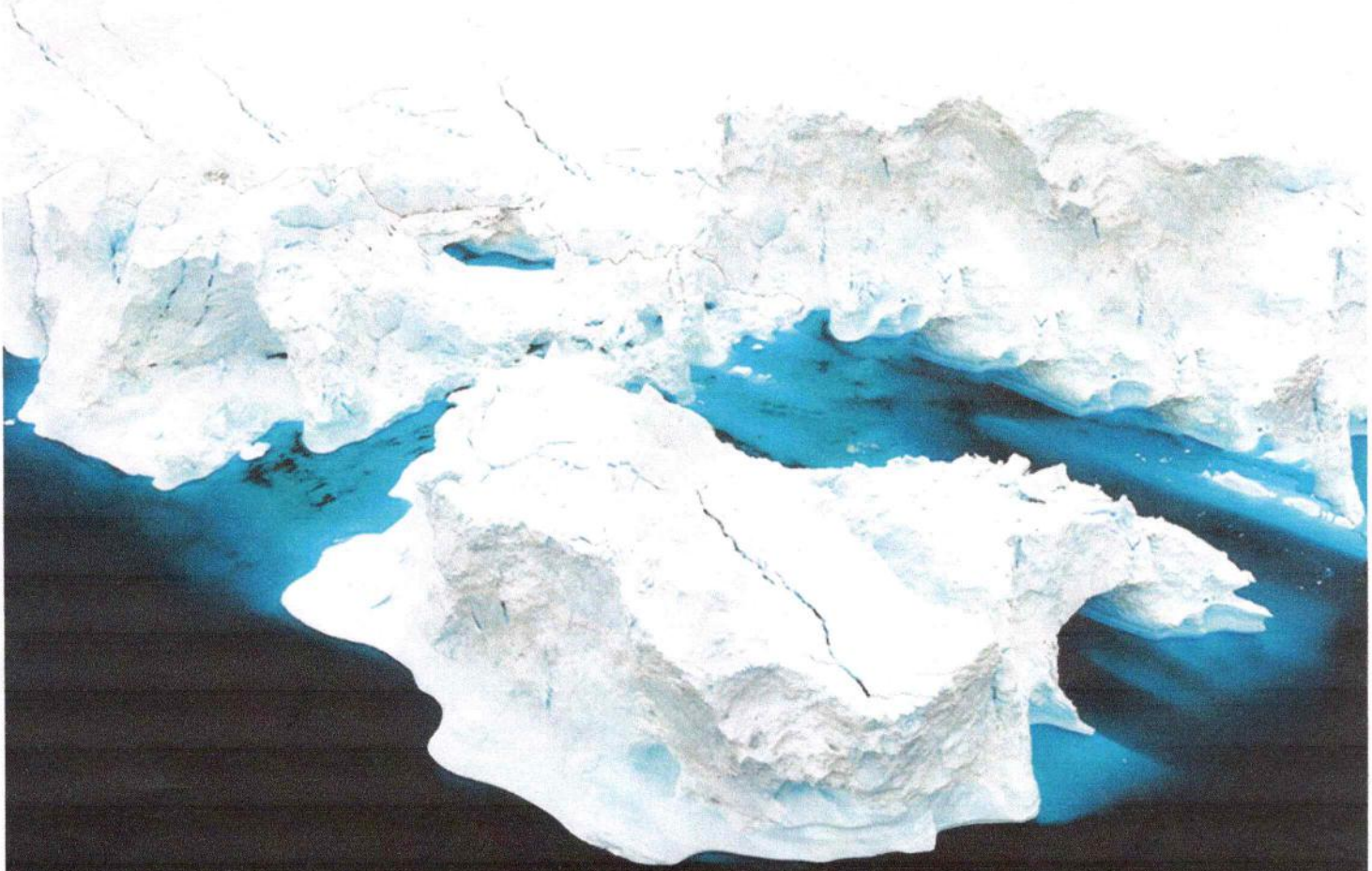
UNDERSTANDING PRESENT AND PAST ARCTIC ENVIRONMENTS

AN INTEGRATED APPROACH FROM CLIMATE CHANGE PERSPECTIVES



Edited by
Neloy Khare

ELSEVIER

Elsevier
Radarweg 29, PO Box 211, 1000 AE Amsterdam, Netherlands
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress

ISBN: 978-0-12-822869-2

For Information on all Elsevier publications
visit our website at https://www.elsevier.com/books-and-journals

Publisher: Candice Janco
Acquisitions Editor: Marisa LaFleur
Editorial Project Manager: Ruby Gammell
Production Project Manager: Kumar Anbazhagan
Cover Designer: Miles Hitchen

Typeset by MPS Limited, Chennai, India

List of contributors

Y.N. Ahammed
Department of Physics, Yogi Vemana University, Kadapa, India

K. Amrutha
Department of Geology, Central University of Punjab, Bathinda, India

B.C. Arya
Radio and Atmospheric Sciences Division, National Physical Laboratory, New Delhi, India

Kato K. Ayemi
Geological Survey of India, Faridabad, India

Ruchika Bajpai
Department of Agronomy, Assam Agricultural University, Jorhat, India

Felix Bast
Department of Botany, Central University of Punjab, Ghudda-VPO, Bathinda, India

Himanshu Chaurasia
Department of Physics, Govt. College Rehti, Sehore, India

Shabnam Choudhary
Ministry of Earth Sciences, Govt. of India, New Delhi, India; National Centre for Polar and Ocean Research (NCPOR), Goa, India

Suryanshu Choudhary
Department of Physics, Rabindranath Tagore University, Bhopal, India

Moumita Das
Mahila Mahavidyalaya, Banaras Hindu University, Varanasi, India

Sweta Baidya Das
National Institute of Disaster Management, New Delhi, India

Supriya Dey
Department of Earth Sciences, Indian Institute of Science Education and Research Kolkata, Mohanpur, India

Amit Dharwadkar
Geological Survey of India, Faridabad, India

Som Dutt
Wadia Institute of Himalayan Geology, Dehradun, India

Deepak Y. Gajbhiye
Geological Survey of India, Faridabad, India

Sasi Kiran Gera
National Centre for Seismology, Ministry of Earth Sciences, New Delhi, India

CHAPTER 17

Measurements of carbon monoxide at Polar regions

B.C. Arya[1], Sachin D. Ghude[2], Y.N. Ahammed[3], Arun Kumar[1], Devesh Kumar Shukla[4] and S.L. Jain[1]
[1]Radio and Atmospheric Sciences Division, National Physical Laboratory, New Delhi, India
[2]Indian Institute of Tropical Meteorology, Pashan, Pune, India
[3]Department of Physics, Yogi Vemana University, Kadapa, India
[4]Environmental Science and Bio-medical Metrology Division, National Physical Laboratory, New Delhi, India

17.1 Introduction

Carbon monoxide (CO) is a chemically important gas in the atmosphere. It is mainly removed from the atmosphere by reaction with hydroxyl radical (OH) (Thompson, 1992). Information about concentrations of OH radical and other trace gases (e.g., ozone, CO, nitrogen oxides, and formaldehyde) help to provide a better understanding of the chemistry of the atmosphere. Carbon monoxide, as a major sink of OH radical, controls the lifetime of many gases which are relevant for climate change studies (Logan et al., 1981; Crutzen, 1995). As a result, CO distribution and trend should influence OH concentration and act in a significant manner on the oxidation capacity of the atmosphere. Therefore an anthropogenic or natural disturbance in the CO concentration could perturb OH concentration and have a significant impact on many aspects of atmospheric chemistry (Thompson and Cicerone, 1986; Khalil and Rasmussen, 1990).

The global budget of atmospheric CO is moderately estimated (Seiler and Conrad, 1987; Crutzen, 1995; Houghton et al., 1995; Holloway et al., 2000); however, it is uncertain. It is generally believed that atmospheric CO comes from fossil fuel combustion, biomass burning, and gas-phase oxidation of natural hydrocarbon (McConnell et al., 1971; Erickson, 1989; Khalil and Rasmussen, 1990). However, there is lack of information about the CO production and distribution processes. Measurements have shown that natural dissolved organic matter (DOM) in lake, wetland, surface marine and fresh water, and rain water leads to

Understanding Present and Past Arctic Environments
DOI: https://doi.org/10.1016/B978-0-12-822869-2.00014-1

the production of CO (Zuo and Jones, 1995, 1996, 1997; Vaughan and Biough, 1998).

Dissolved organic carbon in seawater represents one of the largest reservoirs of carbon on the Earth. Sea ice is often enriched with DOM. Photochemical degradation of DOM from sea-ice, snow-covered regions and seawater by sunlight [ultraviolet visible (UV) radiation] produces carbonyl compounds and carbon gases (primarily CO). Greenland Ice core also showed high CO values suggesting CO production process within the ice.

Measurements showed that the CO production process is found to be radiation dependent and active in the surface snow layer. Strong absorption of UV and visible radiations within the Arctic Sea has been observed in spite of the usually high albedos of sea ice and overlying snow. Studies over Franklin Bay, Arctic region during early March to mid-July show that the total amount of CO emitted from sea ice to the Arctic atmosphere would be 1.4×10^{10} moles a^{-1}, taking the main sea-ice area to be 12×10^6 km^2 in the Northern Hemisphere from March to mid-July. This value represents 3% of the global oceanic CO flux to the atmosphere.

Measurements made from the snow samples (Rasmussen et al., 1982; Haan et al., 1996) showed a large amount of CO and the abundant of CO observed was attributed to the adsorption of atmospheric CO molecules on snow crystal. Recent investigations (Haan et al., 2001) have shown that CO production processes are likely to be involved in freshly fallen snow and significant release of CO flux from the snowpack. This CO production process found to be radiation dependent and active in the surface snow layer, suggesting HCHO photolysis to be partly responsible for CO production in snow (Haan et al., 2001). Therefore, to define the role of snow- and ice-covered region in the atmospheric chemistry and CO budget, information about CO production process from snow are important.

To measure the CO concentration and variability in the surface air over the snow-covered region of Antarctica, measurements were carried out at Maitri (Indian Research Base in Antarctica) during summer campaign of XXII Indian Antarctic Scientific Expedition (2003–04). Measurements were also carried out in the first Arctic winter phase expedition (March 3–31, 2008). The measurements of CO and surface ozone were also carried out at Indian Arctic station "Himadri," Ny-Ålesund, Svalbard (78°54′N, 11°53′E) from March 20 to April 19, 2010, which coincide with the episode of tropospheric ozone depletion that occurred

from March 29, 2010, 2200 hours to April 01, 2010, 1700 hours. Here, we report the results obtained from these measurements, which show the diurnal cycle of carbon monoxide and daytime increase along with solar actinic radiation.

17.2 Experimental site and setup

Measurement of surface-level CO concentration has been carried out at a high latitude site (70.46S, 11.44E), Maitri, located in the Schirmacher region of east Antarctica. Schirmacher Oasis is a rocky hill range of about 35 sq km. Maitri, is situated on the ice-free rocky area of Schirmacher Oasis. The entire area is surrounded by the adulatory shelf ice and polar ice sheet (Ravendra et al., 2001), and snow deposition is widespread on the leeward side of the hillocks. The northeastern and north-western corners of the area are on shelf ice, while the south-western extremity is on polar ice sheet. The southernmost ice sheet is bare "blue ice." The northernmost part of the area comprises shelf ice. The central part of the area is occupied by Lake B7 (500 m × 300 m) (Ravendra et al., 2001) where the Maitri (140 masl) station is located. It is a lake of glacial origin. On both the northern and southern sides of Maitri, ice region exists at about 500 m from the station. Snowfall is quite frequent during the winter months, but gale force winds scrub the rocky surfaces clean; however, snow deposition is widespread on the leeward side of the hillocks. The single-storey building of Maitri station and other structures such as generator huts, incinerator, were about 150–200 m away in the northeast from the site of the measurements so that any pollutant released from them had little or no chance of reaching the site of measurements with the prevalent winds, except during few exceptional episodes.

CO measurements were carried out using ultrasensitive gas filter correlation (GFC) nondispersive infrared absorption CO analyzer of Advanced Pollution Instrument Inc. (API, Model 300), which is described in detail by Dickerson and Delancy (1988) and Cogan and Lobert (1998). This instrument is equipped with an internal zero and span option (IZA), which allows for internal creation of zero gas that effectively removes ambient level of CO from the sample gas. Interfering effects of H_2O are minimized by the GFC wheel yielding a rejection ratio of H_2O of the order of 5×10^{-6}:1.

Therefore for an ambient water vapor of about 2800 ppm (observed at observation site during February) the water vapor interference would be

less than 1 ppb. To minimize zero drift of the instrument the laboratory temperature was maintained at 20°C. The main air inlet was installed on top of the sidewall of the observatory 2.5 m above the ground. The Teflon tube between the inlet and the instrument was around 2 m long with an inner diameter of 4 mm. Great care has been taken to avoid any error throughout the measurement period. The zero and span calibration were performed regularly for data accuracy and to enhance its stability for low-level detection. Regular automatic zero checking, every 2 hours, was carried out and daily span checks of the instrument were performed with 1 ppm (1%) commercial gas standard (Scott specialty gases, San Bernardino, CA). This calibration frequency was found to be adequate as no significant difference was observed in the measurement made before and after the calibration. The technical specification of the CO analyzer is given in Table 17.1. This instrument measures the CO concentration continuously and averages it for time intervals programmed by the user. The analyzer stored data separately in the data record format of 5-minute average and 1-hour average (5-minute average is based on 1-minute average calculated with sampling rate of 10 seconds and 1 hour average is calculated by 5-minute average). We have used 5-minute data record to calculate hourly average and SD.

