Shraddhanand College, University of Delhi, Delhi 110036, India*
[b]*Department of Chemistry, Hans Raj College, University of Delhi, Delhi 110007, India*

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Transition-metal nanoparticles have attracted attention in the last few decades due to their potential applications in biomedical, optical, electronic areas and catalysis. Ruthenium (Ru) compounds such as Ru oxide (RuO_2) and Ru oxide hydrate ($RuO_2 \cdot nH_2O$) have been investigated for applications such as electrocatalysts, materials for electrochemical supercapacitors, catalysts for hydrogen production, or CO oxidizing catalysts. Supported Ru nanoparticles (NPs) such as Ru oxide nanotubes, ruthenic acid nanosheets, and Ru oxide-based nanocomposites are highly efficient in various reactions, such as ammonia synthesis, Fischer–Tropsch synthesis, selective hydrogenation, and cellulose hydrolysis. Ru nanoparticle have also found medical applications and as a probe for upconversion luminescence sensing and bioimaging of intracellular metal ions. This chapter will focus on

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NANOTECHNOLOGY FOR SUSTAINABLE WATER RESOURCES

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3

Nanotechnology: An Emerging Field for Sustainable Water Resources

Pradeep Pratap Singh[1] and Ambika[2*]

[1]*Department of Chemistry, Swami Shraddhanand College, University of Delhi, Delhi, India*
[2]*Department of Chemistry, Hansraj College, University of Delhi, Delhi, India*

Abstract

Water is an essential component of life. Only 2.5% of the total percentage of water available on earth is fresh. As the world's population is increasing, water pollution is becoming more complex and difficult to remove. Due to change in climatic conditions globally, many regions of the world is facing multiple challenges in sustainable supply of water and its magnitude is rapidly increasing. Therefore, reuse of waste water is becoming a common necessity. However, due to the presence of water contaminants, such as heavy metals, organic pollutants, and many other complex compounds, treatment of contaminated waste water is essential for a healthy life. Nanotechnology offers opportunities to provide efficient, cost-effective, and environmentally sustainable solutions for supplying potable water for human use and clean water for agricultural and industrial uses. This chapter reviews the role of nanotechnology in sustainability of water resources.

Keywords: Organic pollutants, adsorption, nanotechnology, nanoadsorbant, nanocatalyst, nanomembrane

3.1 Introduction

In today's world due to industrial revolution and various anthropogenic activities, our environment is filled with various types of pollutants such as carbon monoxide (CO), chlorofluorocarbons (CFCs), heavy metals

**Corresponding author*: ambika@hrc.du.ac.in

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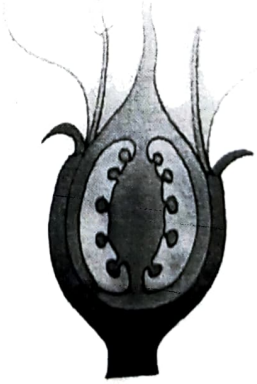

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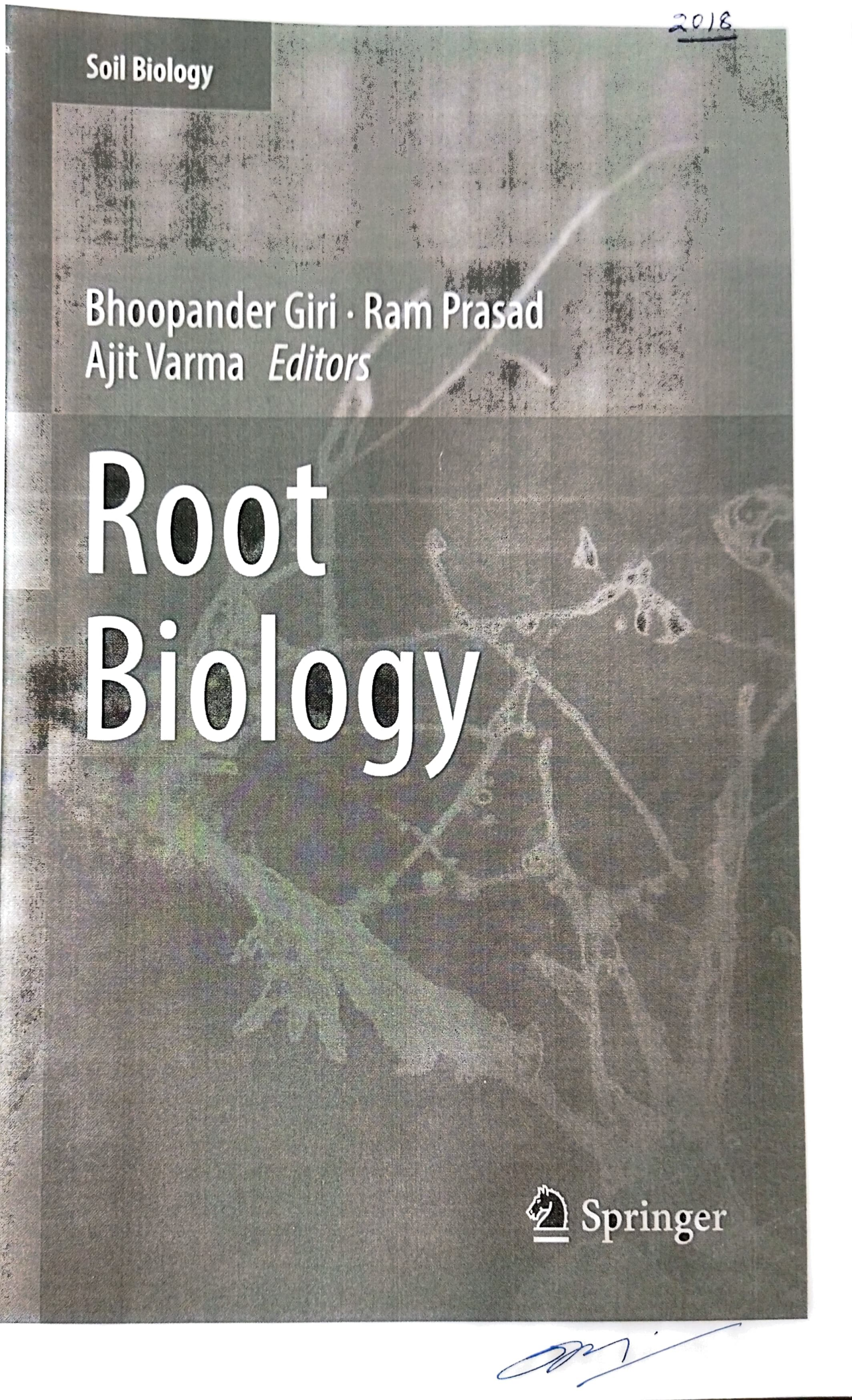

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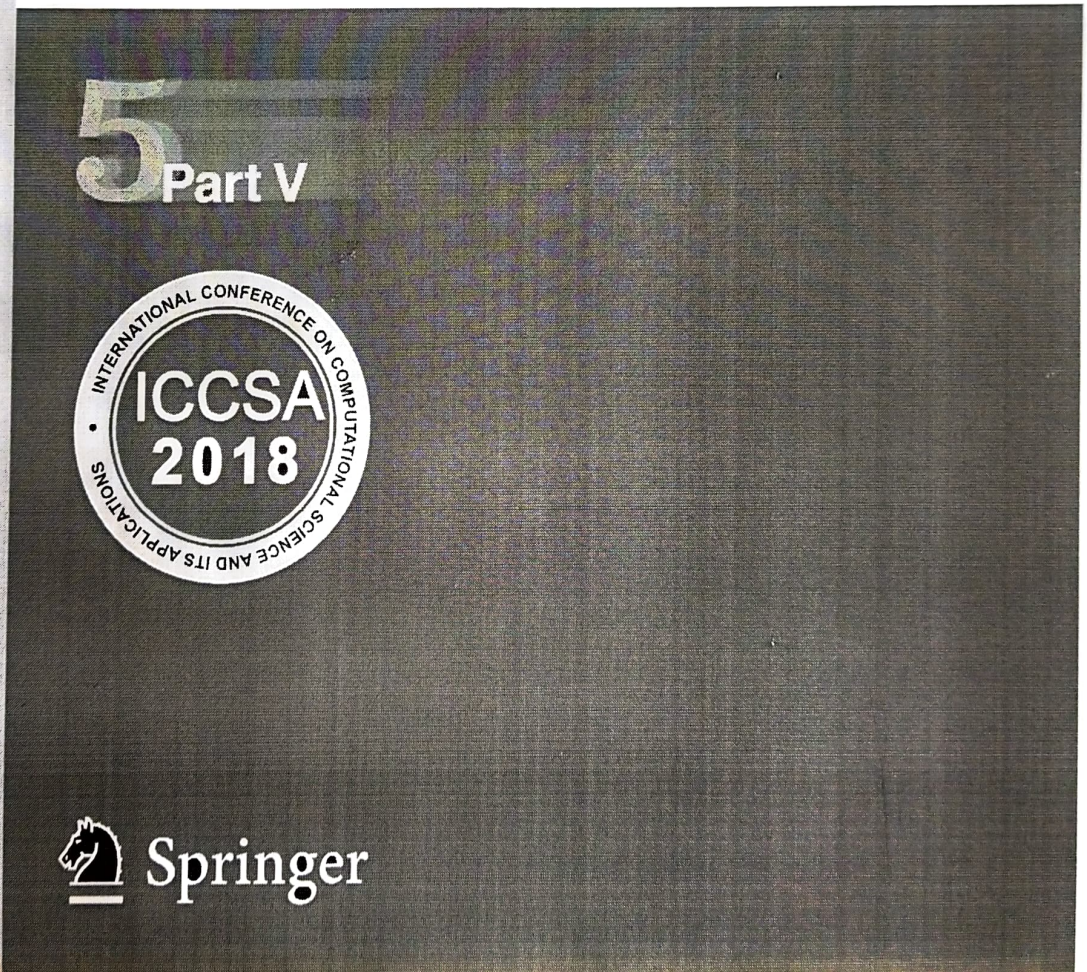

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Quantitative Quality Assessment of Open Source Software by Considering New Features and Feature Improvements

Kamlesh Kumar Raghuvanshi[1], Meera Sharma[2], Abhishek Tandon[3], and V. B. Singh[4(✉)]

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Abstract. Open Source Software (OSS) evolves through active participation of users in terms of requesting for features, i.e. new features (NFs) and improvements in existing features (IMPs). Fixing of these features results in generation of further features improvements. In this paper, we have proposed a mathematical model to embody the OSS development based on the rate at which IMPs are generated as a result of fixing of features (NFs and IMPs). We have validated the model for datasets of five products, namely Avro, Pig, Hive, jUDDI and Whirr of Apache open source project. Results show that the model exhibit significant goodness of fit in terms of MSE (Mean Square Error), Bias, Variation, RMSPE (Root Mean Square Prediction Error) and R^2 performance measures.

1 Introduction

In OSS development paradigm active users/developers are located at different geographical locations and these users are requesting for NFs and IMPs to be introduced in the software. The main constituent for OSS evolution is fixing of these features by the active users. These active users may be the same who have requested for features introduction or may be different who have an interest in the development of the software. Developers review and modify the source code to introduce new features and incorporate improvements in the existing features. Fixing of these features may generate further feature improvements.

In the line of OSS development paradigm proposed in [1], we have extended it by adding requests for features, namely NFs and IMPs. Figure 1 shows that fixing of different features (NFs and IMPs) may result in further IMPs. IMPs are necessary to be incorporated so that the performance and software quality can be improved. This results in various releases of the software. In this paper, we have proposed a mathematical model by considering the rate of generation of feature improvements from fixing of

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different features (NFs and IMPs). The model has been validated on five products of the Apache project. Results show significant goodness of fit for different performance measures.

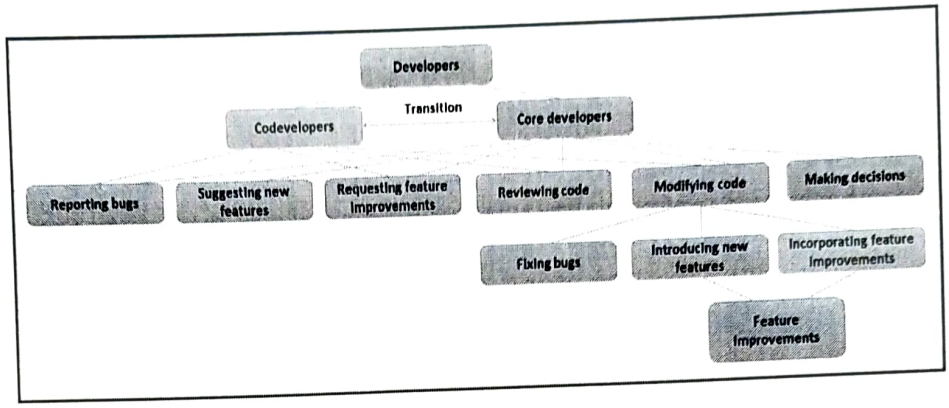

Fig. 1. Fixing of different features results in feature improvements

The rest of the paper is organized as follows: Sect. 2 of the paper describes the data collection and model building. Results have been presented in Sect. 3. Section 4 presents the related work. Threats to validity have been discussed in Sect. 5 and finally the paper is concluded in Sect. 6.

2 Data Collection and Model Building

A. Data Collection

The proposed mathematical model has been validated on issue datasets of five Apache products [2]. In the issue tracking system, different symbols have been used for different types of issues (bugs, NFs and IMPs) as shown in Fig. 2.

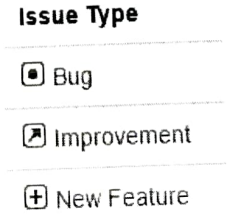

Fig. 2. Apache products have different symbols for different issues

Those features (NFs and IMPs) that are not duplicate and are reproducible for others have been selected. We collected, fixed features on the monthly basis. The time period of data collection is: Avro (July 2009–July 2014), Hive (April 2009–April 2014), Pig (April 2009–October 2013), Whirr (September 2010–April 2013) and jUDDI (February 2009–February 2014).

The features of five products have been collected from [2]. Figure 3 shows sample of different feature reports for Avro project.

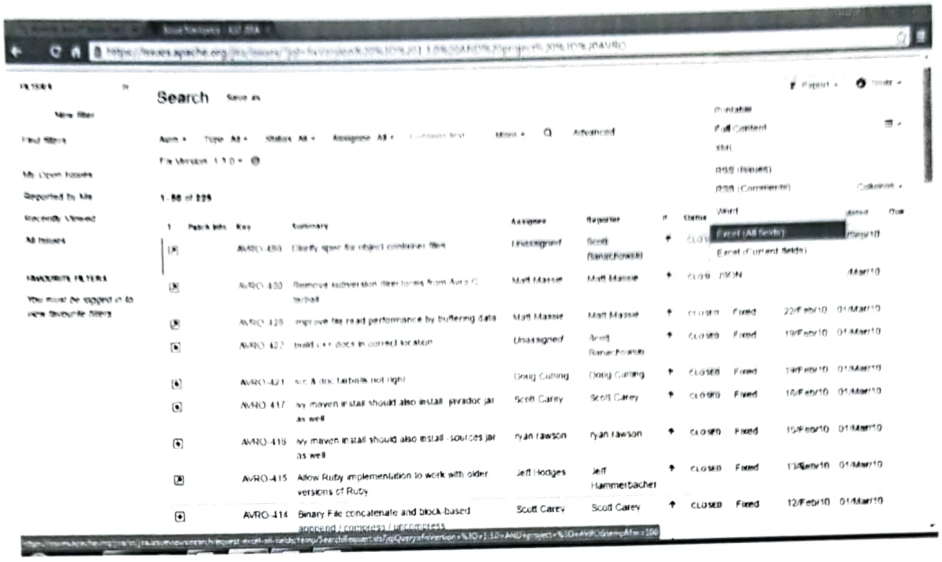

Fig. 3. Sample feature reports for Avro project

Table 1 show the monthly number of features for five Apache products which have been used to validate the proposed model.

Table 1. Monthly number of features in Apache products.

Time (months)	Avro IMPs + NFs	Pig IMPs + NFs	Hive IMPs + NFs	Whirr IMPs + NFs	jUDDI IMPs + NFs
1	8	4	15	9	3
2	4	8	11	5	0
3	15	6	14	9	0
4	16	4	32	5	2
5	30	3	23	20	0
6	13	13	16	6	3
7	53	22	11	8	1
8	26	16	13	15	0
9	20	14	13	11	0
10	8	6	23	8	1
11	5	7	25	3	1
12	8	14	15	12	0
13	8	18	12	2	0
14	20	14	8	13	0
15	9	13	19	1	0

(*continued*)

Table 1. (*continued*)

Time (months)	Avro	Pig	Hive	Whirr	jUDDI
	IMPs + NFs	IMPs + NFs	IMPs + NFs	IMPs + NFs	IMPs + NFs
16	4	25	11	1	0
17	2	25	20	7	1
18	5	11	12	11	1
19	10	1	15	7	0
20	17	2	24	0	0
21	9	8	18	2	2
22	10	10	15	0	0
23	2	8	19	2	0
24	4	17	12	10	1
25	8	17	12	4	0
26	5	8	9	3	4
27	15	4	13	2	1
28	22	12	20	0	1
29	2	15	18	1	0
30	9	7	19	2	0
31	2	5	21	7	0
32	10	12	15	2	3
33	4	9	17	-	0
34	4	12	11	-	0
35	10	9	10	-	0
36	4	8	23	-	0
37	2	9	17	-	0
38	2	15	7	-	0
39	7	11	12	-	1
40	0	4	9	-	0
41	9	5	10	-	0
42	2	13	16	-	0
43	4	9	13	-	0
44	8	10	13	-	0
45	4	5	17	-	0
46	7	7	18	-	1
47	4	6	16	-	0
48	4	14	17	-	0
49	3	6	27	-	0
50	0	7	2	-	4
51	0	4	12	-	6
52	5	6	20	-	7
53	9	4	23	-	4
54	7	9	32	-	6
55	3	5	25	-	6

(*continued*)

Table 1. (*continued*)

Time (months)	Avro	Pig	Hive	Whirr	jUDDI
	IMPs + NFs	IMPs + NFs	IMPs + NFs	IMPs + NFs	IMPs + NFs
56	2	-	29	-	1
57	1	-	24	-	6
58	1	-	23	-	8
59	2	-	19	-	3
60	3	-	19	-	14
61	-	-	6	-	1
62	-	-	1	-	-

Figures 4, 5, 6, 7 and 8 show the monthly distribution of features for different Apache products.

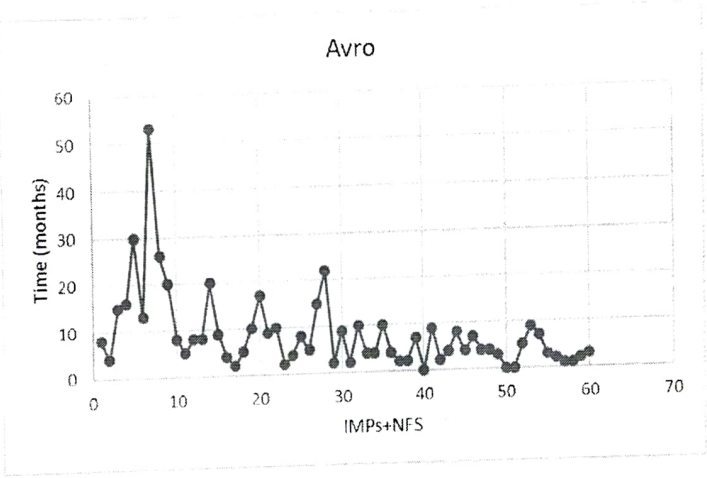

Fig. 4. Monthly feature distribution for Avro

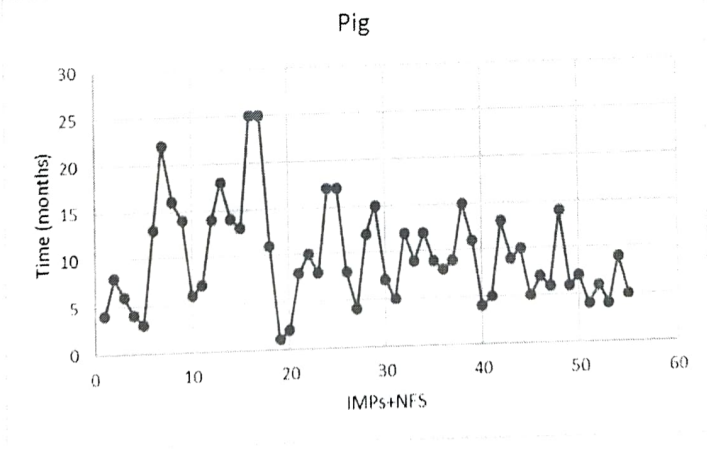

Fig. 5. Monthly feature distribution for Pig

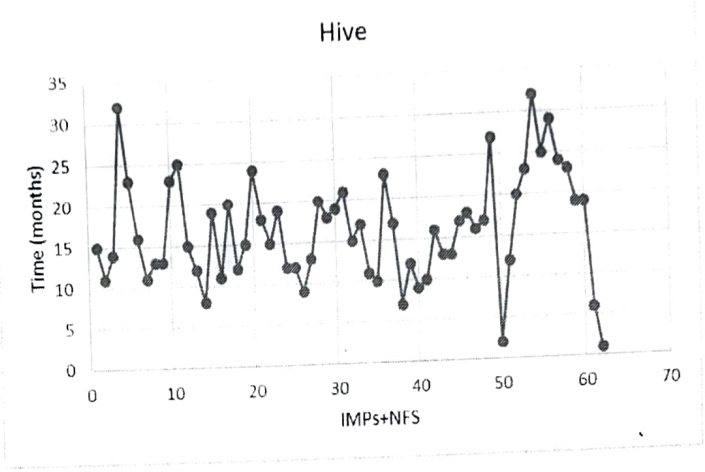

Fig. 6. Monthly feature distribution for Hive

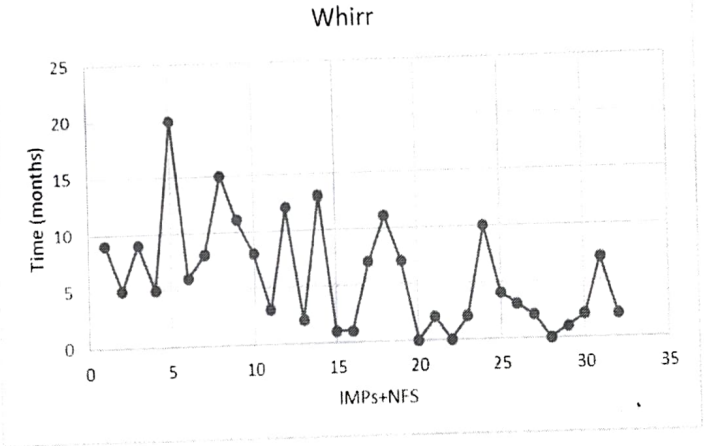

Fig. 7. Monthly feature distribution for Whirr

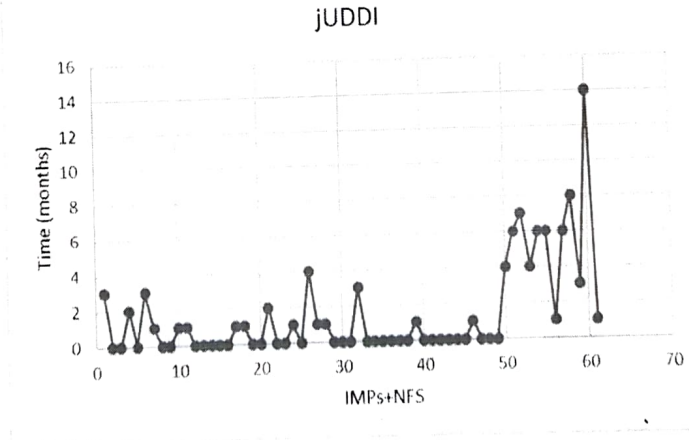

Fig. 8. Monthly feature distribution for jUDDI

B. Model building

In OSS, different features (NFs and IMPs) are requested by active users to be added into the software. Fixing of these features may result in further feature improvements. By considering this fact and following the differential equation given in [3, 14], we can write the following differential equation:

$$\frac{dm(t)}{dt} \propto (a(t) - m(t))$$

$$\frac{dm(t)}{dt} = b(a(t) - m(t)) \tag{1}$$

Here, $m(t)$ is the number of features (NFs + IMPs) introduced in a software at time t. 'a' is the number of features that can be introduced in a software over a long run. 'b' is the rate of introduction of features per remaining feature.

The value of 'a' cannot be constant as this quantity may change due to some improvements may take place for the features fixed. We have,

$$a(t) = a(1 + \alpha t) \tag{2}$$

'α' is the rate at which feature improvements are introduced in a software per feature introduction. '$a\alpha t$' is the number of feature improvements for existing features.

By using (2) in (1), we get (3) as following

$$\frac{dm(t)}{dt} = b(a(1 + \alpha t) - m(t)) \tag{3}$$

$$\text{At } t = 0,\ m(0) = 0$$

$$m(t) = a\left(\alpha t + (1 - \frac{\alpha}{b})(1 - \exp(-bt))\right) \tag{4}$$

The above model is used to predict the number of features that can be introduced in software over a long run and the rate of generation of feature improvements from the fixing of these features. We validated the proposed model discussed above for five Apache products.

We have estimated the parameters a, b and α of the model based on Nonlinear Regression (NLR) using Statistical Package for Social Sciences (SPSS) software.

3 Results

We have estimated the number of features (NFs + IMPs) need to be fixed in a software product over long run and estimated the rate of generation of feature improvements from these fixed features. Table 2 shows the parameter estimates for features of different products. 'O' shows the observed number of features fixed in the software product. 'a' is the number of features that need to be fixed over long run. 'α' is the rate at which feature improvements are introduced in a software per feature introduction.

Table 2. Estimated parameter values for Apache products

Product	O	*a*	*b*	α
Avro	490	432	0.049	0.005
Pig	536	564	0.022	0.013
Hive	1011	1088	0.015	0.015
Whirr	188	239	0.049	0
jUDDI	93	98	0.001	0.301

The rate of generation of feature improvements is 0.005, 0.013, 0.015 and 0.301 in Avro, Pig, Hive and jUDDI respectively. In case of Whirr rate of generation of feature improvements is 0. Table 3 shows the performance measures of the proposed model for different Apache products. R^2 lies in the range of 0.825 to 0.997 across different products. Results show high goodness of fit of the proposed model in terms of MSE, Bias, Variation and RMSPE.

Table 3. Performance measures for Apache products

Product	MSE	Bias	VAR	RMSPE	R^2
Avro	134.02	−1.09	11.62	11.67	0.993
Pig	167.46	−2.58	12.67	12.94	0.994
Hive	266.27	1.67	16.36	16.44	0.997
Whirr	75.69	1.43	8.65	8.77	0.991
jUDDI	25.42	−0.88	5.04	5.04	0.825

Figures 9, 10, 11, 12 and 13 show goodness of fit curve for different Apache products. We observed that the predicted values are close to the observed values for features.