17.3 Observations and results

Continuous measurement of surface CO concentration at Maitri, Antarctica was carried out over a 6-week period during February and March 2003 (austral summer), as a part of the trace gases measurement project. Simultaneously, columnar ozone and water vapor measurements using MICROTOPS sun photometer were also carried out. Direct solar UVB irradiance at 300 and 305 nm was derived using the irradiance

Table 17.1 Technical specifications of carbon monoxide analyzer.

Zero noise	<0.01 ppm RMS
Span noise	<0.5% of reading above 5 ppm (RMS)
Lower detectable limit (LDL)	0.02 ppm
Zero drift	<10 ppb/24 h, 20 ppb/7 days
Span drift	<0.5% of reading/24 h, 1% of reading/7 days
Linearity	1% of full scale
Precision	0.5% of reading
Sample flow rate	1800 scc min^{-1} ± 20%

calibration constant provided by the MICROTOPS instrument, and direct UV irradiance flux between the wavelength 280 and 420 nm has been calculated using the total UV visible (TUV) radiation model (Madronich, 1993), which we used to compare diurnal variation of CO with solar UVB radiation.

Temporal variation of daily mean atmospheric CO concentration along with sunlight hours of day for the period February 1, 2003 to March 14, 2003 is depicted in Fig. 17.1. The daily mean atmospheric CO concentration at Maitri varied significantly from one day to another, ranging from about 22 to 80 ppb. This day-to-day variability reflects the influence of local photochemistry and prevailing meteorological conditions at site (Gros et al., 2001). However, as depicted by the linear fit curve on the set of data shown in Fig. 17.1, CO concentration showed an increasing tendency, in spite of large day-to-day variability. Fig. 17.1 also displays the temporal variation of period of sunlight hour at observational site Maitri. On February 1 the period of sunlight hours was about 2130 hours (time between sunrise and sunset) which gradually decreased to about less than 1330 hours on March 14. Measurement of water vapor (one of the major sources of OH radicals) for the same location also showed a tendency of decreasing water vapor concentration for the same period (Jain et al., 2005).

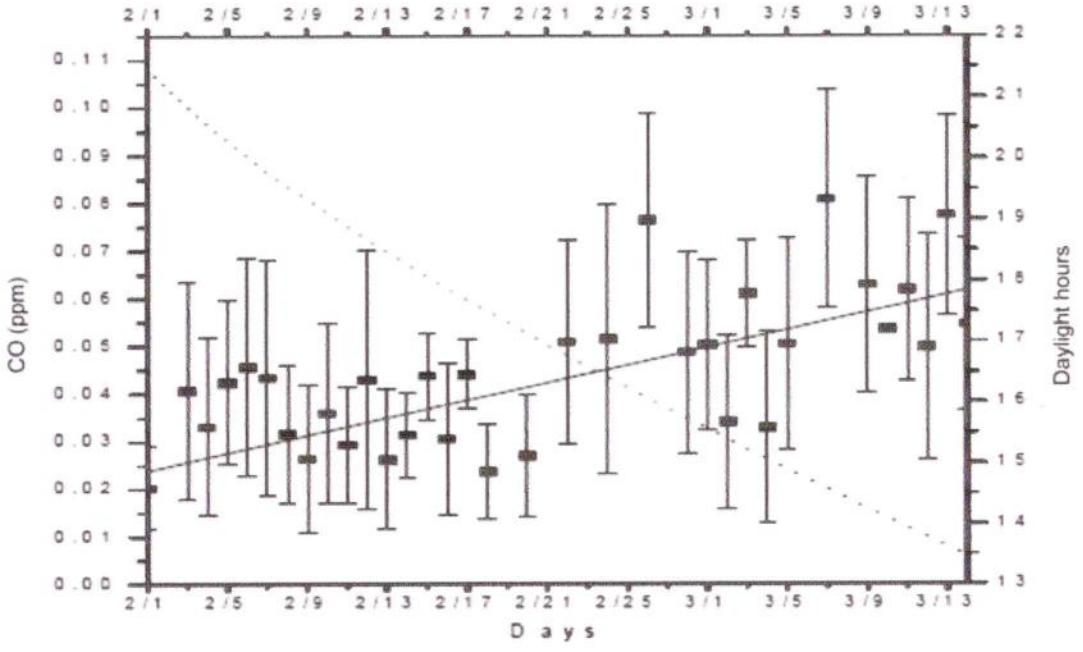


Figure 17.1 Comparison of daily mean CO concentration (dots), observed for February 1, to March 14, 2003 period, together with the daylight hours (*dashed line*). The straight line shows the linear fit cure on daily mean CO concentration.

Fig. 17.1 reveals that the increasing trend of CO concentration coincides with the decreasing trend of the amount of daily solar actinic flux (Correlation $R = -0.62$), as the photochemical oxidization of CO by OH (Spivakovsky et al., 1990; Thompson, 1992) is the main sink of CO. This leads to the slow accumulation of CO in the boundary layer as the amount of solar radiation decreases. Inverse CO correlation with the amount of daily solar actinic flux similar to those observed in our measurement and inverse CO correlation with estimated OH concentration have already been reported by earlier studies (Seiler, 1974; Novelli et al., 1994). Novelli et al. (1998a, b) and Matsueda et al. (1998) have also pointed out that the timing of maximum and minimum CO concentration in the southern hemisphere is delayed by about 2 months from the estimated period of the minimum amount in OH.

In the presence of sunlight, photochemical oxidation of CO by OH considerably decreases its residence time in the atmosphere. The solar actinic flux (Beaglehole and Carter, 1992; Ghude et al., 2005) and OH concentration (Mount, 1995; Lee et al., 2006) over Antarctica showed a marked diurnal variability during the summer season. As shown in Fig. 17.2, the data in the thick line, it has been observed that as the solar elevation increases, the CO concentration increases. To identify this process, measured CO values were compared with direct solar UVB radiation at 300 and 305 nm (measured by MICROTOPS-II sun photometer) and direct UV irradiance flux (280–420 nm) calculated from the TUV model (Fig. 17.2). A rapid increase in CO concentration with the increase of solar UV radiation has been observed. CO was found to increase rapidly between 6 and 13 hours and reached a maximum of about 62 ppb in the early afternoon when the solar irradiation was at its maximum. A direct UV irradiation calculated from TUV model (280–420 nm) was taken to investigate its covariance with observed CO concentration between 4 and 15 hours, as shown in Fig. 17.3. The results from linear regression of CO with UV radiation showed a significant positive correlation.

Fig. 17.4A, B and C, D show the hourly mean CO values for clear sunny days and cloudy days, respectively. During cloud-free sky days, on February 5 and 10, 2003, the weather conditions were mostly characterized by wind speed below 10 m s^{-1} and clear sky during, before, and after the days of observation. While, on cloudy days (18 February and 5 March), the wind speed was above 20 m s^{-1} and sky conditions were cloudy. However, bright intervals occurred sparsely and only for a very short time on the days of observation. As seen from Fig. 17.4A and B,

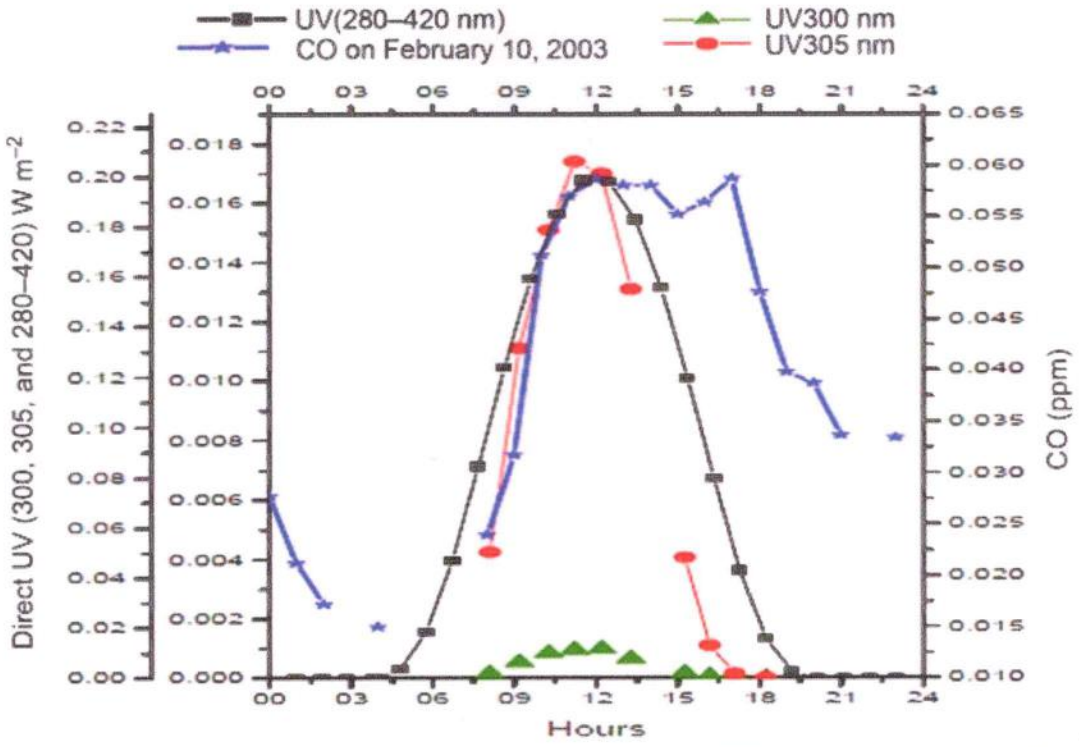


Figure 17.2 Comparison of diurnal variation of CO, on February 10, 2003, together with the direct UV (300 and 305 nm) obtained from MICROTOPS sun photometer and direct UV for the wavelength interval 280–420 nm derived from the TUV model [Columnar ozone = 289 DU; AOD = 0.012 (Gadhavi and Jayaraman, 2004); altitude: 0.140 m]. *TUV*, Total ultraviolet visible.

diurnal cycle was apparent during clear sky conditions with a higher CO mixing ratio during daytime. On the clear sky days, CO concentration has been observed to increase with a rate of approximately 5.1 ppb h^{-1} between the interval 06 and 13 hours. A maximum of about 62 ppb has been observed in the afternoon (from 12 to 18 hours) and then gradually decline to a minimum of about 20 ppb in the early morning. On the cloudy days however, CO concentration decreased during daytime, and cloudy condition and no diurnal variation were observed.

To study the mean of diurnal variability during the observational period of 6 weeks (from February 01–March 11, 2003), hourly mean values were plotted in Fig. 17.5. The vertical error bars show the one sigma standard deviation. Standard deviation has been observed relatively higher during the daylight hours (about ± 0.023 ppb) and reduces (about ± 0.013 ppb) during the dark hours. This signifies that more changes of CO occur during the day than nighttime hours. The variability in CO concentration has been observed with hourly mixing ratio ranging from 30 (± 0.014) to 65 ($+0.023$) ppb. This shows about twofold diurnal

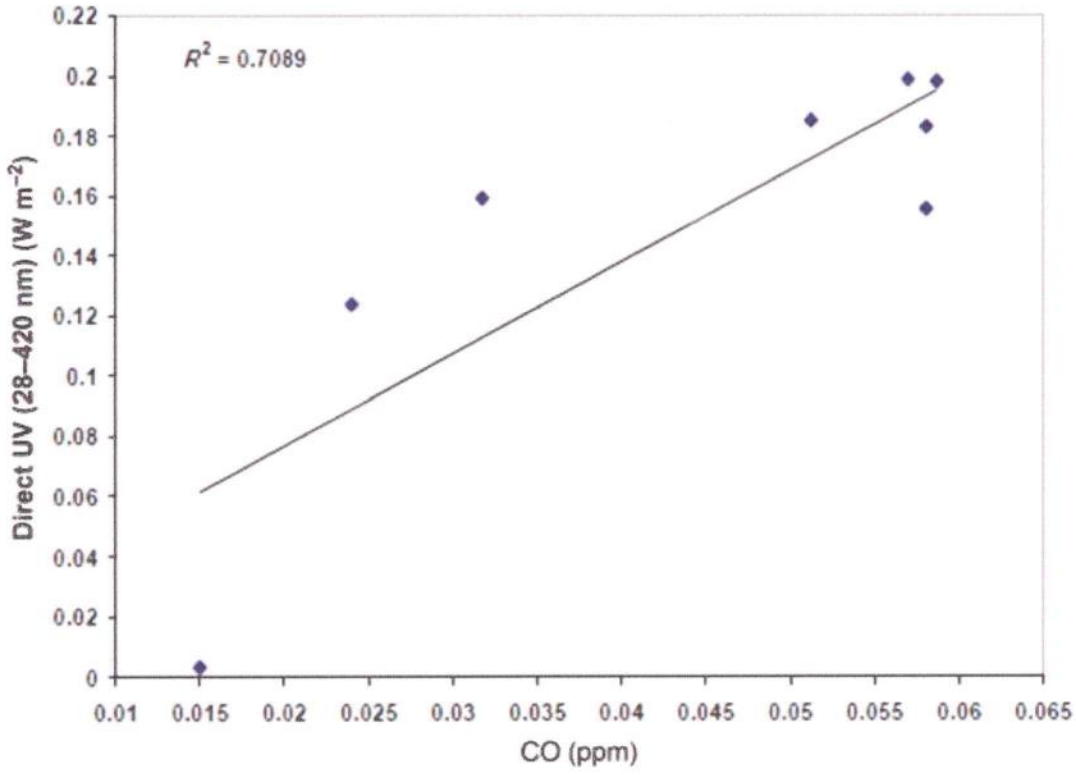


Figure 17.3 A scattered plot between direct UV irradiation calculated from TUV model (280–420 nm) and observed CO concentration between 4 and 15 h. *TUV*, Total ultraviolet visible.