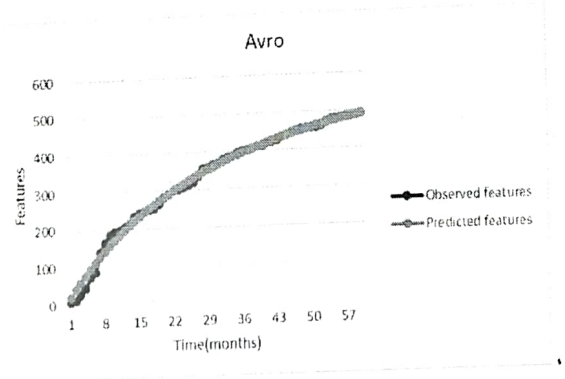

Fig. 9. Goodness of fit curves for Avro

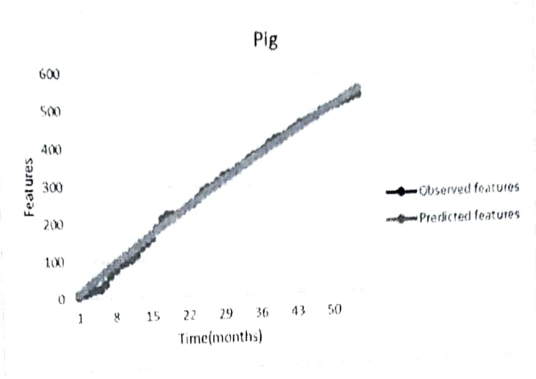

Fig. 10. Goodness of fit curves for Pig

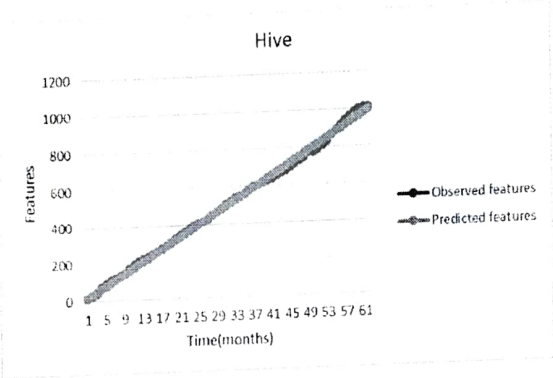

Fig. 11. Goodness of fit curves for Hive

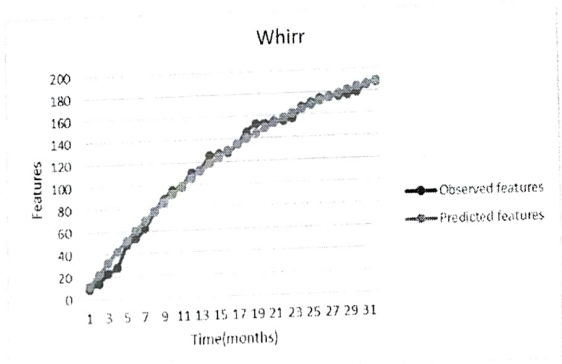

Fig. 12. Goodness of fit curves for Whirr

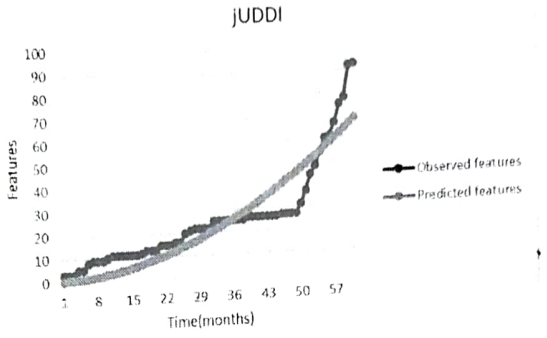

Fig. 13. Goodness of fit curves for jUDDI

4 Related Work

Mathematical models are proven to be useful in measuring the reliability growth of the software products. The development of OSS is different from the closed source software. The failure data of OSS has been modelled by applying different mathematical models to show their applicability [4]. A model has been developed for OSS using power function of testing time and change point. The model has provided a better goodness of fit [5]. In another study, bug reported data has been collected from the bug tracking system and an empirical investigation has been done. The authors found that open source reliability growth is in line with that of the closed source reliability growth [6]. The reliability assessment of OSS has been done and an effective reliability assessment method has been proposed by authors by considering the actual OSS development paradigm [7]. A modified software reliability growth model to reconsider the reliability of OSS systems has been proposed by using a power-law function of testing effort and the interdependency of multigeneration faults. The models have been validated on several real-world data [8]. In another study, defect data of twenty five releases of five OSS projects has been considered. These data sets have been modelled using eight software reliability growth models. It has been found that it is better to take the defect creation date instead of defects fixing date during quantitative quality assessment of open source software products [9]. In [10], the authors proposed reliability analysis of the projects as a three stage process, namely bug-gathering, bug-filtering and bug-analysis. It was found that Weibull distribution well fits in the reliability growth modeling of such products. A bug has different severity levels and a generalized reliability growth model has been proposed to measure the reliability growth of the OSS product [4]. A bug reported on the bug tracking system keeps an irregular state, this characteristic follows in OSS bug reporting. A model has been proposed by considering this characteristic using a stochastic differential equation [11]. Modeling of failure occurrence in OSS has been presented with reliability growth in [12]. Recently, an entropy based reliability growth model has been proposed for multi-version open source software products. A release time problem has also been proposed in [13]. It is evident from the review of the related literature that mathematical

models have been widely used to measure the reliability growth of the OSS products. But, none of the work presented or exist in the literature to the best of our knowledge which deals with the development paradigm of the OSS products. In this paper, we have proposed a mathematical model which considers the open source software development paradigm where features (NFs + IMPs) are requested/fixed by the users and improvements to these features are added later on.

5 Threats to Validity

The factors that affect the validity of our study are as follows:

Internal Validity: We proposed a model based on the rate of generation of improvements in features from the fixing of features (NFs + IMPs). But, we have not empirically validated the real number of feature improvements generated from the fixing of different features.

External Validity: We have studied feature datasets of five Apache products. Our results may not generalize to all software products. More software projects need to be studied.

6 Conclusion

In this paper, we have proposed a mathematical model for feature prediction based on OSS development paradigm that fixing of different features (NFs + IMPs) generates further feature improvements. We investigated the quantitative quality assessment of the OSS products by predicting the potential number of features that need to be fixed in the software over a long run. We have used rate of generation of these feature improvements. We have validated the model by using feature datasets of five Apache products (Pig, Hive, jUDDI, Avro and Whirr). Results show a high goodness of fit of the model across different products for different performance measures, i.e. MSE, Bias, Variation, RMSPE and R^2. The value of R^2 lies in the range of 0.825 to 0.997 across different products.

In the future, we will extend the proposed work by taking other rates of feature introduction like Erlang and logistic.

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Forest Dependence and Poverty in the Himalayas—Differences Between India and Nepal

Priya Shyamsundar, Saudamini Das and Mani Nepal

1 Introduction

There are over 1 billion people around the world who are dependent on forests for a variety of goods and services (World Bank 2016). For such forest-dependent people, forests act as both a constraint to movements out of poverty and a source of economic well-being. Thus, strategies to conserve forests and reduce rural poverty, often, revolve around a legitimate enquiry about how poor households, whose livelihoods depend on forests, can be supported alongside forests.

Poverty reduction in most rural areas is a result of improvements in agricultural productivity, income diversification, or migration (World Bank 2008, ILO 2014). The remote locations where forests are found make it difficult for households to access public infrastructure, services, and markets. This in turn constrains their ability to diversify income sources or build the required human or economic capital. In fact, it is possible that such households are in geographic poverty traps that keep them tied to subsistence activities and relatively unproductive lands (Jalan and Ravillion 2002; Kray and McKensie 2014; Barbier and Hochard 2016).

Forests are also a source of "environmental income" to many households. Families depend on timber and non-timber forest products to meet multiple

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Forest Dependence and Poverty in the Himalayas—Differences Between India and Nepal

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Abstract

In the remote Himalayan districts of Pithoragarh, India and Baitadi, Nepal, households are dependent on agriculture and forests for their livelihood. In this paper, we examine poverty–forest linkages by examining data from a survey of 652 households from these districts, who live on either side of the Mahakali River. Per capita income in Nepal is half of that in India. Yet, in the Himalayas, where households live in a similar geographic terrain, we find that households in Nepal are much better off in terms of assets and income relative to their Indian

IMPACT, ISSUES AND FUTURE PROSPECTS OF COMPONENT OF ENVIRONMENT AND ALLIED SCIENCES

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Environmental and ecosystem science focuses on the interactions of physical, chemical, and biological conditions of natural and human-modified environments, with the goal of solving growing environmental challenges.

1 Scientific Foundations

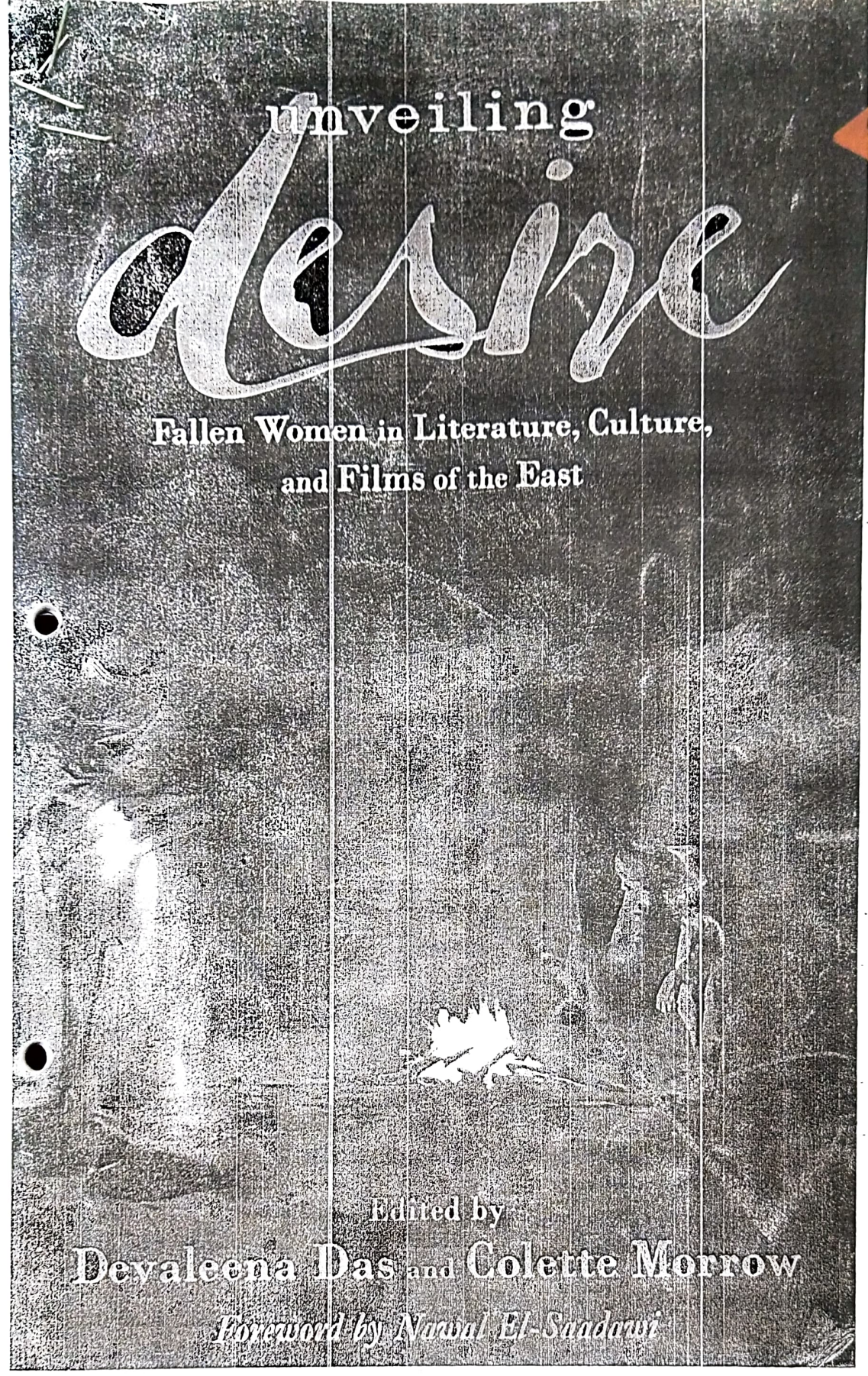
Competition in an ecological sense is the struggle between individuals for environmental resources. Resources include anything found in the environment that is necessary for growth and reproduction such as food, shelter, water, light, and substrate or territory. For individuals of the same species, resources can also include mates. Resources are different from environmental conditions because resources have the potential to become scarce. Environmental conditions include components of the environment that affect the growth and reproduction of organisms but are shared identically among all members of an ecosystem. Such conditions include temperature, salinity, and pH.

Smita

Chapter in edited book

unveiling desire

Fallen Women in Literature, Culture, and Films of the East



Edited by

Devaleena Das and Colette Morrow

Foreword by Nawal El-Saadawi

UNVEILING DESIRE

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Fallen Women in Literature, Culture, and Films of the East

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CONTENTS

FOREWORD

Unveiling Desire: Fallen Women in Literature, Culture, and Films of the East offers new perspectives of different characters of women and various female professions imposed on them by the patriarchal, classist, religious, racist system. This system is universal, not Eastern or Western, not Islamic or Christian or other. It is inherited from the old slave period in history and survives until today, the neopostmodern slave capitalist patriarchal system. Women and slaves were and are used by their masters: physically, spiritually, sexually, economically, socially, morally, and religiously.

Women and slaves never submitted to this multiple oppression and exploitation. The so-called sexual prostitution was and is a profession created by the system to satisfy the sexual needs of the hypersexual male. But only women are punished or condemned like their Mother Eve; the hypersexuality of men is accepted or even praised.

The book offers a new discourse to undo these injustices and double standards, to liberate the so-called hypersexually erotic, hysterical, rebellious woman from the prison of patriarchy, religion, and politics. To undo the major taboos inherited since slavery, to show the power of women in their struggle and resistance, this book offers a model for transnational feminist research that promotes equality, justice, freedom, and dignity for all and encourages women to resist old-slave-colonial and neocolonial sexual and cultural constructs.

It is an illuminating book, and I hope many women and men read it in the East and in the West as well.

Nawal El-Saadawi
Cairo, Egypt
July 26, 2015

15 ⟡ HOMOEROTICISM AND REACCESSING THE IDEA OF "FALLEN WOMAN" IN KEVAL SOOD'S *MURGIKHANA*

KUHU SHARMA CHANANA

This last chapter, "Homoeroticism and Reaccessing the Idea of 'Fallen Woman' in Keval Sood's *Murgikhana*," asserts that the so-called straight fallen woman does not threaten heterosexual male dominion as radically as the lesbian does, an argument that implicitly invokes Judith Butler's theory that dichotomizing and then "Othering" homosexuality and transgenderism constitutes and gives definition to heterosexuality, for, as she writes, heterosexuality is that which nonnormative performances *are not*. Thus Chanana suggests that lesbianism mitigates heterosexual privilege by erasing men from women's sexual gratification, which challenges patriarchal social and familial structures at various levels. She further claims that sexuality is an expression of power and that by removing men from this domain through same-sex relationships, women rupture the structures of patriarchal subjugation. Analyzing Keval Sood's text *Murgikhana* (*Henhouse*), Chanana asserts that the figure of the nonnormative lesbian, not the sexually liberated heterosexual woman, transcends narrow boundaries that define "fallenness" and alleviate misogynist opprobrium of women. As a result, *Murgikhana*'s depiction of lesbianism is complex, simultaneously regressive and progressive, both giving impetus to and obstructing the production of a nonpatriarchal counterculture: while the book's portrayal of lesbianism resists hegemonic patriarchalism, its use of the lesbian figure to

normalize heterosexual women's transgressions of traditional sexual mores undermines what could have been a profoundly radical text.

INTRODUCTION

Keval Sood's 2013 Hindi-language novel, *Murgikhana* (*Henhouse*), both showcases the radical potential of lesbianism to subvert the patriarchal hegemony and exhibits anxieties that reify homophobia. *Murgikhana* traces the relationship between two lesbians, Sheela and Savita, from its inception, when Savita rapes Sheela, to its tragic ending when Sheela murders Savita. Sheela is unmarried and childless, whereas Savita is a married mother, and as such, her sexual encounters with women constitute adultery. At the outset, the novel portrays Sheela sympathetically but quickly undermines this stance by depicting her as fraught with internalized homophobia. In contrast, the book treats Savita's double "fallenness"—her marital infidelity and her lesbianism—far less harshly. This difference is attributable to various factors. One is that Savita does not abdicate her role as mother as she gratifies her sexual desire for women. This disassociates Savita from lesbianism and aligns her with heterosexuality. While the book's depiction of Savita as "less lesbian" than Sheela is steeped in patriarchalism, the gentler treatment it allots her implies that the figure of the lesbian mitigates sexual opprobrium more effectively than the sexually liberated heterosexual woman. In Indian contexts, this phenomenon is due to the low status historically accorded "fallen" heterosexual women—those who transgress traditional sexual boundaries—whether in the *Kama Sutra*, an ancient Sanskrit tract on the philosophy of human sexuality, or today's legal codes, as evidenced by the fact, for instance, that neither acknowledge the existence of female adultery. Two additional factors that implant homophobic anxieties in *Murgikhana* and undercut its initially progressive approach to lesbianism are settings that are simultaneously queer and homophobic and the book's conspicuously stereotypical ending—one lesbian murdering another. This complex combination of sympathy and antipathy vis-à-vis character development, setting, and the conclusion embed *Murgikhana* with a set of countervalences—progressive and regressive—that lend it a disconcerting ambivalence about lesbianism.

That lesbianism is the ultimate marker of a fallen woman is not difficult to envisage. Lesbianism challenges heteronormativity, eliminates the male role in women's sexual gratification, and contests patriarchal family structures. Sexuality is a power assertion, and by excluding men from same-sex relationships, lesbians create significant ruptures in the structural subjugation of women in patriarchal society. This perforation of the heterosexual hegemony has intensified with the advancement of reproductive technologies ranging from test tube babies to assisted insemination. Not only do these resources make lesbian motherhood

a reality, but they increase the numbers and forms of alternative family structures. In contrast, the so-called promiscuity and sexual liberation of heterosexual women can create ripples in the patriarchal structure but will never be the means of dismantling patriarchy's basic fabric. Hence the "fallen" heterosexual woman cannot threaten male domination in the same manner that the lesbian does.

LESBIAN AS INVISIBLE OTHER

One indicator of the greater threat that the lesbian poses the patriarchy, in Indian contexts, is that Section 377 of the Indian Penal Code (IPC), which dates back to 1860 and criminalizes sexual activities "against the order of nature,"[1] is completely silent about lesbianism despite identifying gay copulation as a criminal offence: the very acknowledgment of lesbian lovemaking is threatening to the core, thus lesbianism is erased from this and other discourses. In contrast, Section 497, which deals with adultery,[2] defines the male adulterer as the only criminal offender, while women in adulterous heterosexual relationships are treated solely as victims. At first glance, this legislation appears to favor women, but close scrutiny proves otherwise: "Whoever has sexual intercourse with a person who is and whom he knows or has reason to believe to be the wife of another man, without the consent or connivance of that man, such sexual intercourse not amounting to the offense of rape, is guilty of the offense of adultery, and shall be punished with imprisonment of either description for a term which may extend to five years, or with fine, or with both. In such case the wife shall not be punishable as an abettor" (IPC 497). Significantly, a woman cannot be charged under adultery not because the state desires to grant her sexual license but because she is considered a "movable object" without a will or sexual agency and thus assumed to have been misguided or tricked into the relationship. Strangely enough, even the National Commission for Women's (NCW)[3] plea against including women under adultery laws smacked of this bias (though unwittingly) by arguing that women are not offenders but always victims, a position that created a huge controversy in 2006 and 2007 ("NCW Rejects Proposal to Punish Women for Adultery").

The sexism manifest in IPC 497 has a long history in Indian literary production and can be traced in representations of women and gender in many ancient Sanskrit myths,[4] such as the *Ramayana* and the *Mahābhārata*. But for the purposes of this chapter, looking at the philosophy of sexuality articulated in the *Kama Sutra* is more to the point. In the West, the *Kama Sutra* is stereotyped as a "how-to" guidebook for sex acts; however, it is actually a philosophical tract on the erotics and ethics of sexuality. Consequently, it reveals sexual values, including beliefs about women and the "nature" of femininity, unfiltered by elements of literature, such as plot, narrative structure, character development, and setting.

The *Kama Sutra* was composed between 400 BCE and 200 CE and is strongly influenced by principles expressed in the *Vedas* and other pre-Hindu sacred texts of Vedic religion, a polytheistic belief system whose divinities are associated with natural phenomena. It is commonly attributed to Vatsyayana, a second-century Hindu philosopher who identifies himself as the author, although it is more likely that he edited rather than wrote the text. The *Kama Sutra*, he explains, is a resource for attaining mastery of the senses by cultivating virtue, wealth, and sensual pleasure: "This treatise was composed, according to the precepts of the Holy Writ . . . for the benefit of the world. . . . This work is not to be used merely as an instrument for satisfying our desires. A person acquainted with the true principles of this science, who preserves his *Dharma* [virtue or religious merit], his *Artha* [worldly wealth] and his *Kama* [pleasure or sensual gratification], and who has regard to the customs of the people, is sure to obtain the mastery over his senses" (Jones and Ryan 225).

With this aim, the *Kama Sutra* includes passages that clarify when it is permissible to violate traditional sexual norms, including adultery. In chapter 5, a subsection entitled "Talking about the Kind of Women Men Can Sleep With," which is part of a larger section entitled "Permissible Women and Adultery," the *Kama Sutra* permits adultery with women who have already been deprived of their virtue and when a sexual relationship with a married woman will produce material benefits:

> The fourth kind can optionally even be married to another man, but this depends on particular reasons. For example, she may already be known as a loose woman robbed of her virtue by many others. So, even though she is of a higher caste, sleeping with her is like with a courtesan or a previously married woman, and will not go against Dharama. . . . A variation may concern the woman's husband. "He is a great lord," one may consider, "and he is partial to someone who is my enemy. She has influence over him and, on becoming my intimate, she can turn him against that person out of love for me." Or, "her husband has the ability to harm me and now seems set to do so as he has turned hostile. She can improve the attitude towards me." Or, "winning his friendship through her, I will be able to help my comrades, repel my foes or accomplish some other difficult task." (21–22)

The language, tone, and imagery in this passage demonstrate that the *Kama Sutra*, which aims to produce sexual awakening in its readers and, as such, should address both sexes, is saturated with sexism, starting with the presumption that with rare exception the audience will consist solely of men. For one thing, it describes the means of achieving "sexual gratification" with men in mind and objectifies women in the process. Moreover, these instructions construct women as instruments of men's social and sexual interests, while representing the so-called fallen, adulterous woman as a commodity that fulfills the man's sensual and material desires.

Similarly, IPC 498,[5] entitled "Enticing or Taking away or Detaining with Criminal Intent a Married Woman," incessantly cloaks its chauvinism in a language of protectionism that suppresses feminine sexuality. This desire to protect women is rooted in the state's refusal to recognize women as able to make clear-cut, individual choices regarding their sexual needs. Of course, such an acknowledgement would be an admission that women are sexually aware desiring subjects, which, in turn, would threaten patriarchal order and opprobrium: "Whoever takes or entices away any woman who is and whom he knows or has reason to believe to be the wife of any other man, from that man, or from any person having the care of her on behalf of that man, with intent that she may have illicit intercourse with any person, or conceals or detains with that intent any such woman, shall be punished with imprisonment of either description for a term which may extend to two years, or with fine, or with both" (IPC 498).

On the surface, this paragraph takes a chivalric approach to the adulterous woman, depicting her as a victim of male aggression. In reality, however, such chivalry, as demonstrated by the law's use of the words "taking away" and "enticing," categorizes a woman not only as a man's property but as someone who cannot assert her own sexual choices and is easily manipulated into an adulterous relationship. Thus the law's "chivalry" is a sinister form of chauvinism founded on the prejudiced belief that women are sexually naïve and unable to resist or defend against men's illicit intentions. This repressive model of feminine sexuality has deep cultural roots. In the *Kama Sutra*, for instance, the chapter entitled, "The Arts Outlined," specifies that the married woman should read the treatise only with the consent of her husband. It further states that women should not be taught the "art of sexuality" because they are not intellectually capable of understanding it: "Some teachers say that instructing women in this knowledge is meaningless as they cannot comprehend science" (11). Essentially, this repressive model of feminine sexuality rests on the misogynist belief that women are so lacking in intelligence that they are unable to make choices about their bodies and sexual practices.

That two texts separated by approximately two millennia—an ancient philosophical tract on sexuality and the other a penal code defining sexual crimes in present-day India—so vehemently insist that women lack sexual agency (to the point that lawmakers offer them relief from prosecution) underscores how intimidating, destabilizing, it would be to recognize women as sexual beings. If heterosexual women's sexuality poses such danger to men's dominance, it is not difficult to imagine that lesbianism, which eliminates men's participation in women's sexual gratification, can be unnerving to the core. Lesbianism's potential to unravel the patriarchy is, in fact, so terrifying that historically it has been even less recognized or visible than heterosexual women's desire. In Western literature, for example, few works have thematized lesbianism until the twentieth century, a notable exception being Sappho's poems. Additionally, history has mostly been

silent about lesbians until the advent of modernism in the West, though women's diaries and journals sometimes offer tantalizing hints of intimate "sisterhoods."[6] The same pattern marks criminal justice where antilesbian legislation is relatively rare, and few lesbians have been charged or convicted under such laws. As Lillian Faderman suggests in *Surpassing the Love of Men*, one reason for this aporia is that lesbianism is such an anathema to patriarchal culture. She cites the case of Woods and Jane Pirie v. Dame Helen to make her point. In Scotland in 1811, a troubled student, Helen Cumming, falsely accused Marianne Woods and Jane Pirie, owners of a girls' school in Edinburgh, of being lesbian lovers. Although the school failed and Woods's and Pierie's lives were ruined, they were acquitted at trial because, Faderman writes, the judge could not imagine women having sex without men:

> The lawyers for Woods and Pirie based their major arguments on that opinion. After establishing the good character of both these women, they demanded, "Is it no violent improbability that no less than *two* such persons should at last have been guilty of a crime so utterly abandoned, that it is totally unknown, and even doubtful that if it can exist?" That argument settled the case, in effect. Could two people engage in venereal activity though the male sex is absent? One judge asked, "Could murder be committed by hocus-pocus or paw-waving?" Without an instrument the act is impossible, the judge decided. (149)

This result, symptomatic of the nearly wholesale erasure of lesbians and lesbianism from history, strongly suggests that heterosexual women's sexual liberty is far less dangerous to the heteropatriarchal order than the so-called lavender menace.[7] Furthermore, lesbianism's radicalism may offer new paradigms for heterosexual women. For instance, lesbianism completely destabilizes norms that stipulate that monogamous marital sex is the only means by which heterosexual women can attain libidinal satiation. Hence it's not surprising that the Indian legal code would go so far as to exempt women from prosecution for adultery—rather than chivalry, this relief is actually motivated by a sinister agenda, a fear-driven wish to render women's sexuality invisible.

MURGIKHANA'S IRONIC AMBIVALENCE

Murgikhana is a controversial novel—it could not be published in India for fifteen years—because it showcases the potential disruptiveness of the lesbian to transcend narrow definitions of female fallenness and mitigate the sexual opprobrium and other hegemonic patriarchal structures. However, the text also manifests anxieties that blunt these possibilities or, more precisely, limits their radicalism. Sood's social location may account for these anxieties, or they may be attributable to a sense of audience—*Murgikhana*'s typical readers are Hindi speaking and generally consumers of mass fiction rather than English-speaking elites[8] and not

immune to homophobia.[9] Thus, at one level, the writer posits the radical promise of feminine sexuality by drawing attention to the ways lesbians perform emotional and sexual intimacy, but at another level, the "new homonormativity"—accepting homosexuals only as long as they do not threaten the basic heterosexual patriarchal structure—and lesbophobia are so pervasive in the text that the disruptive potential of lesbianism is neutralized. In this light, the book implicitly suggests that the straight woman who is considered fallen because she indulges in forbidden relationships with men, such as extramarital affairs, is far more accepted, or *acceptable*, than the lesbian because the straight woman is at least heterosexual and a male partner contributes to her sexual pleasure. Hence *Murgikhana*'s depiction of lesbianism is convoluted even as it gives impetus to the production of a lesbian counterculture.

The story revolves around the protagonist, Sheela, whose internalized homophobia prevents her from coming to terms with her lesbianism. Her first sexual encounter occurs in a female-only hostel (a dormitory) where an absence of men has fostered a homosocial atmosphere. Savita, the hostel's manager, rapes Sheela, an act that initiates an ongoing sexual relationship between them. Prior to coming to the hostel, Sheela had plans to marry a man named Suneel, but they are abandoned due to the rape. Throughout the rest of the story, Sheela has rampant, incestuous, short-term homosexual relationships with numerous bisexuals and lesbians.[10] These relationships are bereft of any emotional or long-term commitment, two of the most cherished though often unfulfilled heterosexual ideals, and Sheela relentlessly explores her sexuality in these superficial encounters with other women. Thus at the outset, the novel seems to portray Sheela and her sexual choices sympathetically, but as the story unfolds, it consistently undercuts this tone. This endows the novel with a deep ambivalence about lesbians and lesbianism that culminates when Sheela murders her rapist and first lesbian lover, Savita, who was responsible for initiating many women into lesbian sex.

An early scene that highlights lesbianism's transformative capacity and offers a positive representation of Sheela focuses on her ability to be self-nurturing (my translation). Set in her home, this space is both a metaphor for her lesbian body and a place where she can "love herself," a phrase that, in the Hindi original, signifies both self-caring and masturbation: "Sheela strokes the pink walls of her room with her eyes and kisses her body all over. At times she feels a strong desire to kiss her own fair and pink body from top to bottom passionately" (my translation; 10). Her gaze caresses the walls as her hands or perhaps her tongue, if it could, stroke and arouse her body. Here, she embraces herself psychologically and physically, and her self-affirming mind-set is manifest in her fascination with her own body. In this passage, Sheela's self-loving transforms the domestic, traditionally a heterosexual site, into a radically queer domain. This appropriation of the domestic from the heterosexual realm underscores lesbianism's capacity to challenge the patriarchy. Clearly, this early

immune to homophobia.[9] Thus, at one level, the writer posits the radical promise of feminine sexuality by drawing attention to the ways lesbians perform emotional and sexual intimacy, but at another level, the "new homonormativity"—accepting homosexuals only as long as they do not threaten the basic heterosexual patriarchal structure—and lesbophobia are so pervasive in the text that the disruptive potential of lesbianism is neutralized. In this light, the book implicitly suggests that the straight woman who is considered fallen because she indulges in forbidden relationships with men, such as extramarital affairs, is far more accepted, or *acceptable*, than the lesbian because the straight woman is at least heterosexual and a male partner contributes to her sexual pleasure. Hence *Murgikhana*'s depiction of lesbianism is convoluted even as it gives impetus to the production of a lesbian counterculture.