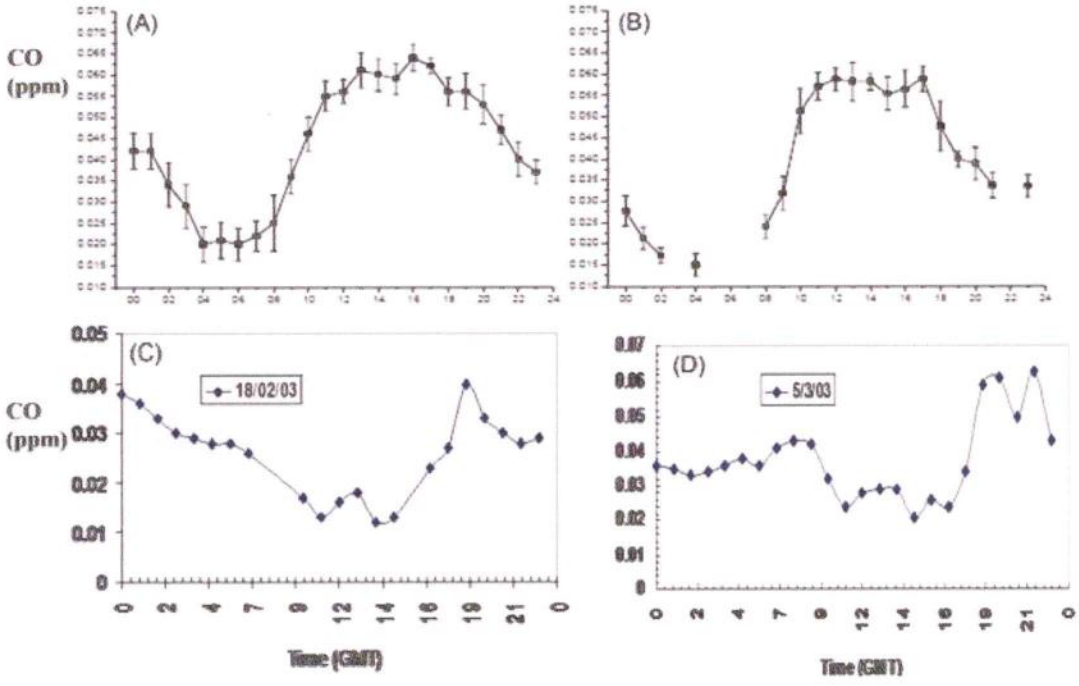


Figure 17.4 Diurnal variation of CO on clear sky days: (A) February 5, 2003 and (B) February 10, 2003; and on cloudy days: (C) February 18, 2003 and (D) March 5, 2003. The vertical bars show the one sigma standard deviation.

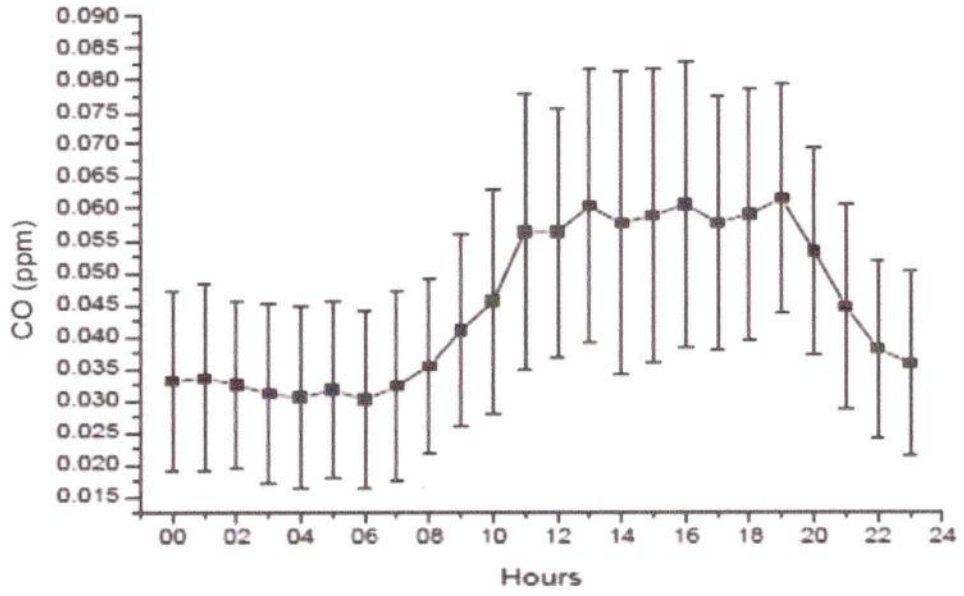


Figure 17.5 Diurnal cycle of CO concentration, observed from February 1–March 14, 2003. The vertical bar shows the one sigma standard deviation.

change that corresponds to about 30 ppb increases in the afternoon. The mean rate of increase in CO concentration has been observed 4.2 ppb h^{-1} (6–13 hours). The maximum CO concentration was detected in the afternoon when the solar elevation angle was high. During nighttime, CO concentration declined to minimum.

In view of the above, CO measurements were also carried out at Indian Arctic station "Himadri," Ny-Ålesund, International Research and Monitoring Facility, Svalbard (78°54′N, 11°53′E), in the Norwegian Arctic, during the first Indian Arctic winter phase expedition (March 3–31, 2008) to study the snow-pack production of carbon monoxide and its diurnal variability. Ny-Ålesund is a village located on the southern shore of Kongsfjorden, on the west coast of Spitsbergen (78°54′N, 11° 53′E) which is the largest of the Svalbard Islands. The facility is surrounded by steep mountains, among which the Zeppelin mountain is ~2 km from Ny-Ålesund, peaks at 474 masl. The sampling site was located at the foot of the Zeppelin mountain.

Continuous measurements of carbon monoxide (CO) have been carried out at Ny-Ålesund, Arctic using Horiba (APMA 370) Ambient CO monitor during March 9–27, 2008 with a 5-minute interval. CO analyzer was precalibrated at NPL using zero air and calibration standard of 10 ppmv CO concentration. CO concentration at measurement site varies between 147 and 201 ppbv with an average value of 164 ppbv, whereas

at Maitri, Antarctica CO concentration varies between 20 and 90 ppbv with an average value of 60 ppbv (Fig. 17.6).

During the measurement period, that is, from March 10 to 24, 2008, there were two events of snowfall at an observation site. We attempted to correlate UV radiation with ambient CO concentration of measured data of CO and UV radiation from March 10 to 14, 2008 and March 24 to 27, 2008 (Fig. 17.7). The measurements of both these periods were

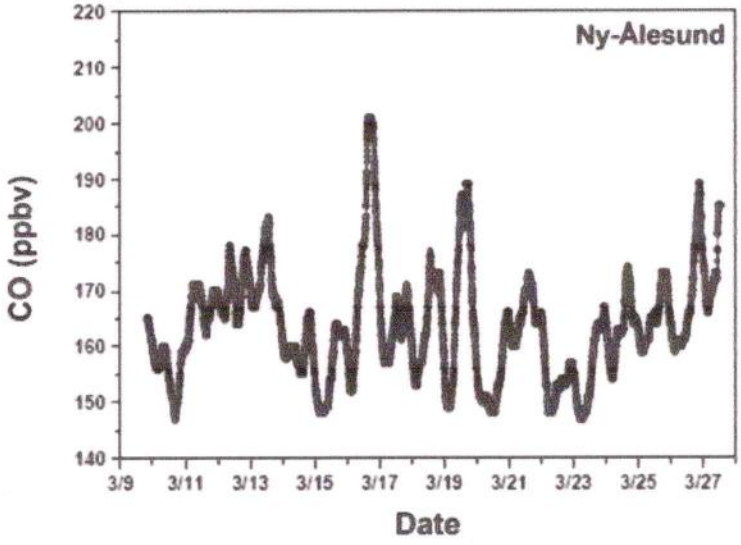


Figure 17.6 Temporal variation of carbon monoxide (CO) in ppbv at Ny-Ålesund, Arctic during March 9–27, 2008.

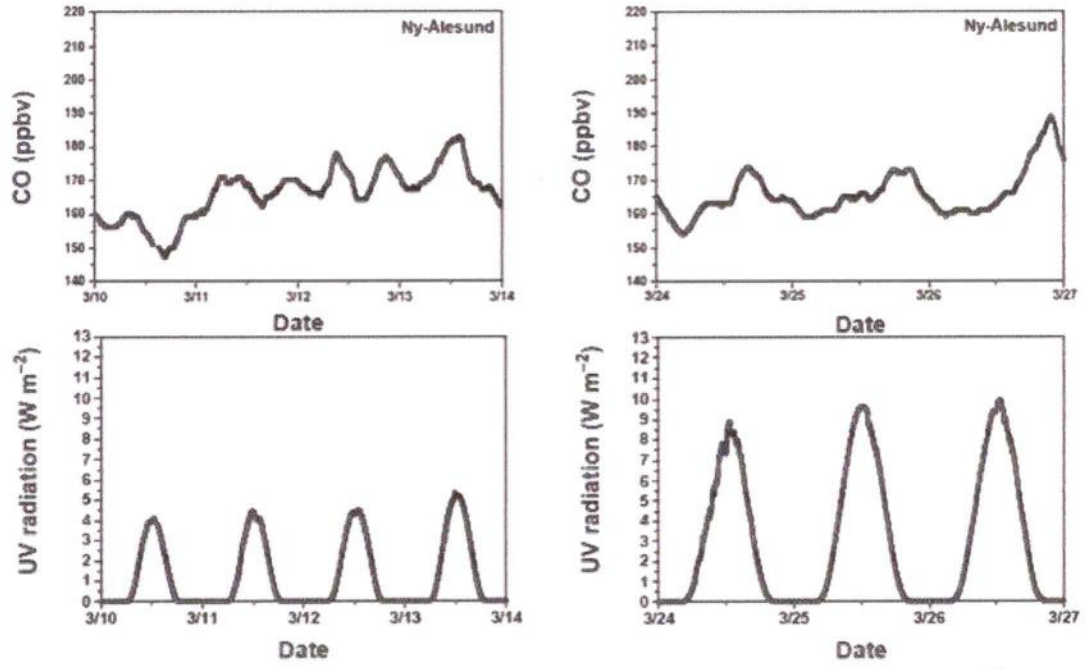


Figure 17.7 Diurnal variation of CO concentration and UV radiation at Ny-Ålesund during and after snowfall events.

characterized by atmospheric condition with calm wind condition and clear sunny days which leads to a very stable boundary layer. A positive correlation was observed between CO concentration and UV radiation. As UV radiation increases, the concentration increase in CO is also apparent. The integrated solar irradiation (measured at Koldewey station in Ny-Ålesund) of the UV radiation flux ($300\ \text{nm} < \lambda < 370\ \text{nm}$) was used to correlate UV radiation with ambient CO concentration. CO concentration attains comparatively a high value (190 ppbv) when fresh fallen snow is exposed to UV radiation on March 27, 2008.

The dramatic loss of O_3 and Hg over a period of days to week in Arctic boundary layer during polar sunrise has been investigated and analyzed by several investigators. This depletion process is related to the presence of bromine. The main source of reactive bromine species (Br and BrO) is bromide which is released via photochemical and heterogeneous chemical reactions from sea salt. Most of the ozone depletion events (ODEs) have been observed from coastal sites when is frozen and snow covered. The duration of ODEs at coastal sites was found typically between 1 and 3 days depending on meteorology.

$$\text{Br} + \text{O}_3 \rightarrow \text{BrO} + \text{O}_2 \tag{17.1}$$

$$\text{BrO} + \text{BrO} \rightarrow 2\text{Br} + \text{O}_2 \tag{17.2}$$

$$\text{BrO} + h\nu \rightarrow \text{Br} + \text{O}$$

Another ozone destruction reaction involves reactions of halogen oxides with HO_2:

$$\text{BrO} + \text{HO}_2 \rightarrow \text{HOBr} + \text{O}_2$$
$$\text{HOBr} + h\nu \rightarrow \text{Br} + \text{OH}$$

During this sunlit period, series of field and laboratory experiments have also shown that many chemical species such as carbonyl compounds (HCHO, CH3COH, acetone, etc.), NO_x, C_2H_2, and CO are produced photochemically from snowpack, as a result of which the ozone destruction chain is reduced by reaction of Br atoms with aldehydes.

$$\text{Br} + \text{HCHO} \rightarrow \text{HBr} + \text{HCO} \tag{17.3}$$

$$\text{Br} + \text{CH3CHO} \rightarrow \text{HBr} + \text{CH}_3\text{C(O)} \tag{17.4}$$

The rate constant for the reaction of formaldehyde with Br atoms is relatively fast ($1.7 \times 10{-}11\ \exp\ (-800/T)$).

The photolysis and oxidation of HCHO or other aldehydes yield either hydrogen atoms and HCO radicals or hydrogen molecules and carbon monoxide (CO) depending on the wavelength. Aldehydes especially HCHO are an important source of CO and HO_2 radicals in the clean atmosphere.

Any reactions that produce H or HCO in the troposphere act as HO_2 and CO sources:

$$HCHO + h\nu(\lambda < 325\ nm) \rightarrow H + HCO \tag{17.5}$$

$$HCHO + h\nu(325\ nm < \lambda < 360\ nm) \rightarrow H_2 + CO \tag{17.6}$$

$$H + O_2 \rightarrow HO_2 \tag{17.7}$$

$$HCO + O_2 \rightarrow HO_2 + CO \tag{17.8}$$

In addition to Br, chemically induced Cl reaction also takes place during ODEs. Due to relatively high rate constants of Cl with hydrocarbons as compared to oxidation by OH, Cl readily reacts with hydrocarbon, which leads to the production of CO.