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passage casts Sheela in a positive light and, by demonstrating that lesbianism has the capacity to transvalue meaning—to claim heterosexual space and reconstitute it as a site of radical lesbianism—illustrates the lesbian woman's ability to upset the heterosexual status quo. Lesbianism is thus equated with self-loving within the book's opening pages and portrayed as posing a powerful challenge to heterosexism.

However, thereafter *Murgikhana* reveals a far more negative side of Sheela's character. For example, she is deeply jealous after she realizes that Savita is happily married with two children:

> Standing straight, she [Sheela] stares at the vacuum above the crowd and the long darkness over the sea. Within a few moments a strange tension appears in her eyes and then it evaporates. What should she [Sheela] tell Savita? [She considers the options], "That after pushing me into a deep water you have reached the shore?" Or, "Now you are in my grip, should I trap you?" Perhaps: "I am alone in my boat and your boat is filled. Yes, it is filled . . . and I know this for sure. But I will not be able to do this even if I wish. I will not be able to do this. . . . But you cannot be held responsible. There was a time when we both were in the same boat, but you escaped." (my translation; 48)

Furthermore, *Murgikhana* offsets depictions of Sheela's initial self-nurturing with passages that feature self-recrimination and self-loathing—that is, internalized homophobia. After her first sexual encounter with Savita, for example, Sheela rejects Suneel's advances by saying that she has corrupted herself and cannot be part of the fold again, meaning that she is a sexual outlaw, that she stands outside the boundaries of normative sexual morality. In essence, she is a sexual Other, and her deviation from the heteropatriarchal structure prompts her to exclaim: "No Suneel do not touch me, I am not worthy of it" (my translation; 57).

Unlike the masturbation scene, Sheela's language and descriptions of her as well as her sexual encounters take on a tone of disgust. For instance, Sheela's internalized homophobia is evident in constant fantasies that she will be killed brutally: "Sheela could foresee—a tiger is running and it has her living corpse in its mouth. There is an eagle that is hovering over that tiger. That eagle also has her living corpse . . . and she is crying vehemently to extract her dead body from the grip of the eagle; consequently, she is running and flying at the same time. Her own dead body is there on her shoulders" (my translation; 72). Such extreme responses to her desire and, specifically, her relationship with Savita offset the book's more positive representations of Sheela as self-embracing. This in turn reverses *Murgikhana*'s earlier affirming tone toward lesbianism. In so doing, the book diminishes the subversive potential of the lesbian woman to redefine and reevaluate the heterosexual definition of fallenness. Indeed, as the book takes an increasingly ambivalent stance toward

lesbianism, it undermines the symbolic and actual power of the lesbian figure to disrupt heteropatriarchalism.

In contrast, Savita's status as a mother and wife is exculpating, for in Indian contexts where motherhood is a responsibility of citizenship as well as a highly idealized social role, she fulfills her duty toward the nation by being a "good" mother, by producing and raising the future body politic. Furthermore, Savita is able to navigate both lesbianism and heterosexuality and is rewarded for maintaining the heteropatriarchal framework even as she crosses its boundaries. For example, her homoerotic encounters are described in a language that affirms her passion: "The two pink bodies were floating in the river of flesh—traversing through one corner to another" (70). Moreover, *Murgikhana* implies that Savita's same-sex encounters are necessary for sustaining—refueling—her heterosexual identity. This is evident when, during one of their sexual encounters, Sheela states that she is attracted to Savita primarily because she is a mother. Sheela, however, does not mean that Savita is a revolutionary lesbian mother testing the limits of public tolerance by raising children with a same-sex partner. Rather, Sheela is referring to Savita's performance of heterosexual mothering, for Savita has children with a male partner and ostensibly maintains a conventional—heterosexual—family life.

In any event, the suggestion that Savita's lesbianism feeds or reinforces her heterosexual identity is a theme that recurs in the book. Specifically, Savita's lesbianism is sensually rejuvenating and, as such, fuels her performance of motherhood. Sheela reflects on this dynamic when she is in an introspective mood: "Sheela you are tired of this constant juggling and acrobats . . . yes you are tired . . . Savita wanted to say the same thing that night. Savita, the rugged one is still as fresh and spirited as she has always been . . . may be because she is following both the routes—the natural and the unnatural. . . . But no route is unnatural . . . we have seeds for both the routes" (my translation; 69). This passage implies that the homoerotic rendezvous of a married woman, Savita, with her lesbian lover strengthens the institution of heterosexual motherhood. Thus Savita's lesbianism does not render her fallen because she never abandons heterosexual mating or the patriarchal family. As such, she does not threaten the heteropatriarchal hegemony. In the figure of Savita, therefore, *Murgikhana* suggests that lesbianism is nothing more than a heterosexual woman's sexual resuscitation, for her same-sex relationships do not prevent her from fulfilling the duty to procreate, a responsibility that so often is cited as the basis of the belief that heterosexuality is natural and homosexuality is deviant. In other words, Savita's lesbianism does not prevent her from achieving full sexual citizenship because her relationship with Sheela, rather than diverting Savita from bearing and raising children, reinvigorates her will to produce future citizens, a woman's most important citizenship function in the patriarchal state. Consequently, Savita's lesbianism does not challenge the heteropatriarchal structure. Rather, it is merely a slight deviation outside marriage that is tolerated because, in comparison to the annihilating impact of the lesbianism on

patriarchy, it is a much lesser evil. Ultimately, the book's more generous approach to Savita than Sheela suggests that because Savita performs the traditional social role assigned women, she is less threatening than the single, childless Sheela even though Savita is basically a rapist and an adulteress (if not legally, at least in terms of conventional morality).

This "softer" treatment of Savita calls to mind the heterosexist masculine gaze's construction of lesbian desire as a male-titillating performance. In this respect, *Murgikhana* is far less like "lesbian literature" and more like fiction that, Faderman contends, employs same-sex female relationships to satisfy heterosexual male fantasies: "Society did not object to the theme of passionate [female] friendship in literature because it appealed to male voyeurism" (109). Under such conditions, of course, descriptions of lesbian sex treat it as precursor to and part of heterosexual lovemaking. Faderman, quoting Pierre de Boudeille, Seignior de Brantome, explains that in these circumstances lesbian eroticism is "an apprentice to heterosexuality" (110). Hence any apparent acceptance of lesbianism is only another means of reinforcing heterosexuality and blunting the threat that the lesbian "outlaw" poses it.

Interestingly, a similar phenomenon exists in historic Indian visual and literary arts. Devdutt Pattanaik explains that same-sex relationships are depicted with moderate tolerance if not sympathy in age-old artifacts but primarily in order to redirect homosexuality into heterosexual desire (even if temporarily): "An overview of temple imagery, sacred narratives and religious scriptures does suggest that homosexual activities—in some form—did exist in ancient India. Though not part of the mainstream, its existence was acknowledged but not approved. There was some degree of tolerance when the act expressed itself in heterosexual terms—when men 'became women' in their desire for other men, as the *hijra* legacy suggests" ("Did Homosexuality Exist in Ancient India?").[11] *Murgikhana* combines these two approaches in its treatment of Savita. Her relationship with Sheela titillates male heterosexual desire even as it bespeaks lesbian eroticism. This, of course, erodes the book's initial celebration of lesbianism and exhibits palpable antipathy toward lesbianism.

Ultimately, *Murgikhana*'s voyeurism-inviting passages, combined with its contrasting characterization of the two major female figures—its condemnation of Sheela and relative tolerance of Savita—endow the text with crosscurrents, a combination of sympathy and antipathy that fosters a disturbing ambivalence about lesbianism and fails to acknowledge the extent of the threat that lesbianism poses patriarchal order.

A similar crosscurrent marks the book's settings as well. Throughout, the story of Sheela and Savita is told against a landscape that is simultaneously queer and homophobic. When the book opens, Sheela's rape takes place in the homosocial space of a hostel beyond the fringe of heterosexual society. That the hostel is depicted as being on the outside edge of society is one of the book's first expressions of lesbophobia. As the novel progresses, setting continues to

intensify this lesbophobia. The location in which Sheela murders Savita—a henhouse—is the most extreme example. Symbolically, of course, the henhouse signifies female-only homosocial space, as is underscored when one of the characters asks how the hens can get along without roosters: "What is the life of these hens without roosters? Why have they been deprived of this primitive pleasure—how do they manage?" The question embarrasses her interlocutor, Mrs. Sharma, who, nonetheless explains that the hens have sex with each other. The narrator explains, "She [Mrs. Sharma] in a quite naughty fashion states that they do it among themselves." Then the lesson turns ominous as Mrs. Sharma adds that if "any rooster gets trapped inside it [the henhouse], these scoundrels [the hens] kill it" (my translation; 86). If the comparison of lesbians to hens seems innocuous at first, Mrs. Sharma reveals that, in fact, the hens are men killers, an assertion that invokes the negative stereotype that lesbians "hate" men, commonplace in the long catalogue of lesbophobic slurs. Furthermore, the hen analogy bestializes lesbians, a characterization that Savita reinforces as she repeatedly announces that she sometimes puts a rooster inside the henhouse just for the sadistic pleasure of witnessing the hens brutally mutilating him. These contrasting depictions of the henhouse—it is a space where hens "do it" without men (presumably happily and freely) and where male intruders are brutally killed—simultaneously valorizes and vilifies lesbianism. They depict lesbianism as the ultimate panacea for the patriarchy, while at the same time, undermining this characterization by representing the henhouse as a place where women destroy men. In the end, Sheela's murder of Savita, a stereotypical fate meted lesbians in heterosexist, homophobic fiction and other media as punishment for their transgressions completely overshadows the book's more progressive treatment of lesbianism in other passages. Sheela, torturing and murdering her mentor and paramour, Savita, reifies heteropatriarchal supremacy by performing lesbianism as depraved and dehumanizing.

CONCLUSION

In the final analysis, *Murgikhana* bears out the theory that in *lesbophobic* societies—and this caveat is critical—the figure of the lesbian challenges the heterosexual status quo *and* ameliorates the negative consequences of heterosexual women's fallenness because she is an extreme outlier in the field of unconventional, transgressive sexualities and, as such, serves as a lightning rod that normalizes heterosexuality. That is to say that lesbianism enables heterosexual women to exercise transgressive sexualities without suffering the full force of patriarchal opprobrium meted lesbians, for as long as heterosexual women comply with other patriarchal mandates, such as the duty to be a "good" mother, they are less threatening to the social order than lesbians. Thus lesbianism mitigates the worst consequences that fallen heterosexual women face and ruptures the stringent boundaries that regulate and police their sexuality. *Murgikhana*'s ambivalent depiction of lesbianism underscores this irony.

NOTES

1 Section 377 of the Indian Penal Code, an archaic, colonialist, nineteenth-century document, criminalizes sexual activities "against the order of nature." It states that "whoever voluntarily has carnal intercourse against the order of nature with any man, woman or animal, shall be punished with imprisonment for life or a term which may extend to ten years, and shall also be liable to fine." This clause covers homosexuality, but a further passages specifies that penetration is a necessary condition of such intercourse, which exempts lesbianism from the law's purview. AIDS Bhedbhav Virodhi Andolan, a movement that aims to end discrimination against AIDS patients, in 1991 launched an initiative to repeal Section 377. Their publication, "A Citizen's Report" catalogues the problems with 377. The Naz Foundation also worked with a legal team from the Lawyer's Collective to decriminalize homosexuality. In a momentous judgment in July 2009, the Delhi High Court overturned the 150-year-old section, legalizing consensual homosexual activities between adults. However, on December 11, 2013, the Supreme Court of India upheld Section 377. The decision recriminalizing homosexuality states, "We hold that Section 377 IPC does not suffer from the vice of unconstitutionality and the declaration made by the Division Bench of the High court is legally unsustainable" (Koushal 97).

2 Section 497 is found in chapter 20 of Indian Penal Code, which deals with the "offence related to marriage," and contains Section 497. The Supreme Court has affirmed that only a man can be prosecuted for adultery but not the wife, even as an abettor. Justices Aftab Alam and R. M. Lodha ruled, "Section 497 of the Indian Penal Code [which deals with adultery] is currently under criticism from certain quarters for showing a strong gender bias, for it makes the position of a married woman almost as a property of her husband. But in terms of the law as it stands, it is evident from a plain reading of the Section that only a man can be proceeded against and punished for . . . adultery. Indeed, the Section provides expressly that the wife cannot be punished even as an abettor" (Venkatesan).

3 The NCW is the national level organization of India to protect the interests of women. It was set up as statutory body in January 1992 under the National Commission for Women Act, 1990 (Act No. 20 of Govt. of India) to review the constitutional and legal safeguards for women and develop a mechanism for the redressal of grievances and to send recommendations to the government for constituting polices that affect the welfare of women.

4 See Chandrani Biswas's chapter in this volume.

5 Chapter 20-A of Indian Penal Code contains Section 498, which is "enticing or taking away or detaining with criminal intent a married woman." Sub-section A adds that whoever subjects the woman to cruelty will be fined and shall be punished with imprisonment for a term of up to three years. "Cruelty" is defined as (a) any willful conduct that is likely to drive the woman to commit suicide or to cause grave injury or danger to life, limb, or health (whether mental or physical) or (b) harassment of the woman for the purpose of coercing her or any person related to her to comply to an unlawful demand. This provision was enacted to combat dowry deaths and introduced to the Penal Code by the Criminal Law Amendment Act, 1983 (ACT 46 of 1983). By the same legislation, Section 113-A was added to the Indian Evidence Act to protect women from being harassed by their husbands or relatives (Mishra).

6 Some examples of lesbian subtexts in fiction include poems by Katherine Philips, the Anglo-Welsh poet known as "The Matchless Orinda," including "To My Excellent Lucasia, on Our Friendship," "Parting with Lucasia: A Song," and "Orinda to Lucasia." Other authors whose works hint at lesbianism are Aphra Behn, Sor Juana Ines de la Cruz, Queen Christina of Sweden, and Jane Addams.

7 Betty Friedan coined the term "lavender menace" 1969 when she served as president of the National Organization for Women, because she believed that associating feminism with lesbianism would undermine the women's movement in the United States.