Fig. 17.8 showed a time series of O_3 and CO measurements carried out at Ny-Ålesund at Indian Arctic station Himadri from March 28 to April 19, 2010, which coincide with the episode of tropospheric ozone depletion that occurred from March 29, 2010, 22:00 hours to April 01, 2010, 17:00 hours. Ozone measurements were carried out using Horiba (APOA-370) Ambient Ozone Monitor. Zeppelin station data are also shown in the figure for comparison. A back trajectory analysis (not shown) showed that episodes of ozone depletion are found associated with air masses advected from frozen Arctic Ocean site. A signature of slightly gradual increase (approx. 215 ppb to 240 ppb) of CO levels was observed during depletion event when the ozone depleted from 55 to 25 ppb, from March 29, 2010, 22:00 hours to April 01, 2010, 17:00 hours. The elevated level of CO may be attributed to the production of CO as a result of reaction of Cl and Br with nonmethane hydrocarbons.

17.4 Discussion

The results obtained from the field measurement of CO from a high latitude site (Maitri, Antarctica) for a 6-week period and CO measurements

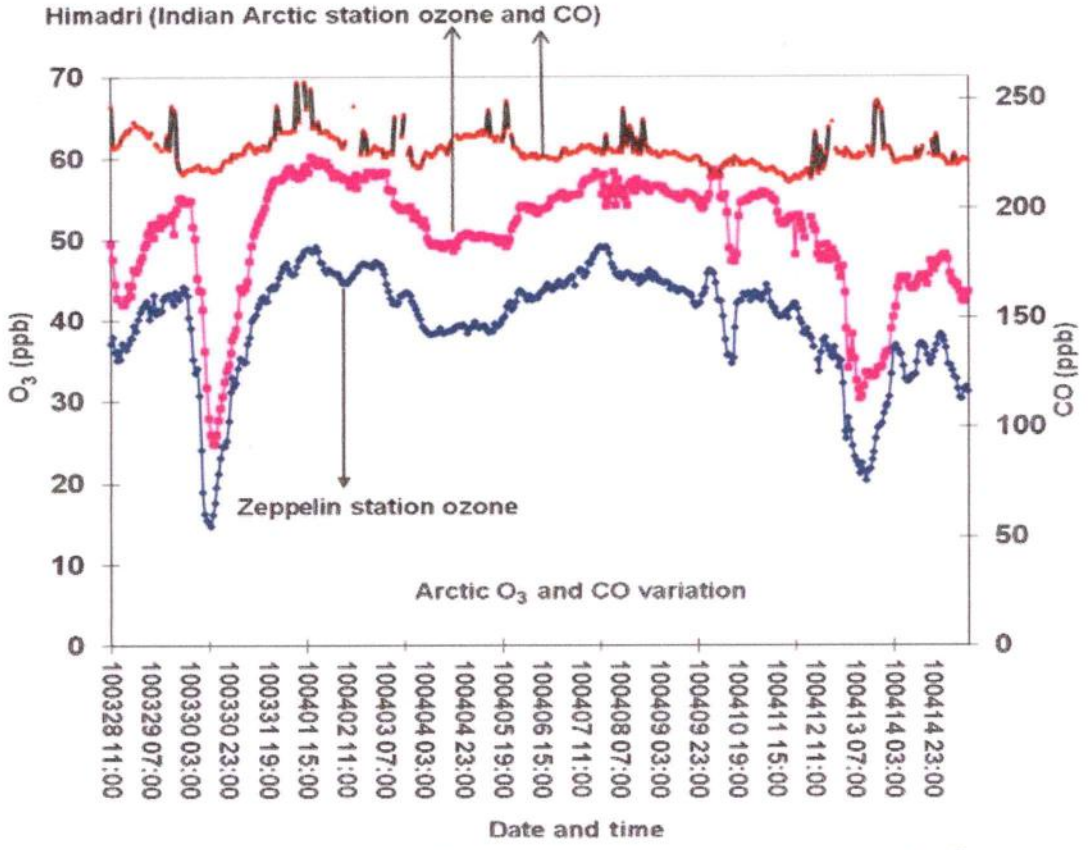


Figure 17.8 Time series of O_3 and CO measurements carried out at Ny-Ålesund at Indian Arctic station "Himadri" from March 28 April 19, 2010.

carried out at Indian Arctic station "Himadri," Ny-Ålesund, Svalbard (78° 54′N, 11°53′E) during the first Indian Arctic winter phase expedition (March 3–31, 2008) and from March 20 to April 19, 2010 are presented here. Diurnal changes in CO concentration were observed with higher CO mixing ratios in the daytime during clear sky at Maitri, Antarctica. On cloudy days, no diurnal variation was observed. This observation suggests that the increase in CO concentration (with increase in solar elevation) probably takes place through photochemical mechanisms that are activated by sunlight or some other unknown process that is correlated with the sunlight. Haan et al. (2001) conducted chamber experiments on freshly fallen snow from Mount Sonnblick in Austria and found evidence for light dependent. He noticed that CO generation was a function of snow total organic compound concentration and suggested that it is related to the oxidation of organic compounds. Similarly Grannas et al. (2002) found that ice pellets made from melted Arctic and Antarctic snow produced CH_2O and CH_3CHO when irradiated in the laboratory. Production rates were enhanced by the addition of nitrate to the melted

snow, perhaps due to enhanced OH production. Sumner and Shepson (1999) suggested that carbonyl compounds may be generated by reactions of DOM with condensed phase OH radicals. It has recently been shown that direct photochemical transformation (295–340 nm) of DOM present in seawater results in the production of carbonyl compounds and alkenes, which are then released to the atmosphere. If this chemistry also occurs in the snowpack, photooxidation of DOM could serve as a source of carbonyl compounds in the Arctic snowpack. The presence of several organic compounds in snow has already been reported by Legrand and Mayewski (1997) and by other investigators (Li and Wsnclsester, 1993; Shepson et al., 1996; Hutterli et al., 1999; Couch et al., 2000). The result of closed chamber experiment conducted by Haan et al. (2001) at Mt. Sonnblick, Austria observed an increase of CO concentration of 3.8–9.5 ppb min^{-1} in the box and a decrease of 6 ppb min^{-1} when the box is darkened, which they attributed to loss of CO through porous layer. From this experiment, they derived that the diurnal variation of CO in snow is controlled by photochemical processes leading to large amount of CO production in the freshly fallen snow and release into the atmosphere when snow was exposed to sunlight during daytime.

A number of field and modeling studies indicate that a source of gas-phase organic compounds exists in polar snowpacks and that the evolution and emission of these species may significantly impact the overlying boundary layer. The snow-pack chemistry of H_2O_2 and volatile carbonyls (as well as other organic compounds) is likely to have a close interaction with hydroxyl radical. Because of its very high reactivity, OH is probably the major oxidant for organic compounds and other contaminants on sun-lit snow grains (Anastasio et al., 2007; France et al., 2007). The most significant role of hydrogen peroxide in snow grain chemistry is a photo-chemical source of OH radical. Calculations based on laboratory measure-ments showed that H_2O_2 photolysis is the dominant source of OH on Antarctic and Arctic snow grains (Chu and Anastasio, 2005). Away from coastal reigns with elevated sea salt levels, the greatest sinks for snow grain OH is possibly organic compounds (Anastasio et al., 2007). In this case, most photo-formed OH will react with organics and these reactions prob-ably account for a significant portion of the carbon-containing products that are emitted from snow. In addition to CH_2O and other carbonyls such as those described earlier, the products formed from OH reactions with organics may also include CO and carboxylic acids. So it is impor-tant, that other mechanisms such as direct photoreactions of organic

compounds and indirect photoreactions involving other oxidants are probably also significant in the release of CO and volatile organic compounds (VOCs).

Low molecular weight aldehyde (RH(C = O)) and ketones (RR′ (C = O)) are ubiquitous VOCs in the Arctic atmosphere (Barrie et al., 1988; Bottenheim et al., 1990; De Serves, 1994; Shepson et al., 1996). Recent observations that formaldehyde (HCHO), acetaldehyde (CH_3CH), and acetone ($(CH_3)_2CO$) were elevated in snow-pack interstitial air (Couch et al., 2000), and the NO_x was photochemically produced in the snowpack indicate that the snowpack is chemically active and that it can release carbonyl compounds to the troposphere. Such a source may explain why their Arctic troposphere concentrations cannot be explained by considering only (1) gas-phase oxidation of hydrocarbons as the main source and (2) photolysis and radical oxidation as the main sinks (Shepson et al., 1996; Sumner and Shepson, 1999). Hydrocarbon precursors were measured both at Narwhal and Alert in April 1994. The dominant reactive hydrocarbons were CH_4, C_2H_6, C_3H_8, n-C_4H_{10}, i-C_4H_{10}, n-C_5H_{12}, and i-C_5H_{12}.

The photolysis and oxidation of HCHO or other aldehydes yield either hydrogen atoms and HCO radicals or hydrogen molecules and carbon monoxide (CO) depending on the wavelength. Aldehydes especially HCHO are an important source of CO and HO_2 radicals in the clean atmosphere. Any reactions that produce H or HCO in the troposphere act as HO_2 and CO sources. The photolysis of higher aldehydes, RCHO, also forms HCO and hence HO_2.

The ozone depletion and halogen chemistry have a significant impact on nonmethane hydrocarbons photochemistry. Jobson et al. (1994) and Yokouchi et al. (1994) first observed that light hydrocarbons are rapidly consumed (mostly by CI atoms) during ODEs. They showed that reactive alkanes such as butane and *n*-isopentane are almost completely removed during ODEs. During ODEs relatively high rate constants of Cl with hydrocarbons as compared to oxidation by OH, Cl readily reacts with hydrocarbons and thus extensive chlorine atoms processing of VOCs take place. For example, during ODEs, there is a substantial consumption of propane, and a concomitant increase in acetone was observed. As discussed, HO_2 is produced in significant part by CI atom reaction with nonmethane hydrocarbons to produce HO_2 directly, or through photolysis of the product HCHO.

Haan et al. (2001) suggested that photolysis of the formaldehyde could be partially responsible for observed CO increase. Very recently, some

studies have reported high HCHO concentration in the snowpack (Hutterli et al., 1999; Katja et al., 1999; Sumner and Shepson, 1999; Couch et al., 2000; Riedel et al., 2005) and favored the degassing process. Formaldehyde is rapidly destroyed by sunlight producing hydroperoxyle radical and CO through the following photolysis reaction:

1. $HCHO + h\nu \rightarrow CO + H_2$, $J_1 = 3.73 \times 10^{-05}\ S^{-1}$
2. $HCHO + h\nu \rightarrow H + CHO$, $J_2 = 2.17 \times 10^{-05}\ S^{-1}$
3. $HCO + O_2 \rightarrow HO_2 + CO$

The product of the second reaction reacts rapidly with molecular oxygen for HO_2 and CO.

For example, if we take a measurement of HCHO at Antarctica's Neumayer station concentration (400 ppt), a simple calculation of HCHO photolysis leading to CO production rate of about 85 ppt/h^{-1}. By taking two photodissociation rate coefficient (J) obtained using TUV model for clear sky condition at noontime for 11.44E, 70.46S, K represented the volumetric CO production rate ($K = (J_1 + J_2) \times [HCHO]$). This CO production rate is much lower (ignoring other CO production mechanism) than that of the observed rate of CO increase (approximately 5.1 ppb h^{-1}) during daytime. This suggests and as discussed earlier, there are various physical and chemical processes that determine the concentration of carbon monoxide in polar atmosphere. During nighttime, CO concentration declined to minimum. The decrease in CO concentration during nighttime and early morning conditions may be determined by the deposition of CO through porous snow layer. The upper part of the snowpack exhibits a high porosity, supports the diffusion of CO to deeper layers, and increases the surface area that interacts with the atmosphere (Haan et al., 2001).

17.5 Conclusion

On the basis of measurements made at Maitri, Antarctica, and Indian Arctic station "Himadri" a detailed analysis of the surface CO concentration was presented. A distinct diel variation was observed coinciding with the diurnal cycle of solar actinic radiation at Maitri, Antarctica. This observation implies that the diurnal variation in CO concentration has probably activated the process that is correlated with the sunlight, photochemical processing of organic matter trapped in snow. However, there are various process mechanisms in Polar regions, which account for observed diurnal variability of CO.

Acknowledgments

We express our sincere thanks to the Director of NPL for the encouragement and taking a keen interest in the progress of the work. The authors are grateful to the National Center for Antarctic and Ocean Research, Goa for the logistic support during Antarctic and Arctic expeditions. Thanks are also due to the leaders of 21st and 22nd Indian Scientific Expedition to Antarctica for providing the infrastructure for the experiment. We are also grateful to Sasha Madronich for the TUV model and valuable suggestions.

References

Anastasio, C., Galbavy, E.S., Hutterli, M.A., Burkhart, J.F., Friel, D.K., 2007. Photoformation of hydroxyl radical on snowgrains at Summit, Greenland. Atmos. Environ. 41 (24), 5110–5121. Available from: https://doi.org/10.1016/j.atmosenv.2006.12.011.

Barrie, L.A., Bottenheim, J.W., Schnell, R.C., Crutzen, P.J., Rasmussen, R.A., 1988. Ozone destruction and photochemical reactions at polar sunrise in the lower Arctic atmosphere. Nature 334, 138–141.

Beaglehole, D., Carter, G.G., 1992. Antarctic skies 1. Diurnal variations of the sky irradiance and UV effects of the ozone hole, spring 1990. J. Geophys. Res. 97 (D2), 2589–2596.