8 Before the advent of European colonizers, Arabic, Urdu, and Sanskrit were the languages of the elites because they were taught only to upper class-caste Indians, but during colonization, India's ruling classes added English to their linguistic repertoire due to their interactions with the British. However, substantial debate about the desirability of English arose in the nineteenth century. Indian Orientalists favored Indian languages, and Anglicists or Occidentalists supported English, leading to a rift between intellectuals and British administrators. But the controversy ended when Thomas Babington Macaulay—who served in numerous government positions in England, including as Secretary of War, and held a seat on the Supreme Council of India between 1834 and 1838—published his "Minute on Indian Education" (1835) in which he called for the creation of an English-speaking Indian class of interpreters. This resulted in the adoption of English as India's official language. Sociolinguistics argue that this created an Anglophone subculture in India, rendering English a marker of elitist schooling, the key to powerful government positions, and an entrée into upper-class status. Nonelites did not favor English, and their dissatisfaction over linguistic policy was among the grievances that led to the unsuccessful Revolution of 1857. Today, upper-class parents pay heavy fees to send their children to English-language schools, while government schools provide instruction in Bengali, Hindi, or other regional languages. Students in these schools have poor English skills, and this is an impediment when they pursue higher education.

9 Dating to the colonial era, India's English-language readership was familiar with oblique and implicit references to homosexuality in fiction; however, after independence, homophobia emerged in public discourses, with debates about, for example, *Chocolate and Other Writings on Male Homoeroticism* by Pandey Bechan Sharma, a 1927 collection of eight stories that was the first Hindi fiction to focus on male same-sex relationships. Many prominent figures, including Gandhi, weighed in on the controversy, which lasted into the 1950s.

10 These relationships are considered incestuous because in Indian contexts the concept of family is expansive—the kinship network is heavily populated, so a sexual relationship with a distant relation would be incestuous.

11 Known by a myriad of names, including *khwaja sara, khusra, zenana, jhanka, khusa,* transgender, and transsexual, *hijras* are often men who have chosen to be castrated, have not fully developed sex organs at puberty, or were born hermaphrodites. They may also be biologically female and choose to live as males, or they may occupy an ambiguous sexual "identity" that has no parallel among western sexual categories. Neither men nor women, *hijras* have been considered members of a third sex in South Asia for the last three thousand years. At the same time, some *hijras* do not identify as a third sexual category outside the male/female binary. Instead they display mannerisms and signs of femininity that at times combine with traditionally masculine traits and behaviors. Furthermore, *hijras* do not always consider individual expressions of desire the sole defining feature of their lives. Instead, their histories move us toward an understanding of how sexuality is implicated in religion, community networks, and class. *Hijra* communities are present in both Hindu and Islamic enclaves in South Asia. Hindu scripture identifies gods who embody aspects of both male and female, like Lord Shiva who in his incarnation as Ardhanarishvara is half woman and who became the female Parvati, his wife and goddess of fertility, in the course of love play. In the *Mahābhārata,* Vishnu, another male god, is transfigured into Mohini, an enchantress who entraps her male lovers, dooming them to ill-fated endings. Hindu *hijras'* lineage is said to derive from the female goddess Mata Bahuchara, who, as legend has it, cut off her breast to save her virtue. Serina Nanda's book *Neither Man nor Woman: The Hijras of India* (1999) argues that the sanctity of this goddess is the source

of *hijras'* powers to curse or to confer blessings on male infants. In Pakistan, Muslim *hijras* are legitimated by Sura 42:49 of the Qur'an, which states, "To Allah belongs the dominion of the heavens and the earth; He creates what he wills. He gives to whom He wills female [children], and He gives to whom He wills males," and 42:50, "Or He makes them [both] males and females, and He renders whom He wills barren. Indeed, He is Knowing and Competent."

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Saumya Chaturvedi
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Preface

This book on ***Principles of Insurance*** has been specially designed to meet the syllabus requirements of B.Com students of Osmania University, other Universities of Telangana State based on Common Core Syllabus under Semester System as well as other Indian universities. It has been our earnest endeavor to see that each and every topic included in the prescribed syllabus is discussed and analysed in a precise as well as systematic manner. Definitions and concepts have duly been highlighted for the benefit of the students. A number of figures, tables and charts have been incorporated at appropriate places in the book to keep the presentation intelligible as well as understandable. The idea is to expose and enrich the subject in a crisp manner while familiarising with theoretical concepts as well as analytical issues. We are confident that students going through this book would be able to strengthen their analytical regor and have clarity in the understanding.

Chapter Outline has been provided in the beginning of each chapter for the convenience of the students. Students may check their grasping power of the subject matter discussed, by answering the questions listed at the end of each chapter.

We express our sincere gratitude to Mr. Riyaz Ali, Assistant Professor in Commerce, Swami Shradhanand College, University of Delhi for contributing Chapter 9 on *Operations of Insurance Companies and Intermediaries*. We also express our heartful thanks to Ms. Gurveen Kaur, Assistant Professor in Commerce, Satyavati College, University of Delhi for contributing Chapter 11 entitled *Common and Specific Terms in Insurance* and Ms. Shabani Bagai, Research Scholar, Faculty of Management Studies, University of Delhi for writing Chapters 12 & 13 on *Understanding Insurance Customers* and *Legal Aspects of Insurance Contract.*

We solicit valuable inputs from fellow teachers. Their comments, suggestions and constructive criticism will act as stepping stones for improvement in this academic work in full splendor.

Arjun Mittal
Saumya Chaturvedi
Anand Mittal

Chapter

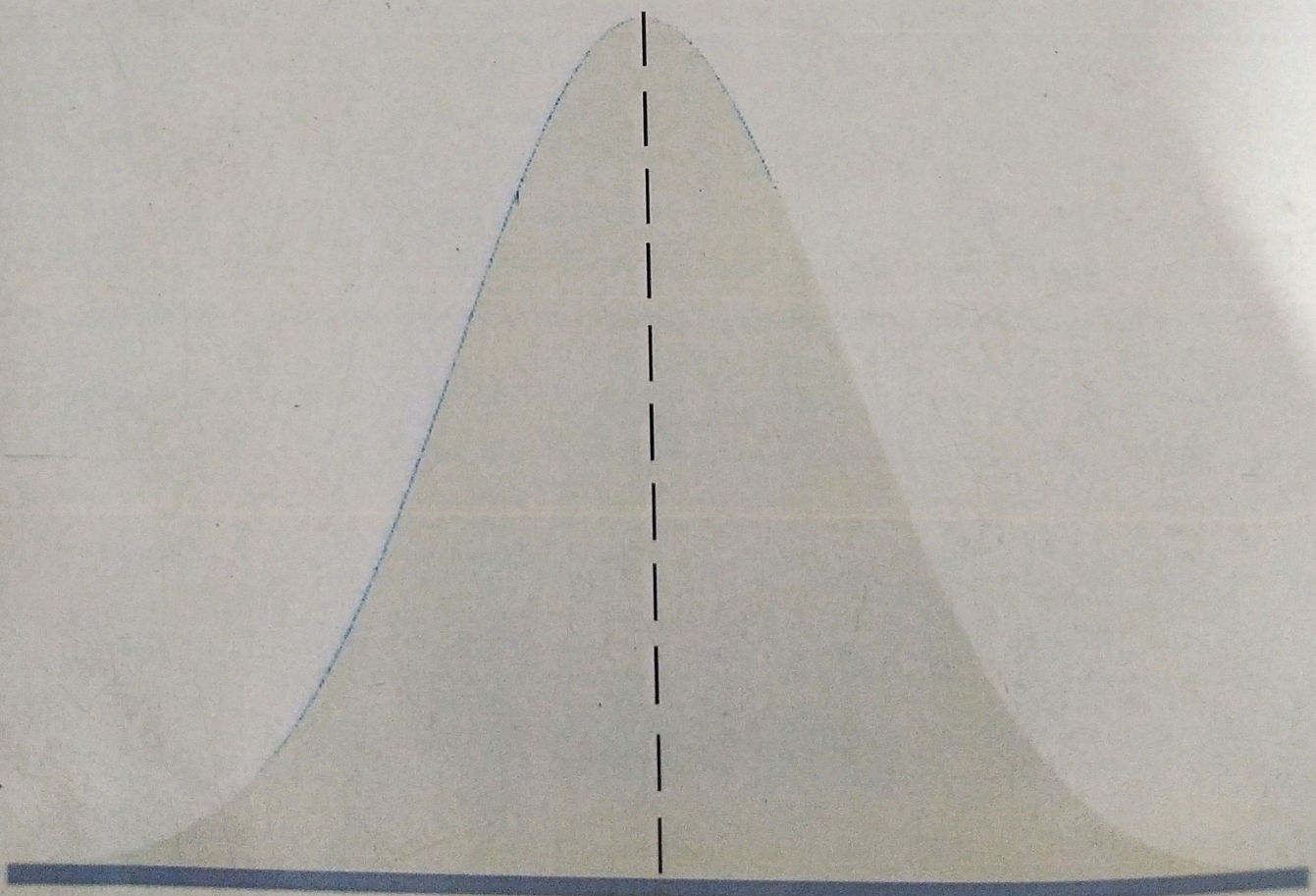
9

OPERATIONS OF INSURANCE COMPANIES AND INTERMEDIARIES

Chapter Outline

BUSINESS STATISTICS -I

Dr. Anand Mittal
Gurveen Kaur
Saumya Chaturvedi



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Chapter Outline has been provided in the beginning of each chapter for the convenience of the students. Students may check their grasping power of the subject matter discussed, by answering the questions listed at the end of each chapter.

We express our sincere gratitude to Mr. Riyaz Ali, Assistant Professor in Commerce, Swami Shradhanand College, University of Delhi for contributing Chapter 8 on *Correlation*. We also express our heartful thanks to Mr. Prabhjeet Singh, Delhi for contributing Chapter 6 entitled *Measures of Dispersion*.

We solicit valuable inputs from fellow teachers. Their comments, suggestions and constructive criticism will act as stepping stones for improvement in this academic work in full splendor.

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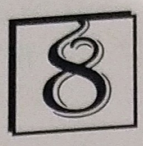


Correlation

Chapter Outline

8.1 MEANING OF CORRELATION

Correlation is a statistical tool which studies the relationship between two or more variables. Following are some of its definitions.

"Correlation is an analysis of covariation between two or more variables."

A.M. Tuttle

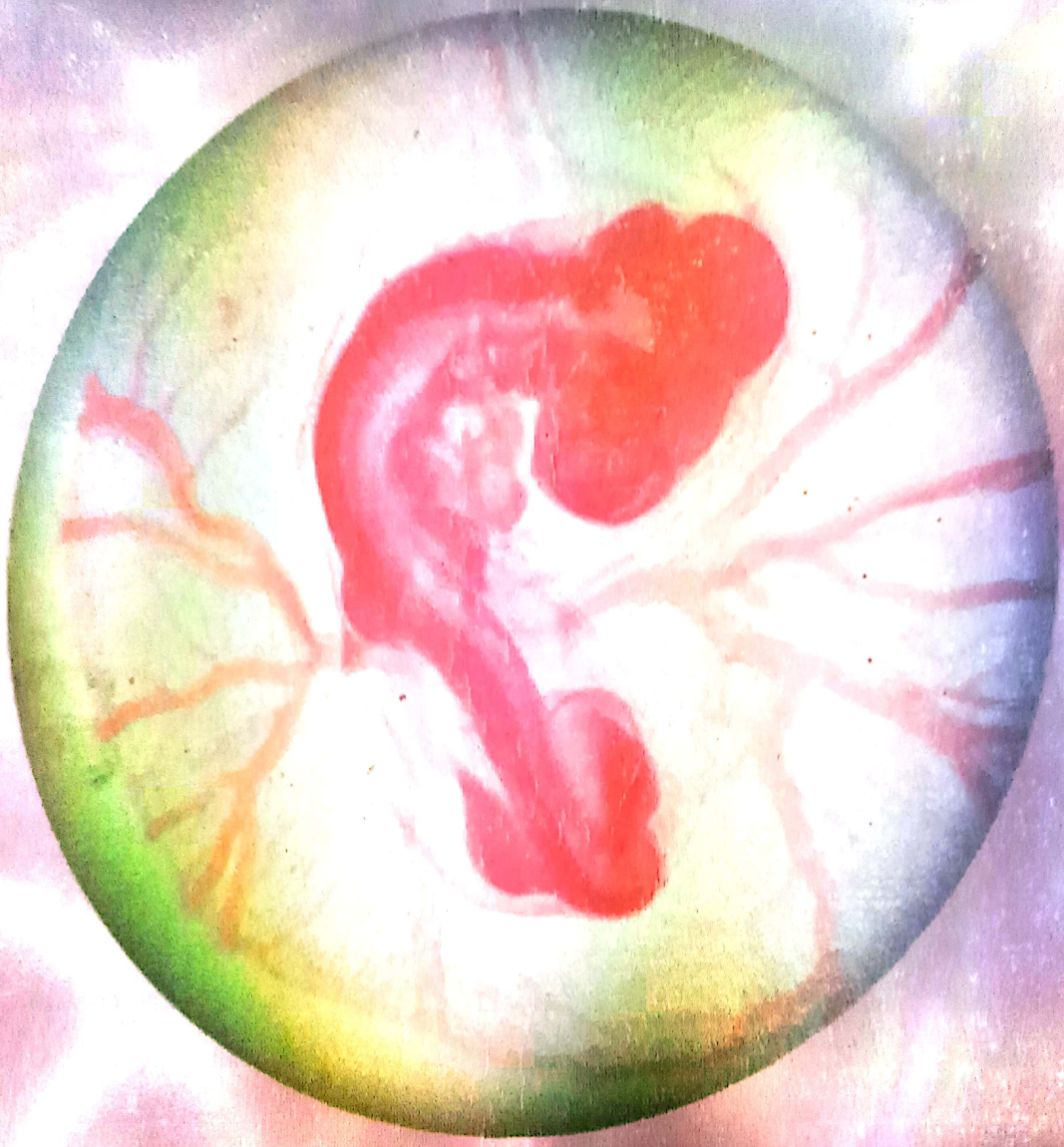
"Correlation analysis deals with the association between two or more variables."

Simpson and Kafka

DEVELOPMENTAL BIOLOGY

PRINCIPLES & CONCEPTS

Dr. Rajni Arora • Dr. Anita Grover



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DEVELOPMENTAL BIOLOGY
Principles and Concepts

DEVELOPMENTAL BIOLOGY
PRINCIPLES AND CONCEPTS

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PREFACE

The field of developmental biology is ever expanding and has undergone revolutionary changes because of explosion of new knowledge pouring in from various other branches of life science. Recent research in developmental biology has provided us with answers to many questions relating to the development of an animal. The book entitled "**Developmental Biology-Principles and Concepts**" is designed as a core text book for undergraduate students. It is an outcome of our interest and teaching experience of more than two decades in the subject. We have made an attempt to pen down the topics in an easy, comprehensive and lucid way. The book presents the basic concepts and facts relating to developmental biology. We have also dealt with the topics of great contemporary interest like aging, regeneration, regenerative medicine, stem cells and assisted reproductive technology.