Bottenheim, J.W., Barrie, L.A., Atlas, E., Heidt, I., Niki, H., Rasmussen, R.A., et al., 1990. Depletion of lower tropospheric ozone during Arctic spring: The Polar Sunrise Experiment. J. Geophys. Res. 95, 18555–18568.

Chu, L., Anastasio, C., 2005. Formation of hydroxyl radical from the photolysis of frozen hydrogen peroxide. J. Phys. Chem. A 109 (28), 6264–6271.

Cogan, M., Lobert, J.M., 1998. Instrumentation for trace – level measurement of carbon monoxide in pristine environments. In: Proceedings of the 43rd Annual ISA Analysis Division Symposium, vol. 31, pp. 229–236.

Couch, T.L., Sumner, A.L., Dassau, T.M., Shepson, P.B., 2000. An investigation of the interaction of carbonyl compounds with the snowpack. Geophys. Res. Lett. 27, 2241–2244.

Crutzen, P.J., 1995. Overview of tropospheric chemistry: developments during the past quarter century and a look ahead. Faraday Discuss. 100, 1–21.

De Serves, C., 1994. Gas phase formaldehyde and peroxide measurements in the Arctic atmosphere. J. Geophys. Res. 99, 25391–25398.

Dickerson, R.R., Delancy, A.C., 1988. Modifications of a commercial gas filter correlation CO detector for enhanced sensitivity. J. Atmos. Oceanic Technol. 5, 424–431.

Erickson III, D.J., 1989. Ocean to atmosphere carbon monoxide flux: Global inventory and climate implications. Global Biogeochem. Cycles 3, 305–314.

France, J.L., King, M.D., Lee-Taylor, J., 2007. Hydroxyl (OH) radical production rates in snowpacks from photolysis of hydrogen peroxide (H_2O_2) and nitrate (NO_3^-). Atmos. Environ. 41, 5502–5509.

Gadhavi, H., Jayaraman, A., 2004. Aerosol characteristics and aerosol radiative forcing over Maitri, Antarctica. Curr. Sci. 86, 296–304.

Ghude, S.D., Jain, S.L., Arya, B.C., Kulakarni, P.S., Kumar, A., 2005. Direct solar ultraviolet irradiance (305 nm, 312 nm, 320 nm) at Schirmacher Region of East Antarctica and Delhi: observations, comparison and model calculations. In: *URSI XXVIII General Assembly*, F10P.20 (0096).

Gros, V., Bräunlich, M., Rbckmann, T., Jbckel, P., Bergamaschi, P., Brenninkmeijer, C. A.M., et al., 2001. Detailed analysis of the isotopic composition of CO and

characterization of the air masses arriving at Mt. Sonnblick (Austrian Alps). J. Geophys. Res. 106, 3179–3193.
Haan, D., Martinerie, P., Raynaud, D., 1996. Ice core data of atmospheric carbon monoxide over Antarctica and Greenland during the last 200 years. Geophys. Res. Lett. 2235–2238.
Haan, D., Zuo, Y., Gros, V., Brenninkmeijer, C.A.M., 2001. Photochemical production of carbon monoxide in snow. J. Atmos. Chem. 40 (3), 217–230.
Holloway, T., Levy II, H., Kasibhatla, P., 2000. Global distribution of carbon monoxide. J. Geophys. Res. 105D, 12,123–12,147.
Radiative forcing of climate change and an evaluation of the IPCC IS92 emisssions scenarios. In: Houghton, J.T., et al., (Eds.), Intergovernmental Panel on Climate Change (IPCC) Climate Change (1995). Cambridge University Press, New York, p. 339.
Hutterli, M.A., Rothlisberger, R., Bales, R.C., 1999. Atmosphere-to-snow-to-firn transfer studies of HCHO at Summit, Greenland. Geophys. Res. Lett. 26, 1691–1694.
Jain, S.L., Ghude, S.D., Arya, B.C., Kumar, A., Bajaj, M.M., 2005. Increase in total water vapour column and surface temperature at Maitri, Antarctica. Curr. Sci. 89 (11), 1917–1922.
Jobson, B.T., Niki, H., Yokouchi, Y., Bottenheim, J., Hopper, F., Leaitch, R., 1994. Measurements of C2-C6 hydrocarbons during the polar sunrise 1992 experiment: evidence for Cl atom and Br atom chemistry. J. Geophys. Res. 99, 25355–25368.
Katja, R., Weller, R., Schrems, O., 1999. Variability of formaldehyde in the Antarctic troposphere. Phys. Chem. Chem. Phys. 1, 5523–5527.
Khalil, M.A.K., Rasmussen, R.A., 1990. The global cycle of carbon monoxide: trends and mass balance. Chemosphere 20, 227–242.
Lee, J., Bloss, W., Heard, D., Bauguitte, S., Salmon, R., Roscoe, H., et al., 2006. Measurement of OH and HO_2 in costal Antarctica using laser induced fluorescence. Geophys. Res. Abstr. 8, 01483.
Legrand, M., Mayewski, P., 1997. Glaciochemistry of polar ice cores: a review. Rev. Geophys. 35 (3), 219–243.
Li, S.M., Wsnclsester, J.W., 1993. Water soluble organic constituents in Arctic aerosols and snow pack. Geophys. Res. Lett. 20, 45–48.
Logan, J.A., Prather, M.J., Wofsy, S.C., McElroy, M.B., 1981. Tropospheric chemistry: a global perspective. J. Geophys. Res. 86, 7210–7254.
Madronich, S., 1993. UV radiation in the natural and perturbed atmosphere. In: Tevini, M. (Ed.), Environmental Effects of UV (Ultraviolet) Radiation. Lewis Publisher, Boca Raton, FL, pp. 17–69.
Matsueda, H., Inoue, H.Y., Sawa, Y., Tsutsumi, Y., Ishii, M., 1998. Carbon monoxide in the upper troposphere over the western Pacific between 1993 and 1996. J. Geophys. Res. 103 (D15), 19093–19110.
McConnell, J.C., McElroy, M.B., Wofsy, S.C., 1971. Natural sources of atmospheric CO. Nature 233, 187–188.
Mount, G.H., 1995. New insight and question resulting from recent ion-assisted OH measurements. J. Atmosphere. Sci. 52, 3337–3341.
Novelli, P.C., Masarie, K., Tans, P., Lang, P., 1994. Recent changes in atmospheric carbon monoxide. Science 263, 1587–1590.
Novelli, P.C., Masarie, K.A., Lang, P.M., 1998a. Distributions and recent changes of carbon monoxide in the lower troposphere. J. Geophys. Res. 103, 19,015–19,033.
Novelli, P.C., Connors, V.S., Reichle, J.H.G., Anderson, B.E., Brenninkmeijer, C.A.M., Brunke, E.G., et al., 1998b. An internally consistent set of globally distributed atmospheric carbon monoxide ratios developed using results from an intercomparison of measurements. J.Geophys. Res. 103D, 19,285–19,293.

Rasmussen, R.A., Khalil, M.A.K., Hoyt, S.D., 1982. Methane and carbon monoxide in snow. APCA J. 32, 176–178.

Ravendra, R., Chaturvedi, A., Beg, M.J., 2001. Melt water lakes of Schirmacher Oasis—their genetic aspects and classification. In: Sahu, D.B., Pandey, P.C. (Eds.), Advances in Marine and Antarctic Science, Dariyaganj, New Delhi, pp. 301–313.

Riedel, K., Allan, W., Weller, R., Schrems, O., 2005. Discrepancies between formaldehyde measurements and methane oxidation model predictions in the Antarctic troposphere: An assessment of other possible formaldehyde sources. J. Geophys. Res. 110 (D15308). Available from: https://doi.org/10.1029/2005JD0058592995.

Seiler, W., 1974. The cycle of atmospheric CO. Tellus 26, 118–135.

Seiler, W., Conrad, R., 1987. Contribution of tropical ecosystems to the global budgets of trace gases, especially CH4, H2, CO, and N20. In: Dicnson, R.E. (Ed.), *Geophysiology of* Amazonia. John Wiley & Sons, New York, pp. 219–244.

Shepson, P.B., Sirju, A.P., Hopper, J.F., Barrie, L.A., Young, V., Niki, H., et al., 1996. Sources and sinks of carbonyl compounds in the arctic ocean boundary layer: polar ice floe experiment. J. Geophys. Res. 101, 2177–2193.

Spivakovsky, C.M., Yevich, R., Logan, J.A., Wofsy, S.C., McElroy, M.B., Prather, M.J., 1990. Tropospheric OH in a three-dimensional chemical tracer model: an assessment based on observations of CH3CCl3. J. Geophys. Res. 95, 18441–18471.

Sumner, A.L., Shepson, P.B., 1999. Snowpack production of formaldehyde and its effect on the Artic troposphere. Nature 398, 230–233.

Thompson, A.M., 1992. The oxidizing capacity of the Earth's atmosphere: probable past and future changes. Science 256, 1157–1165.

Thompson, A.M., Cicerone, R.J., 1986. Possible perturbations to atmospheric CO, CH_4, and OH. J. Geophys. Res. 91, 10853–10864.

Vaughan, P.P., Biough, N.V., 1998. Photochemical formation of hydroxyl radical by constituents of natural water. Environ. Sci. Technol. 32, 2947–2953.

Yokouchi, Y., Akimoto, H., Barrie, L.A., Bottenheim, J.W., Anlauf, K., Jobson, B.T., 1994. Serial gas-chromatographic mass-spectrometric measurements of some volatile organic-compounds in the arctic atmosphere during the 1992 Polar Sunrise Experiment. J. Geophys. Res. 99, 25379–25389.

Zuo, Y., Jones, R.D., 1995. Formation of carbon monoxide by photolysis of dissolved marine organic material and its significance in the carbon cycling of the oceans. Naturwissenschaften 82, 472–474.

Zuo, Y., Jones, R.D., 1996. Photochemical production of carbon monoxide in authentic rainwater. Geophys. Res. Lett. 23, 2769–2772.

Zuo, Y., Jones, R.D., 1997. Photochemistry of natural dissolved organic matter in lakes and wetland waters production of carbon monoxide. Water Res. 31, 850–858.

Further reading

Grannas, A.M., Shepson, P.B., Guimbaud, C., Domine, F., Albert, M., Simpson, W., et al., 2002. A Studyof photochemical and physical processes affecting carbonyl compounds in the Arctic marine boundary layer. Atmos. Environ. 36, 2733–2742.

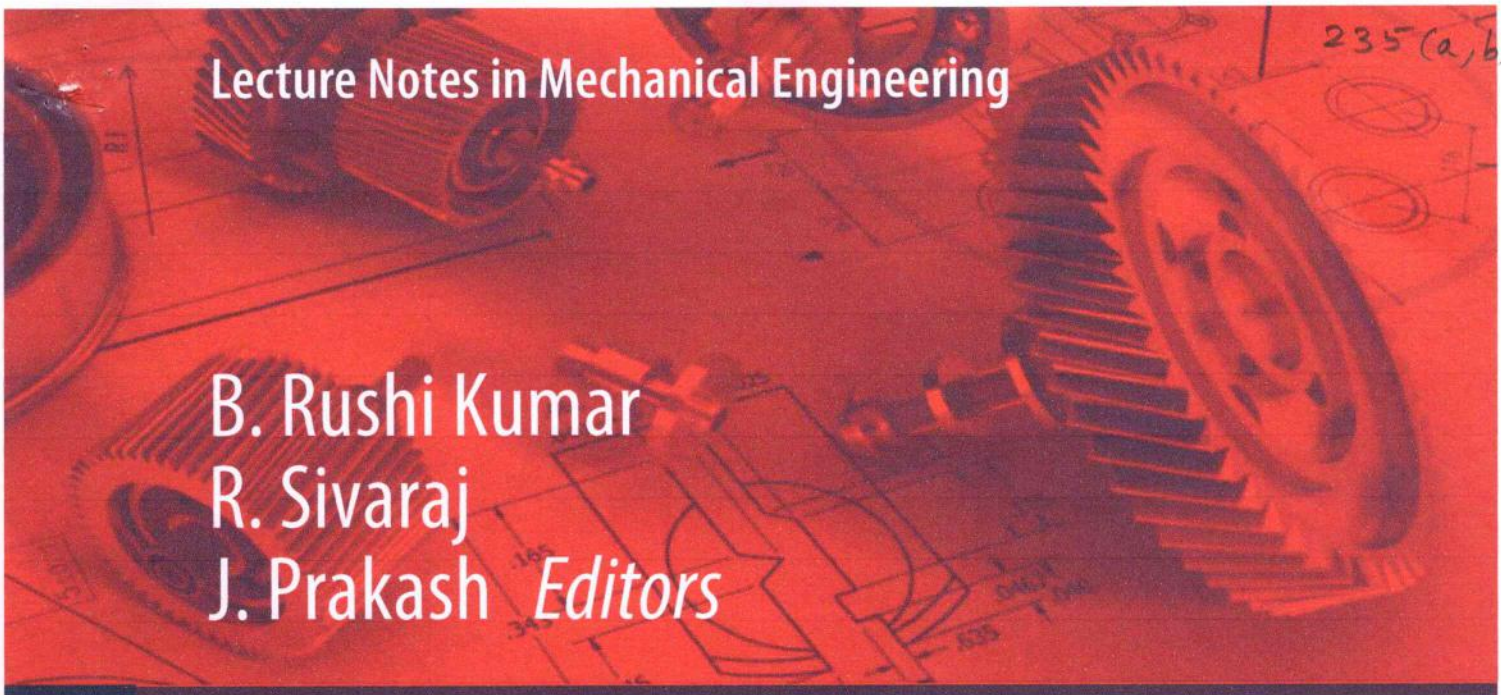
Haan, D., Raynaud, D., 1998. Ice core record of CO variations during the last two millennia: atmospheric implications and chemical interactions within the Greenland ice. Tellus Ser. B 253–262.

König-Langlo, G., King, J.C., Pettré, P., 1998. Climatology of the three coastal Antarctic stations Dumont d'urville, Neumayer, and Halley. J. Geophys. Res. 103, 10,935–10,946.

Rogers, J.D., 1990. Ultraviolet absorption cross sections and atmospheric photo dissociation rate constants of formaldehyde. J. Phys. Chem. 94, 4011–4015.

Warneck, P., 1998. Chemistry of the Natural Atmosphere. Academic Press, San Diego, CA, p. 237.

Lecture Notes in Mechanical Engineering



B. Rushi Kumar
R. Sivaraj
J. Prakash *Editors*

Advances in Fluid Dynamics

Selected Proceedings of ICAFD 2018

Springer

Editors
B. Rushi Kumar
Vellore Institute of Technology
Vellore, Tamil Nadu, India

R. Sivaraj
Vellore Institute of Technology
Vellore, Tamil Nadu, India

J. Prakash
University of Botswana
Gaborone, Botswana

ISSN 2195-4356 ISSN 2195-4364 (electronic)
Lecture Notes in Mechanical Engineering
ISBN 978-981-15-4307-4 ISBN 978-981-15-4308-1 (eBook)
https://doi.org/10.1007/978-981-15-4308-1

Nonlinear Radiative Williamson Fluid Against a Wedge with Aligned Magnetic Field

K. Subbarayudu, L. Wahidunnisa, S. Suneetha, and P. Bala Anki Reddy

Abstract The foremost importance of this presentation is to explore the nonlinear thermal radiation on a Williamson liquid model on a wedge in the company of a heat generation/absorption which is not uniform. An aligned magnetic field, Brownian diffusion and thermophoresis aspects are also investigated. The flow and temperature equations are derived and solved by Runge–Kutta based *MATLAB bvp4c solver.* Results for different flow characteristics are plotted through graphs and discussed in detail. The wall temperature raises as temperature ratio parameter increases and results in a deep penetration for temperature. The concentration of the species seems to be increased with Brownian diffusion and radiation.

Keywords Williamson fluid model · Wedge shape geometry · Aligned magnetic field · Nonlinear thermal radiation

1 Introduction

The contemporary era, researchers are doing many experimental and theoretical studies on the fluid flow and transformation of energy in the non-Newtonian fluid models that have significant applications in engineering, for instance, emulsions, lubricants, polymers, and nuclear fuel slurries. Some alive rheological models are Power law, Carreau, Jeffery, Williamson fluid, and so forth. Out of these, Williamson fluid model is a simple model to suggest the viscoelastic nature and shear thin out features which were introduced by Williamson [1] in 1929. The fluid flow and transfer of heat across wedge-shaped geometries are important in several engineering applications and also in fluid dynamics. Particularly such flows occur in aerodynamics, heat exchangers, geothermal industries, and so on. A number of surveys have been found considering Williamson wedge flow in Ref. [2–4]. The study of fluid past a wedge with MHD has vital applications in nuclear reactor cooling, MHD power generators and

K. Subbarayudu · L. Wahidunnisa · S. Suneetha (✉)
Department of Applied Mathematics, Yogi Vemana University, Kadapa 516005, India
e-mail: suneethayvu@gmail.com

P. Bala Anki Reddy
Department of Mathematics, School of Advanced Sciences, VIT, Vellore 632014, India

B. Rushi Kumar et al. (eds.), *Advances in Fluid Dynamics*, Lecture Notes in Mechanical Engineering, https://doi.org/10.1007/978-981-15-4308-1_21

so forth. Several authors [5–8] examined the MHD effects over a wedge in various types of fluids in different situations. Electromagnetic radiation is the major reason for radiation heat transfer. While framing a system in the industry with a negligible temperature variation inside a fluid, a troublesome is observed. To avoid this complexity, researchers included an extra parameter nonlinear thermal radiation in place of linear thermal radiation. Brief information on this area is quoted in Refs. [9–12]. At present, we consider heat source/sink which is not uniform, i.e., dependent on space and temperature. Some related studies were carried out by some investigators [13–16].

It is noted by the literature survey that a little information is existing on the MHD Williamson fluid model flow via a wedge with heat source/sink which is not uniform and radiation which is nonlinear. Inspired by these uses, the present study examines the influence of the thermophoresis effect and Brownian motion of Williamson fluid model for a radiating flow over a wedge.

2 Description of Physical Model

A two-dimensional, viscous, non-Newtonian liquid with Williamson model over a wedge with time-dependent aligned magnetic field is considered. A non-uniform heat generation/absorption and thermal radiation which is not linear is added. $u_w(x, t')$ represents wedge stretching velocity and is referred by $u_w(x, t') = bx^m(1 - ct')^{-1}$ where b-stretching rate and c-stable value. The flow velocity at free stream, $u_e(x, t') = ax^m(1 - ct')^{-1}$, while, a and c are stable values more than zero with $0 \leq m \leq 1$, along the wedge axis. $\Omega = \beta\pi$ supposed to be the angle of the wedge and the pressure gradient β is given as $\beta = \frac{2m}{m+1}$. The x-axis is incident in the elongating direction and y-axis makes 90° angle outside from it. A geometrical configuration and schematic model of the present objective model is put on viewed in Fig. 1. To study the heat flow on the surface of wedge, the temperature, $T_w(x, t') =$

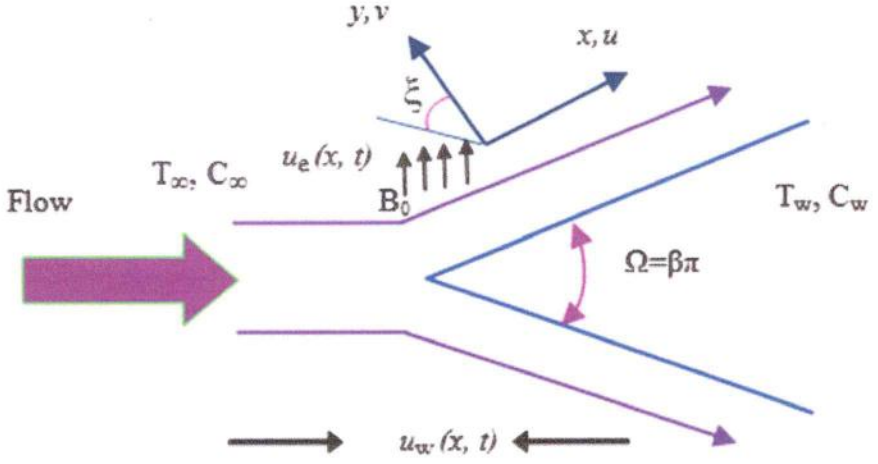


Fig. 1 Flow geometry

$\frac{T_0 u_w x}{\upsilon}\left(1-ct'\right)^{-\frac{1}{2}}+T_\infty$, concentration $C_w(x,t')=\frac{C_0 u_w x}{\upsilon}\left(1-ct'\right)^{-\frac{1}{2}}+C_\infty$, magnetic field $B\left(t'\right)=B_0\left(1-ct'\right)^{-\frac{1}{2}}$, T_0, C_0 be the initial temperature and concentration are considered and also, as y tends to ∞, the free stream gain the constants values T_∞, C_∞. With the above assumption, the equations are

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0 \tag{1}$$

$$\begin{aligned}\frac{\partial u}{\partial t'}+\frac{\partial u}{\partial x}u+\frac{\partial u}{\partial y}v=\frac{\partial u_e}{\partial t'}+u_e\frac{\partial u_e}{\partial x}+\upsilon\frac{\partial^2 u}{\partial y^2}\left[\beta^*+\left(1-\beta^*\right)\left(1-\Gamma\frac{\partial u}{\partial y}\right)^{-1}\right]\\+\upsilon\Gamma\left(\frac{\partial u}{\partial y}\right)\frac{\partial^2 u}{\partial y^2}\left[\left(1-\beta^*\right)\left(1-\Gamma\frac{\partial u}{\partial y}\right)^{-2}\right]\\-\frac{\sigma B_0^2\left(t'\right)}{\rho}\sin^2\xi(u-u_e)\end{aligned} \tag{2}$$

$$\begin{aligned}\frac{\partial T}{\partial t'}+\frac{\partial T}{\partial x}u+\frac{\partial T}{\partial y}v=\alpha\frac{\partial^2 T}{\partial y^2}-\frac{\partial q_r}{\partial y}\frac{1}{\left(\rho c_p\right)}\\+\tau\left[\frac{\partial T}{\partial y}\frac{\partial C}{\partial y}D_B+\frac{D_T}{T_\infty}\left(\frac{\partial T}{\partial y}\right)^2\right]+\frac{q'''}{\rho c_p}\end{aligned} \tag{3}$$

$$\frac{\partial C}{\partial t'}+\frac{\partial C}{\partial x}u+\frac{\partial C}{\partial y}v=\frac{\partial^2 C}{\partial y^2}D_B+\frac{\partial^2 T}{\partial y^2}\frac{D_T}{T_\infty} \tag{4}$$

From Eq. (2) the fluid flow drive to viscous fluid case when $\beta^*=0=\Gamma$. The heat generation or absorption which is not uniform, is denoted as $q'''=\left[f'(T_w-T_\infty)A^*+(T-T_\infty)B^*\right]\frac{ku_w}{x\upsilon}$ where A^*—dependent relative to space and B^*—dependent relative to temperature of heat generation/absorption. The internal heat generation and absorption is noticed when $A^*>0$, $B^*>0$ and $A^*<0$, $B^*<0$.

For optically thick fluid, we use Rosseland approximation in which q_r denote radiative heat flux, is specified as

$$q_r=-(1.333)\frac{\sigma^*}{k^*}\frac{\partial T^4}{\partial y}, \tag{5}$$

We can set the term T^4 stirring in Eq. (5) and availing Taylor series by supposing an undersized deviation in temperature of the fluid and ambient fluid and within the boundary layer, preserving to first-order terms only. Hence T^4 referred to as

$$\frac{1}{4}T^4\cong T_\infty^3 T-\frac{3}{4}T_\infty^4 \tag{6}$$

Equation (3) appears as Eq. (7) by utilizing Eqs. (5) and (6).

$$\frac{\partial T}{\partial t'} + \frac{\partial T}{\partial x}u + \frac{\partial T}{\partial y}v = \frac{\partial^2 T}{\partial y^2}\alpha + \frac{16\sigma^* T^3}{3(\rho c_p)k_1^*}\frac{\partial T}{\partial y} + \tau\left[\frac{\partial C}{\partial y}\frac{\partial T}{\partial y}D_B + \left(\frac{\partial T}{\partial y}\right)^2\frac{D_T}{T_\infty}\right] + \frac{q'''}{\rho c_p} \tag{7}$$

related to the boundary conditions.

The wedge is assumed to be as there is no-slip condition on its surface and it follows:

On the shell of the wedge i.e., at $y = 0$

$$u = u_w, T = T_w, v = 0, C = C_w \tag{8}$$

At open water course i.e., as $y \to \infty$

$$u \to u_e,\ T \to T_\infty, C \to C_\infty \tag{9}$$

Using the quantities of non-dimensional [17]:

$$\eta = y\left(\frac{(m+1)u_e}{2\upsilon x}\right)^{\frac{1}{2}}, \psi = f(\eta)\left(\frac{2\upsilon x u_e}{m+1}\right)^{\frac{1}{2}},$$
$$\phi(\eta) = \frac{C - C_\infty}{C_w - C_\infty}, \theta(\eta) = \frac{T - T_\infty}{T_w - T_\infty} \tag{10}$$

at this juncture, the stream function $\psi\ (x,\ y,\ t)$ satisfies Eq. (1). The velocities are $u = \frac{\partial \psi}{\partial y}$ and $v = -\frac{\partial \psi}{\partial x}$. By using Eq. (10) in Eqs. (2), (7) and (4) we get the corresponding OD equations:

$$f'''\left[\beta^* + \left(1 - wef''\right)^{-2}\left(1 - \beta^*\right)\right] + ff'' + \left(\beta - \beta\left(f'\right)^2\right) - \left(f' + \eta(0.5)f'' - 1\right)(2 - \beta)A - \mathrm{Ha}^2\left\{f' - 1\right\}(2 - \beta)\sin^2\xi = 0, \tag{11}$$

$$\frac{1}{\mathrm{Pr}}\left[(1.333)\mathrm{Rd}[1 + (\theta_w\theta - \theta)]^3 + 1\right]\theta'' + (1.333)\frac{\mathrm{Rd}}{\mathrm{Pr}}(\theta_w - 1)[(\theta_w\theta - \theta) + 1]^2\theta'^2 + \left(f\theta' - 2f'\theta\right) - \frac{A}{2}(2 - \beta)\left(\eta\theta' + 3\theta\right) + N\mathrm{t}\theta'^2 + N\mathrm{b}\phi'\theta' + (A^* f' + B^*\theta) = 0 \tag{12}$$

$$\frac{1}{\mathrm{Le}}\left[\phi'' + \frac{N\mathrm{t}}{N\mathrm{b}}\theta''\right] - \frac{A}{2}(2 - \beta)\left(\eta\phi' + 3\phi\right) - 2\phi f' + f\phi' = 0, \tag{13}$$

with reduced conditions at boundary:

$$f = 0,\ f' = \lambda, \theta = 1, \phi = 1 \text{ at } \eta = 0 \tag{14}$$

$$f' \to 1\ \theta \to 0,\ \phi \to 0 \text{ as } \eta \to \infty \tag{15}$$

Here, the wedge moving parameter, $\lambda = \frac{b}{a}$ and $\lambda > 0$: a stretching wedge, $\lambda < 0$: a shrinking wedge and $\lambda = 0$: a steady wedge.