The contents of the text are divided into six units. *Unit 1* introduces the readers to the historical background and basic concepts of developmental biology. Newer areas of interest in this field have also been briefly dealt with. *Units 2* and *3* comprise of topics relating to early development in animals with emphasis on mechanisms underlying each process. Late embryonic development is discussed in *Unit 4* which includes the fate of germ layers formed as a result of gastrulation, extraembryonic membranes, placentation and neurulation. *Unit 5* deals with the post embryonic development describing the process of metamorphosis and regeneration. During the process of aging one undergoes physical, biochemical, behavioural and physiological changes. Therefore, mechanisms underlying various concepts of aging are also included in this unit. Finally, our efforts in compiling this book would have been incomplete without giving insight to the implications of developmental biology in medicine. We have tried to focus on this aspect in Unit 6. Birth defects caused by mutations and environmental agents, in vitro fertilization for the treatment of infertility, regeneration and stem cell therapy are few of the topics of high interest in today's time. Basic understanding of mammalian development aids in venturing into all these aspects.

The topics and concepts in each unit are supported by figures and flow charts. Important terms have been highlighted and at few places information is tabulated for better presentation and easy understanding. Each chapter of the unit has test questions in the end, which we feel will apprise the students of their understanding and knowledge of the subject. It is assumed that the [illegible] histology, genetics, cell and

During the course of writing this book, we have consulted many books on Embryology/Developmental Biology, for which we are thankful to the authors and the publishers of the same.

We are indebted to our parents and family for their all time support. We are thankful to Gauranjali Sharma for helping with illustrations and figures. We thank our publishers for their contribution and for translating our dreams into presentable form of a book. Despite our every effort to provide facts and avoid any errors, if some loopholes still exist, we shall greatly appreciate receiving criticism and valuable suggestions from the readers.

This book is a tribute to **late Professor K.Vasudeva Rao, Department of Zoology, University of Delhi,** who initiated us into the field of developmental biology.

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CONTENTS

IMPACTS OF ELECTROMAGNETIC RADIATIONS ON PLANTS, HUMAN HEALTH AND ENVIRONMENT

Meenal Gupta[1*], P. K. Singh[1], Ritu Yadav[2], Pushpa Singh[3], Smita Shukla[3]

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Radiation is the emission or transmission of energy in the form of waves or particles through space or through a material medium. These radiations are harmful to immune system of the human body which is already reported. These reports clearly show that effects of various types of radiations is gradually increasing which is responsible of decreasing immune system. Radiation can penetrate into living cells and results in the transfer of radiation energy to biological material. The damage to a living cell by radiation takes place at molecular level. It is already reported that the absorbed energy can cause various changes to DNA, membrane lipids, and protein. It can increase the reactive oxygen species and can break chemical bonds and causes ionization of different biologically essential macromolecules. Damage to the cellular membrane release the hydrolytic enzymes responsible for various catabolic processes and leads to cell death.

It may occur either directly by release of energy from the tissue, within the structure of the molecule itself or indirectly by formation of highly reactive free radicals which interact with sub cellular constituents. Membrane can be easily damaged by the per-oxidative decomposition of their phospholipids. In addition, a

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Nanotechnology in Environmental Science

Volume 1 & 2

25

Nanotechnology: Greener Approach for Sustainable Environment

Ambika[1] *and Pradeep Pratap Singh*[2]

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[2]*University of Delhi, Swami Shraddhanand College, Department of Chemistry, Delhi 110036*

25.1 Introduction

Nanotechnology is a branch of science that deals with the different types of materials in nanoscale range. It offers opportunities for the development of new technologies to produce new products, to substitute existing production equipment, and to reformulate new materials and chemicals with improved performance resulting in less consumption of energy and materials, reduced harm to the environment, and environmental remediation. Nanotechnology presents an opportunity to develop a new technology and a new industry in a sustainable way from the outset. Nanomaterials (NMs) are employed in diverse fields such as electronics and photonics, catalysis, information storage, chemical sensing and imaging, environmental remediation, drug delivery, and biological labeling [1,2]. NMs have been synthesized using a number of methods such as wet method, UV irradiation, aerosol, and lithography that involves hazardous and toxic substances. Thus, there is an urgent need of methods that are clean, biocompatible, nontoxic, and environment-friendly. Recently, green nanotechnology has drawn the attention of scientists and researchers to design new methods for joint economic, social, and health/environmental benefits [3]. This nanotechnology involves the design of NMs by eliminating or minimizing pollution without using hazardous and toxic chemicals harmful to the environment or human health at low temperatures using less energy and renewable inputs wherever possible. In this way, green nanoscience guides materials development, processing, and application design throughout the life cycle, starting with raw material selection through end of life. In this chapter, we highlight some of the most promising and important nanotechnology applications for a clean and sustainable environment (Figure 25.1).

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NEW POLYMER NANOCOMPOSITES FOR ENVIRONMENTAL REMEDIATION

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AJAY KUMAR MISHRA

Environmental remediation by nanoadsorbents-based polymer nanocomposite

10

Pradeep P. Singh, Ambika
University of Delhi, Delhi, India

1 Introduction

The deterioration of the environment is increasing day by day due to human activities resulting in the depletion of natural resources such as air, water, and soil, destruction of the ecosystem, and the extinction of wildlife. The main human activity is rapid industrialization, which has led to an increase in the release of toxic effluents, such as heavy metals, pesticides, toxic dyes, etc. into the environment, which can cause serious problems by entering into the food chain, leading to severe health disorders in humans [1]. Various methods and technologies such as adsorption, ion exchange, ion flotation, chemical precipitation, reverse osmosis, and evaporation have been employed for the removal of toxic metal ions and other contaminants from water. In adsorption, the adsorbing phase is the adsorbent, and the material adsorbed at the surface of the phase is the adsorbate. The removal of the component or impurity in a fluid can be carried out by using a solid adsorbent. Nanosorbents are nanoscale particles of inorganic or organic materials that are capable of absorbing other substances due to their large surface area and a high substance specificity. Because of these advantageous properties, nanosorbents can quickly and specifically remove targeted contaminants. Various adsorbents like polyaniline, activated carbon, anion exchanger, anthracite, biopolymers, carbon nanotubes (CNTs), zeolites, nanofibers, titanium dioxide, etc. have been widely used in environmental remediation for the removal of pollutants [2]. Recently, polymeric-nanocomposites (PNC) have attracted the attention of researchers as another class of adsorbent in environmental remediation [3]. Polymer nanocomposites consist of a polymer or copolymer, filled with synthetic or natural inorganic compounds to improve their chemical and physical properties or to reduce cost by acting as a diluent for the polymer [4,5]. Thus, the polymer is called a matrix. If the filler is in the nanometer range, the composite is called a nanocomposite. The nanofillers include CNTs, nanofiber fillers, plate-like nanofillers, inorganic fillers, and clays. Depending on the nature of the nanophase and the matrix, a wide variety of nanocomposites can be prepared. These composite materials can assume a mixture of the beneficial properties of their parent compounds, leading to materials with improved physical properties and unprecedented flexibility. These may be of different shapes (e.g., platelets, fibers, spheroids), but at least one dimension must be in

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Nanocomposites for Pollution Control

Chapter 4

Dimensions of Nanocomposites in Pollution Control

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Environmental pollution is a serious day-to-day problem faced by developing and the developed nations. Pollution due to the anthropogenic sources contributes a major share to the overall imbalance of the ecosystem, which interferes with human health, the quality of life, natural functioning of living things and their surroundings. Thus, there is an urgent need of technology that is able to monitor, sense and purify the contaminants from the environment. Nanotechnology can be utilized to obtain desirable inexpensive materials with low toxicity and high degradation activity for the protection of the environment. Nanocomposites (NCs) can remove a broad range of pollutants, such as bacteria, heavy metals, and organic pollutants from the surroundings. In addition to remediating pollution, NCs can be used as sensors

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Governance

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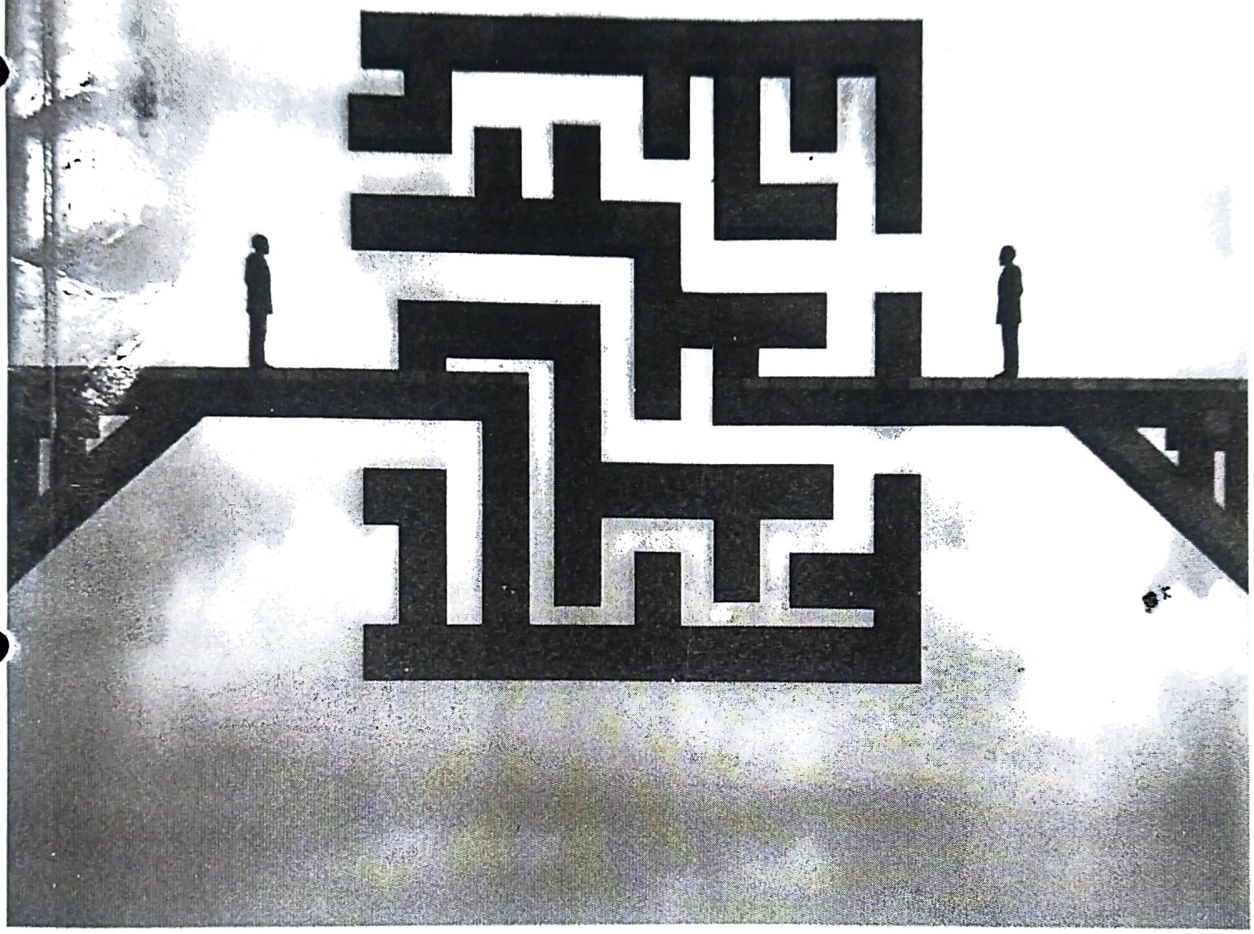

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CONTENTS

CHAPTER 7

Green Governance: Sustainable Human Development

Jeetendra Kumar Pandey and Sonali Chitalkar

Abstract

Cases of environmental degradation and cultural marginalization of traditional societies are universal in the face of deforestation, and severe pollution of rivers, lakes and oceans. Urban, industrial and mining centres in developing countries have become sites of extreme pollution and a threat to human habitation. Such wide-ranging environmental and social breakdown casts a doubt on the capacity of human society to sustain itself. To attain environmental sustainability, society has to design activities to meet human needs as well as preserve the life support system of the planet. Global environmental governance is still in search of an effective model ever since environmental issues gained significance in the international agenda in the 1970s.

Keywords

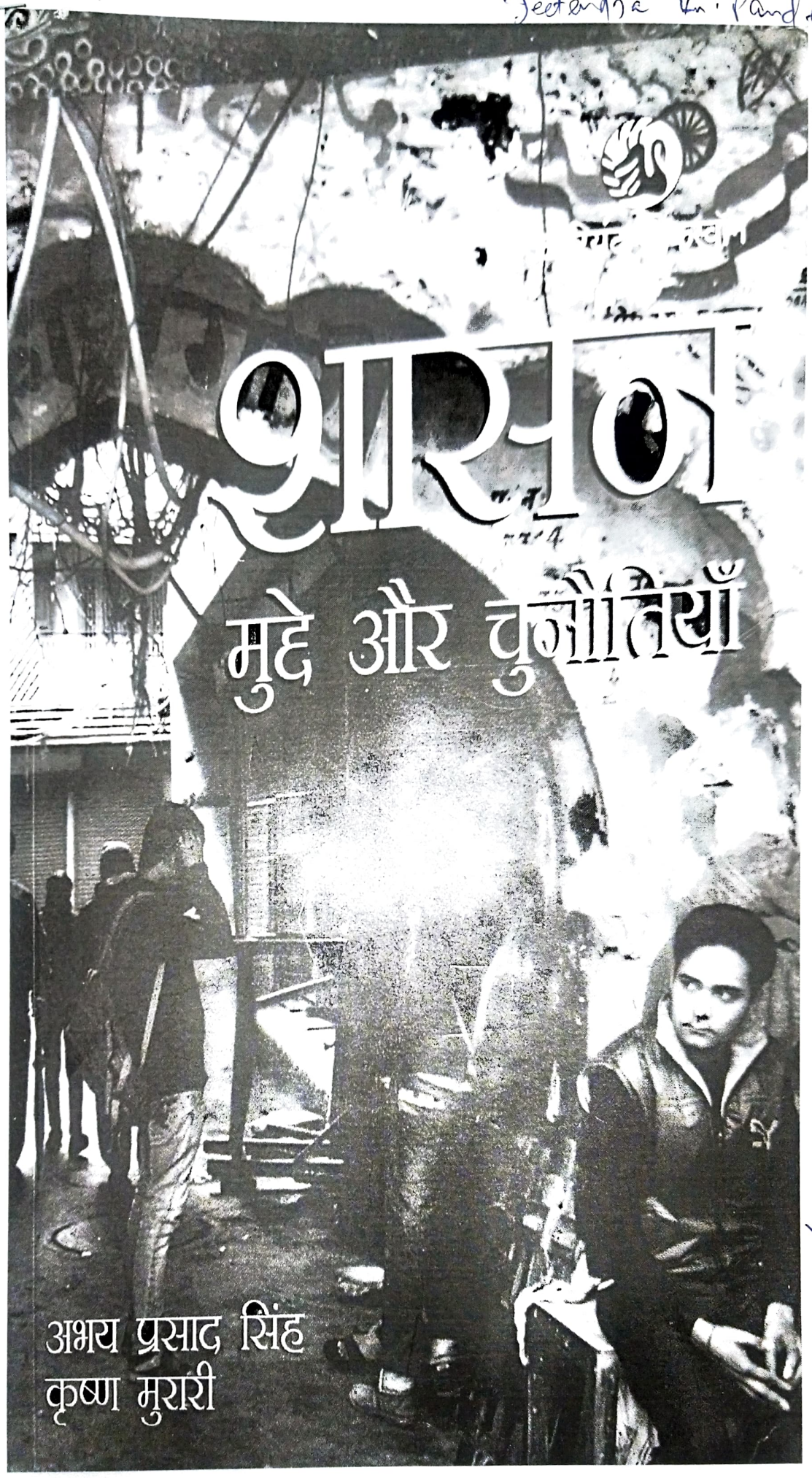
Sustainable Development, Human Development, Green Governance, Environmental Degradation

INTRODUCTION

The concerns and priorities of development policy have been shifting in the latter half of the twentieth century. Till the 1960s, the stress of development policies was on making agriculture more productive and undertaking rapid industrialization. In the 1970s, the focus shifted towards the fulfillment of basic needs like nutrition, sanitation, health, education and employment for the majority, including the poor. However, the assumption that the fruits of development would 'trickle down' to the bottom of the economic pyramid was under severe doubt.