The other engaged physical non-dimensional factors are:

$\beta^* = \frac{\mu_0}{\mu_\infty}$ is the ratio of viscosities, $\alpha = \frac{\kappa}{\rho c_p}$ the effective thermal diffusivity, $\mathrm{We} = \sqrt{\frac{\Gamma^2(m+1)u_e^3}{2\upsilon x}}$ the Weissenberg number, $\mathrm{Pr} = \frac{\mu c_p}{k}$ the Prandtl number, $\mathrm{Rd} = \frac{4\sigma^* T_\infty^3}{k k_1^*}$ the Radiation parameter, $A = \frac{c}{a x^{m-1}}$ the unsteadiness parameter, $\beta = \frac{2m}{m+1}$ the wedge angle parameter, $\theta_w = \frac{T_w}{T_\infty}$ (>1) the temperature ratio parameter, $\mathrm{Ha}^2 = \frac{\rho B_0^2}{\rho a x^{m-1}}$ the Hartmann number, $\mathrm{Le} = \frac{\upsilon}{D_\mathrm{B}}$ the Lewis number, $N\mathrm{t} = \frac{\tau D_T (T_w - T_\infty)}{T_\infty \upsilon}$ the thermophoresis parameter, $N\mathrm{b} = \frac{\tau D_\mathrm{B}(C_w - C_\infty)}{\upsilon}$ the Brownian motion parameter.

The parameters which are useful in engineering are the local non-dimensional friction factor C_{f_x}, Nusselt number Nu_x and Sherwood number Sh_x. They are:

$$C_{f_x} = \frac{\tau_w}{\rho U_w^2}, \mathrm{Nu}_x = \frac{x q_w}{k(T_w - T_\infty)} \text{ and } \mathrm{Sh}_x = \frac{x q_\mathrm{m}}{D_\mathrm{B}(C_w - C_\infty)}$$

where τ_w, q_w and q_m are given as

$$\begin{aligned} \text{At } y = 0,\ \tau_w &= \mu_0 \left(\frac{\partial u}{\partial y}\right)\left[\beta^* + (1-\beta^*)\left(1 - \Gamma \frac{\partial u}{\partial y}\right)^{-1}\right], \\ q_w &= [q_\mathrm{r}] - \left[\frac{\partial T}{\partial y}\left(k + \frac{16\sigma T^3}{3k^*}\right)\right] \text{ and} \\ q_\mathrm{m} &= -D_\mathrm{B}\left(\frac{\partial C}{\partial y}\right) \end{aligned} \tag{16}$$

Using (10) and (16), the dimensionless Engineering quantities are given by

$$\begin{aligned} C_{f_x}\mathrm{Re}_x^{\frac{1}{2}} &= \frac{1}{\sqrt{2-\beta}}\left[\beta^* + \{1 - \mathrm{we}\, f''(0)\}^{-1}(1-\beta^*)\right] f''(0), \\ \mathrm{Nu}_x \mathrm{Re}_x^{\frac{1}{2}} &= -\frac{1}{\sqrt{2-\beta}}\left(1 + \frac{4}{3}\mathrm{Rd}[(\theta_w - 1)\theta(0) + 1]^3\right)\theta'(0) \text{ and} \\ \mathrm{Sh}_x \mathrm{Re}_x^{\frac{1}{2}} &= -\frac{1}{\sqrt{2-\beta}}\phi'(0), \end{aligned} \tag{17}$$

where Reynolds number $\mathrm{Re}_x = \frac{u_e x}{\upsilon}$.

3 Results and Discussions

The set of Eqs. (11)–(13) with (14) and (15) have been solved using the MATLAB bvp4c solver. This section analyzes the effects of parameters $A = 1.0$, $\mathrm{We} = 0.5$, $\beta = 0.1$, $\beta^* = 0.2$, $Nt = 0.5$, $\theta_w = 1.1$, $Nb = 0.5$, $\mathrm{Le} = 0.5$, $\lambda = 0.1$, $Rd = 0.5$, $\mathrm{Ha} = 0.5$, $A^* = -0.05$, $B^* = -0.05$, $\xi = 45°$, $\mathrm{Pr} = 7.2$ associated with the flow problem. All the above values are kept steady unless mentioned in the figure. The mathematical results are plotted in diagrams and tables.

To attest to the genuineness of the attained results, an assessment is made with Hamid et al. [3] (Table 1). A wonderful agreement with the results is noticed. The skin friction values for diverse factors are submitted in Table 2. The development in the enormity of the skin friction is noticed as A, β, Ha and ξ increases. A reverse trend is noticed for λ. Table 3 provides the impact of numerous physical factors on Nusselt number. A rise in Nusselt number is observed as Pr, A rises. A fall in Nusselt number is noticed for a rise in Nb, Nt and We. Table 4 put on view the inspiration

Table 1 Comparison of wall friction coefficient for assorted β whilst $A = \mathrm{Ha} = \beta^* = \mathrm{We} = \lambda = 0$

β	Hamid et al. [3]	Present study
0.0	0.469600	0.4696
0.1	0.587035	0.5869
0.3	0.774755	0.7747
0.5	0.927680	0.8543
0.9	1.232588	0.9392

Table 2 Variations in the skin friction coefficient for variant values of A, β, λ, Ha and ξ when $\mathrm{We} = 0.5$, $\beta^* = 0.2$, $\theta_w = 1.1$, $\mathrm{Rd} = 0.5$, $Nt = 0.5$, $Nb = 0.5$, $\mathrm{Le} = 0.5$, $A^* = -0.05$, $B^* = -0.05$, $\mathrm{Pr} = 7.2$

A	β	λ	Ha	ξ	$-f''(0)$
1.0	0.1	0.1	0.5	$\pi/4$	0.3730
2.0	0.1	0.1	0.5	$\pi/4$	0.5370
3.0	0.1	0.1	0.5	$\pi/4$	0.6461
1.0	0.2	0.1	0.5	$\pi/4$	0.3804
1.0	0.3	0.1	0.5	$\pi/4$	0.3877
1.0	0.1	0.2	0.5	$\pi/4$	0.3114
1.0	0.1	0.3	0.5	$\pi/4$	0.2434
1.0	0.1	0.1	1.0	$\pi/4$	0.4638
1.0	0.1	0.1	1.5	$\pi/4$	0.5758
1.0	0.1	0.1	0.5	$\pi/4$	0.3899
1.0	0.1	0.1	0.5	$\pi/4$	0.4060

Table 3 Variations in the Nusselt number for variant values of Pr, Rd, θ_w, A^*, B^*, A, Nb, Nt, and We when $\beta = 0.1$, $\beta^* = 0.2$, Le $= 0.5$, $\lambda = 0.1$, Ha $= 0.5$, $\xi = 45°$

Pr	Rd	θ_w	A	Nb	Nt	We	$\theta'(0)$
7.2	0.5	1.1	1.0	0.5	0.5	0.5	2.6121
10.0	0.5	1.1	1.0	0.5	0.5	0.5	2.8462
15.0	0.5	1.1	1.0	0.5	0.5	0.5	3.0025
7.2	1.0	1.1	1.0	0.5	0.5	0.5	4.0137
7.2	1.5	1.1	1.0	0.5	0.5	0.5	5.5615
7.2	0.5	1.2	1.0	0.5	0.5	0.5	3.1535
7.2	0.5	1.3	1.0	0.5	0.5	0.5	3.8511
7.2	0.5	1.1	2.0	0.5	0.5	0.5	3.7261
7.2	0.5	1.1	3.0	0.5	0.5	0.5	4.6236
7.2	0.5	1.1	1.0	1.0	0.5	0.5	2.2656
7.2	0.5	1.1	1.0	2.0	0.5	0.5	1.9774
7.2	0.5	1.1	1.0	0.5	1.0	0.5	2.2710
7.2	0.5	1.1	1.0	0.5	2.0	0.5	1.9390
7.2	0.5	1.1	1.0	0.5	0.5	1.0	2.6036
7.2	0.5	1.1	1.0	0.5	0.5	2.0	2.6003

Table 4 Variations in the Sherwood number for variant values of β, Le, A, Nb, Nt and We when $\beta^* = 0.2$, $\theta_w = 1.1$, Rd $= 0.5$, Le $= 0.5$, $\lambda = 0.1$, Ha $= 0.5$, $A^* = -0.05$, $B^* = -0.05$, $\xi = 45°$, Pr $= 7.2$

β	Le	A	Nb	Nt	We	$\phi'(0)$
0.1	0.5	1.0	0.5	0.5	0.5	0.7887
0.2	0.5	1.0	0.5	0.5	0.5	0.8450
0.3	0.5	1.0	0.5	0.5	0.5	0.9038
0.1	0.6	1.0	0.5	0.5	0.5	0.8372
0.1	0.7	1.0	0.5	0.5	0.5	0.8815
0.1	0.5	2.0	0.5	0.5	0.5	0.2527
0.1	0.5	3.0	0.5	0.5	0.5	0.0412
0.1	0.5	1.0	1.0	0.5	0.5	1.2178
0.1	0.5	1.0	1.5	0.5	0.5	1.3409
0.1	0.5	1.0	0.5	1.0	0.5	1.0334
0.1	0.5	1.0	0.5	1.5	0.5	2.0021
0.1	0.5	1.0	0.5	0.5	1.0	0.6514
0.1	0.5	1.0	0.5	0.5	1.5	0.5401

of different physical factors on Sherwood number. A hike in Sherwood number is observed as β, Le, Nt, and Nb rise and an opposite trend is noticed for A and We.

The inspiration of Ha on velocity is shown in Fig. 2. In point of physics, hydromagnetic flow for positive values of Ha and neutral for hydrodynamic flow. As of Fig. 2, it is noted an enhancement in Ha enhances the velocity. Influence of A on velocity is plotted in Fig. 3. With higher unsteadiness parameter, the fluid velocity

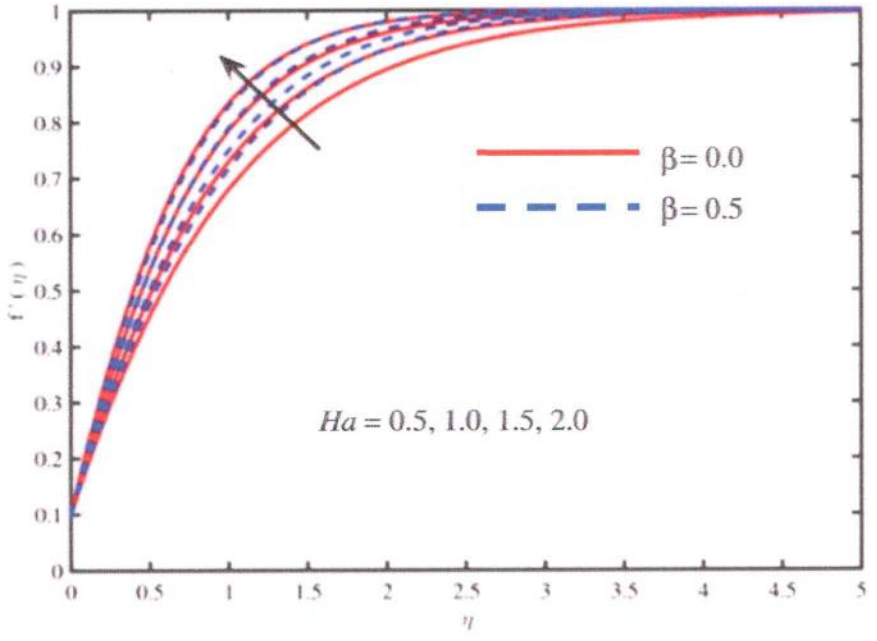


Fig. 2 $f'(\eta)$ via Ha

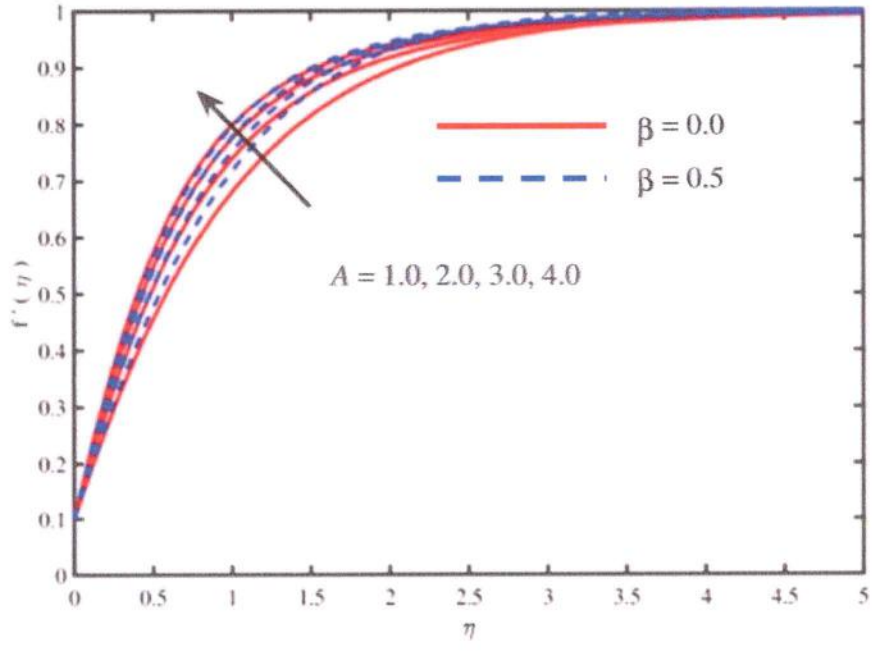


Fig. 3 $f'(\eta)$ via A

demonstrates an escalate behaviour near the boundary whereas a reverse trend is noticed for temperature. Figure 4 displays the upshot of Pr on temperature distribution over a wedge. Fluid temperature simply reduces for elevated Pr. As Pr promoted the rate of thermal diffusion is demoted. That is, accelerating Pr leads a loss in the boundary layer width of temperature. It is also noted that the thermal energy is high for $\beta = 0.5$ case compared with the other case. The outcome of thermophoresis on temperature is captured in 5. From Fig. 5, it is revealed that the temperature in the