In the 1980s and 1990s, there was unprecedented emphasis on structural adjustment which included targeted correction of imbalanced government budgets and reduction of public debt, streamlining bureaucracies and moving away from bureaucracy-centric development model, amendment of

Jeetendra Kr. Pandey



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लखनऊ, मुंबई, नई दिल्ली, नोएडा, पटना, विजयवाड़ा

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6

तत मानव विकास एवं पारिस्थितिकीय शासन

Sustainable Human Development and Ecological Governance

सोनाली चितलकर
जीतेंद्र कुमार पांडे

महत्त्वपूर्ण शब्द उपभोक्तावाद, नागरिक समाज, पर्यावरण शासन, हरित शासन, पर्यावरणीय प्रभाव आंकलन, सतत विकास।

कथ्य *वन कटाव, अतिप्रदूषित नदियां, झील व महासागर, पारंपरिक समाजों में पर्यावरण ध्वंस तथा सांस्कृतिक सीमांतीकरण आज के विश्व में आम हैं। विकासशील देशों में शहरी, औद्योगिक व खनन केंद्र चरम प्रदूषण के स्थल बन गए हैं तथा मानव वास के लिए खतरा उत्पन्न कर रहे हैं। विकास के इस छोटे से काल में ऐसी वृहद् पर्यावरण व सामाजिक बर्बादी आधुनिक मानव समाज की वहनीयता पर प्रश्नचिन्ह खड़ा करती है। पर्यावरण वहनीयता की यह मांग है कि मानव समाज अपनी जरूरतों की पूर्ति के लिए अपने कार्यकलापों को इस प्रकार नियोजित करे कि पृथ्वी की प्राकृतिक जीवन-पोषण प्रणालियां सुरक्षित व संरक्षित रहें। विश्व पर्यावरण शासन की रूपरेखा अभी निर्माण की अवस्था में है तथा 1970 के दशक से ही एक उपयुक्त प्रतिमान की तलाश में है।*

पिछले पांच दशकों में आर्थिक विकास नीति की प्राथमिकताओं में बदलाव होता रहा है। 1960 के दशक तक विकास नीतियों का मुख्य बल कृषि की उत्पादकता बढ़ाने पर तथा तीव्र औद्योगीकरण पर रहा। 1970 के दशक में विकास नीति के केंद्र में पोषण, स्वच्छता, स्वास्थ्य, शिक्षा एवं रोजगार जैसी मौलिक मानवीय जरूरतें आ गईं। आर्थिक विकास का ट्रिकल डाउन (रिसाव) प्रतिमान अब संदेह के घेरे में आ गया था। 1980 तथा 1990 के दशकों में पूरा जोर ढांचागत सुधार पर था, जिसके लक्ष्यों में असंतुलित सरकारी बजट का सुधार, लोक-ऋण में कटौती, नौकरशाही को कार्यकुशल

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Parveen Garg

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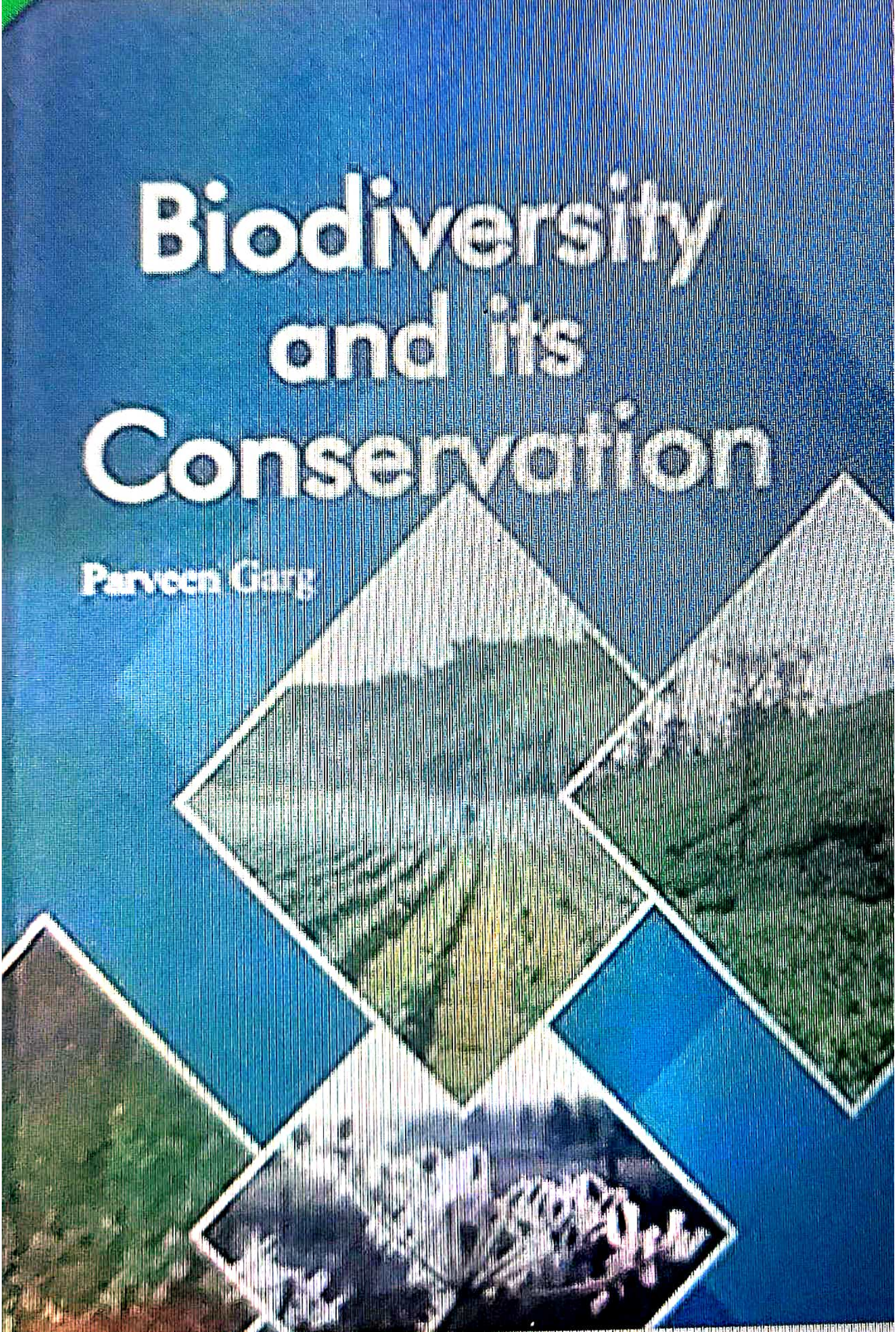
Parveen Garg



Mushroom Cultivation

Parveen Garg

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डॉ. नोदनाथ मिश्र, पूर्व उपशिक्षा सलाहकार, मानव संसाधन एंव विकास मंत्रालय, नई दिल्ली

डॉ. भास्करानंद पांडेय, पूर्व प्राचार्य, शिक्षा विभाग, दिल्ली सरकार, दिल्ली

डॉ. जयंती प्रसाद मिश्र, पूर्व प्राचार्य, शिक्षा विभाग, दिल्ली सरकार, दिल्ली

डॉ. नीलांबर पांडेय, पूर्व निदेशक, (राजभाषा), रक्षा मंत्रालय, नई दिल्ली

डॉ. भारत भूषण शर्मा, पूर्व प्राचार्य, राजकीय महाविद्यालय, नौशहरा, जम्मू एवं कश्मीर

प्रो. मोहनलाल सर, केंद्रीय हिंदी संस्थान, नई दिल्ली

डॉ. हरीश कुमार सेठी, असिस्टेंट प्रोफेसर, इंदिरा गाँधी राष्ट्रीय मुक्त वि.वि., दिल्ली

डॉ. शिव कुमार शर्मा, एसोसिएट प्रोफेसर, महाराजा अग्रसेन महाविद्यालय, दिल्ली

डॉ. विनीता कुमारी, एसोसिएट प्रोफेसर, स्वामी श्रद्धानंद कॉलिज, दिल्ली विश्वविद्यालय

डॉ. ममता सिंगला, एसोसिएट प्रोफेसर, भगिनी निवेदिता कॉलिज दिल्ली विश्वविद्यालय, दिल्ली

डॉ. कुलभूषण शर्मा, असिस्टेंट प्रोफेसर, दिल्ली विश्वविद्यालय, दिल्ली

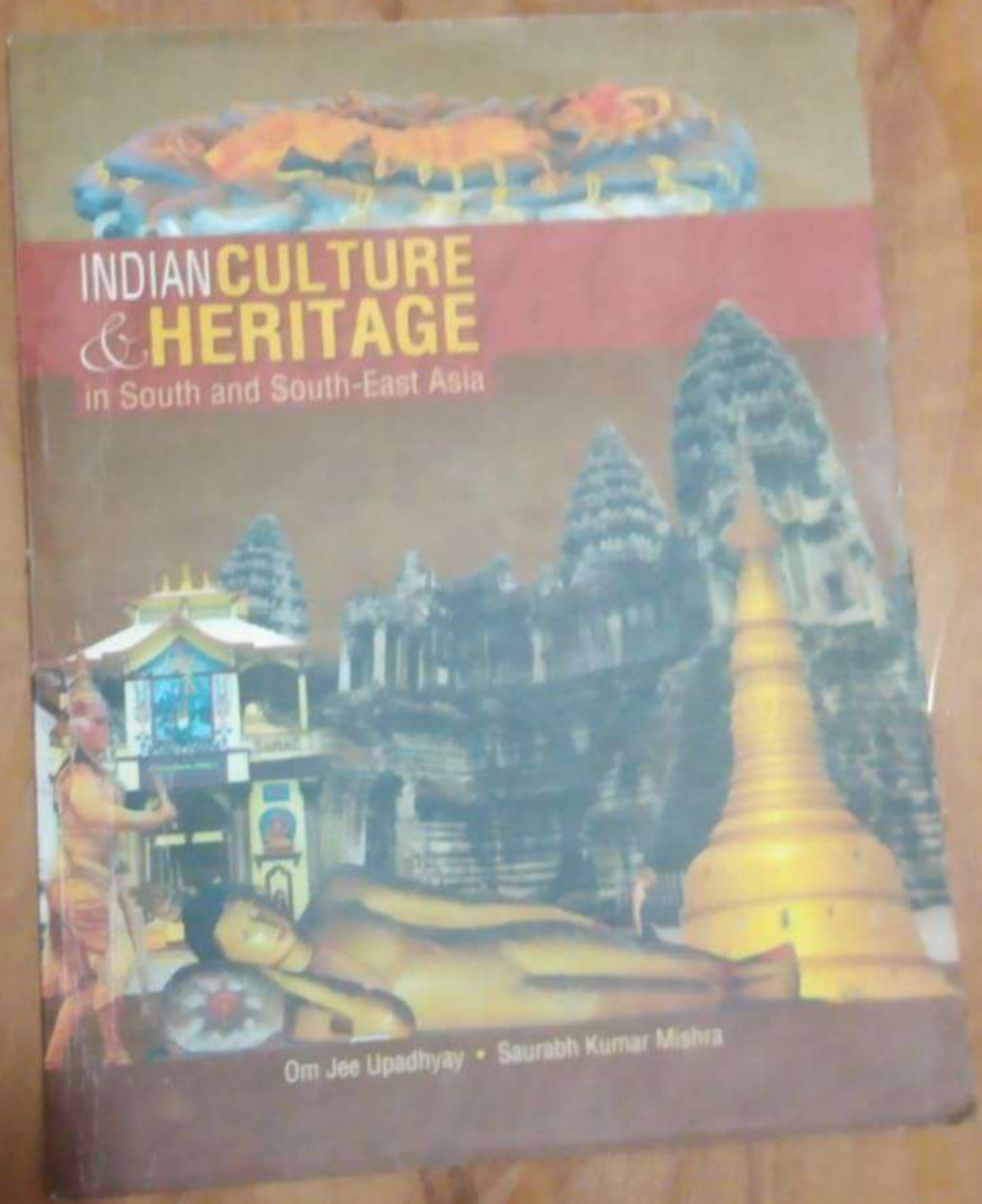
डॉ. सुनील तिवारी, असिस्टेंट प्रोफेसर, शहीद भगतसिंह कालेज, दिल्ली

डॉ. आलोक रंजन पांडेय, असिस्टेंट प्रोफेसर, रामानुजन कालेज, दिल्ली विश्वविद्यालय, दिल्ली

डॉ. सुधांशु कुमार शुक्ला, एसोसिएट प्रोफेसर, हंसराज महाविद्यालय, दिल्ली

डॉ. प्रदीप कुमार, असिस्टेंट प्रोफेसर, स्वामी श्रद्धानंद कालेज, दिल्ली विश्वविद्यालय

डॉ. रामकरण डबास, पूर्व एसोसिएट प्रोफेसर, एस.सी.ई.आर.टी. दिल्ली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