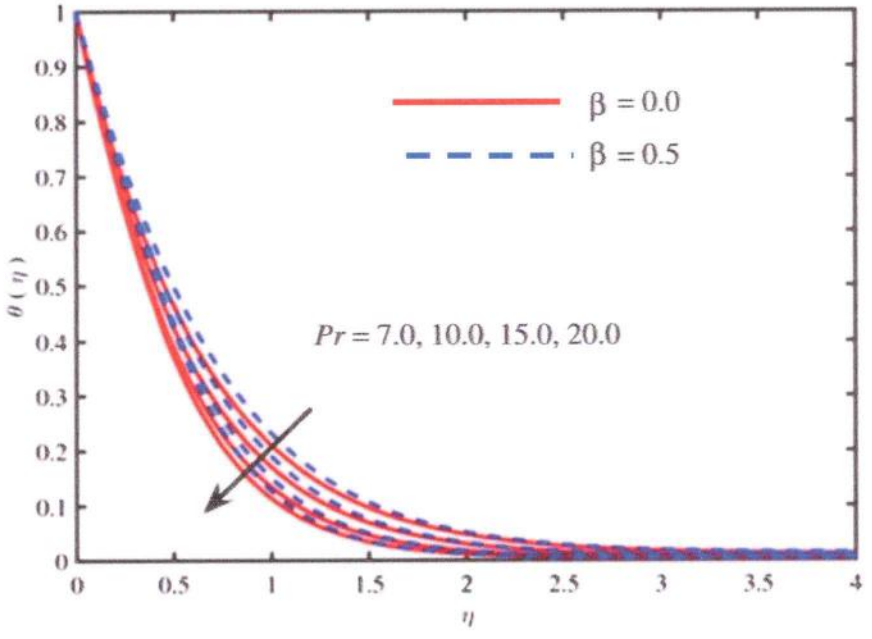


Fig. 4 $\theta\ (\eta)$ via Pr

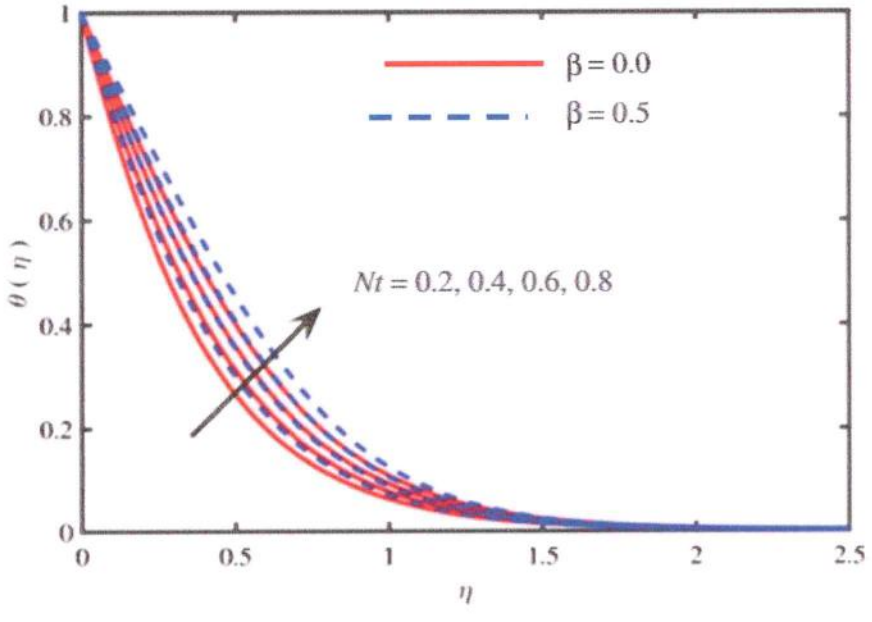


Fig. 5 $\theta(\eta)$ via Nt

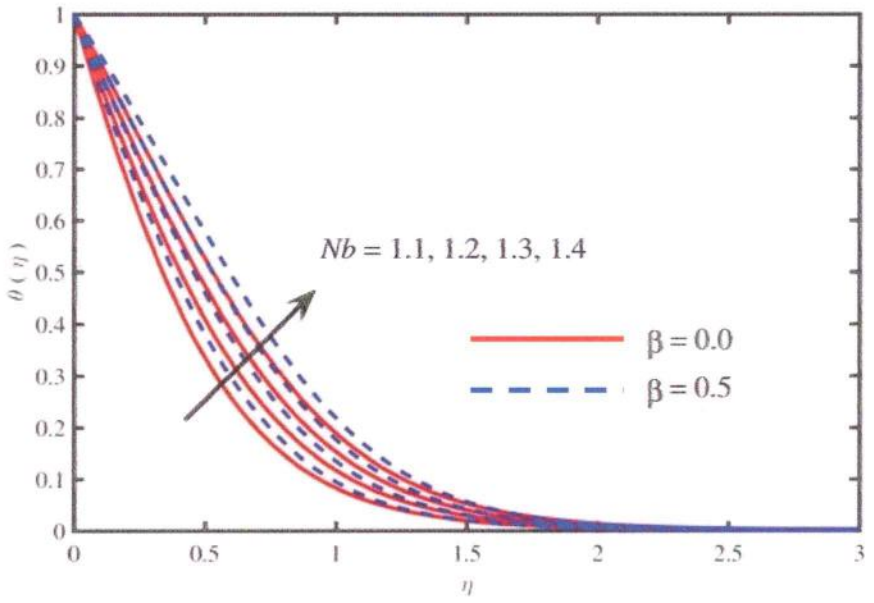


Fig. 6 $\theta(\eta)$ via Nb

boundary layer has increasing behaviour with an enhancement of Nt. In physics, it is a force generated by a tiny particle applying a force physically on another particle so that it moves from hot phase to a cold phase which fruitage a thicker boundary layer for thermal and species. Therefore, far above *Nt* match up to elevated thermophoretic force because of temperature gradient, which promotes a speedy flow far from the wedge. Figure 6 divulge temperature distribution for various values of Nb. It can be viewed from Fig. 6 that the temperature is the proportion with Nb. The reason is that the *Nb* exhibits heat conduction. In addition, an enhancement in the Brownian motion heightens the random movement of the particles thus the width of the border layer grows for temperature. Figure 7 shows the impact of θ_w on temperature. The wall temperature raises as θ_w increases and results in a deep penetration for temperature. At high temperatures, the border layer for a temperature becomes bulky in the vicinity of the wall and skeletal far away from the sheet for low temperatures results in a modulation point at the surface of the wall for larger θ_w. Figure 8a, b depicts Nusselt number and Sherwood number for θ_w. Enhancement of θ_w enhances both the numbers for $\beta = 0.0$, and $\beta = 0.5$. Rising of the rate of heat transfer is observed from Figs. 9 and 10 which results in a growth in A^* and B^* for $\beta = 0.0$, and $\beta = 0.5$.

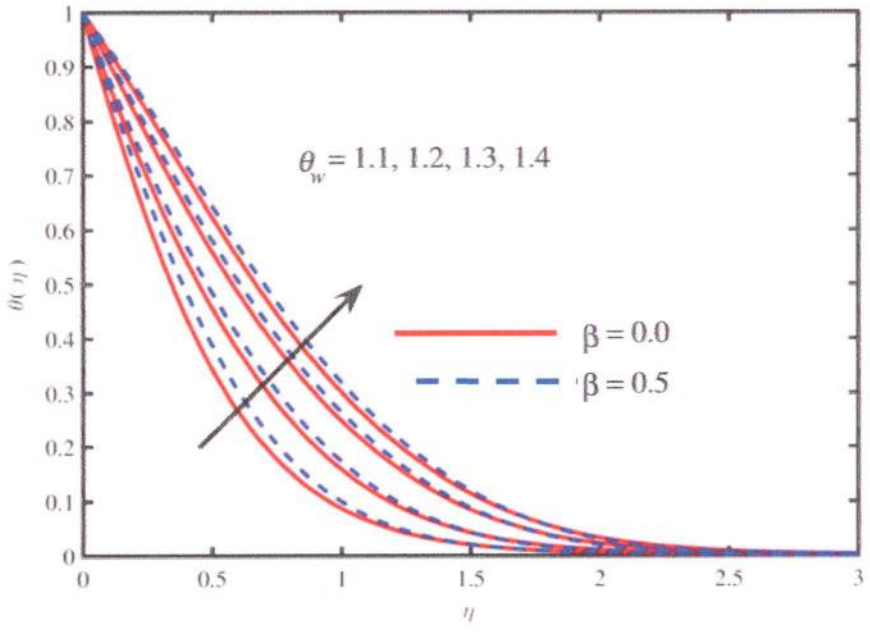


Fig. 7 $\theta(\eta)$ via θ_w .

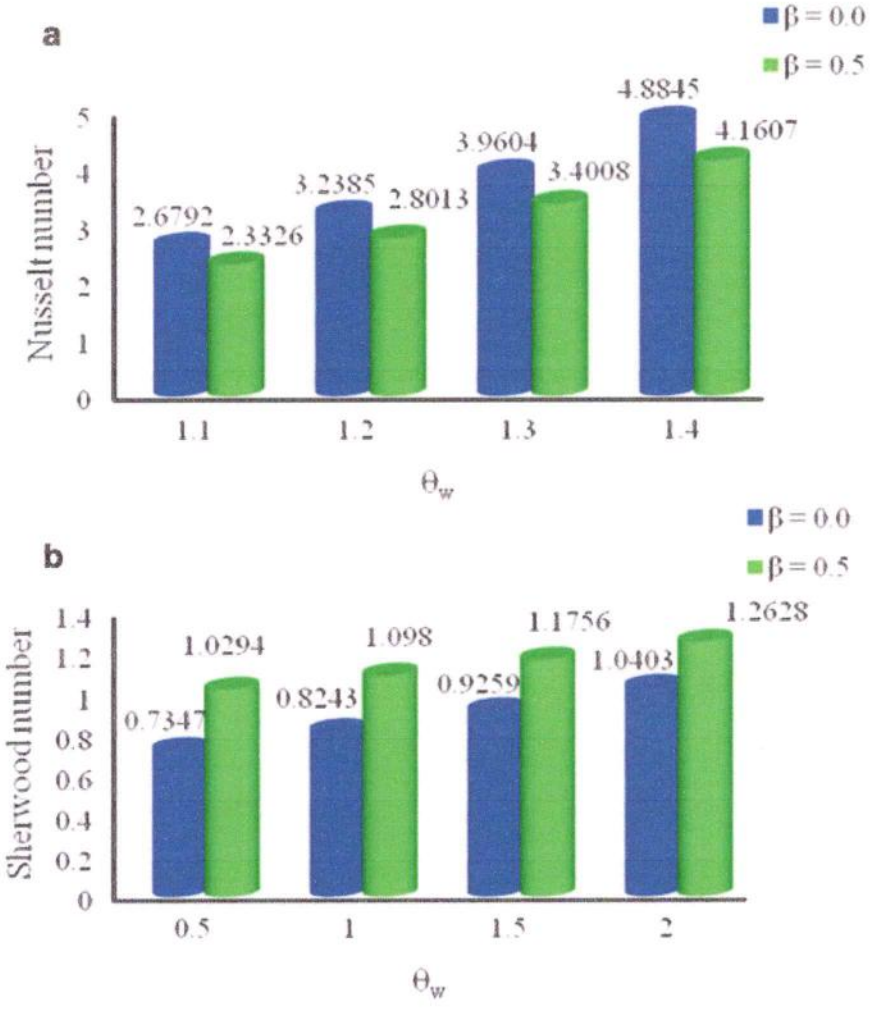


Fig. 8 **a** Nusselt number via θ_w,**b** Sherwood number via θ_w

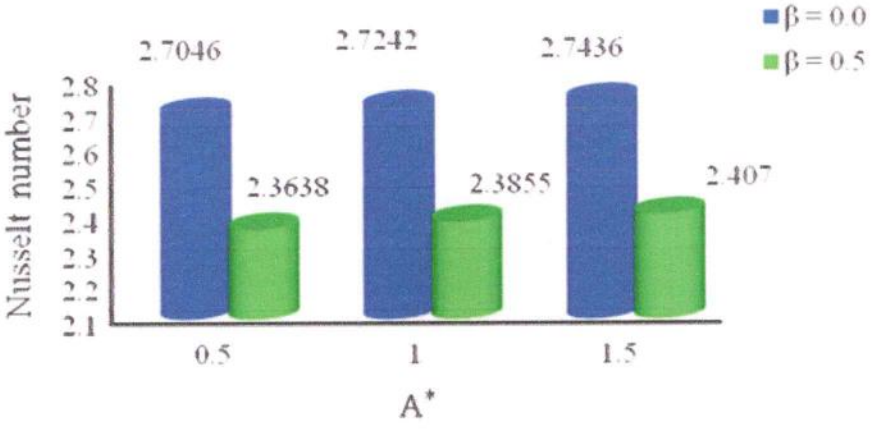


Fig. 9 Nusselt number via A^*

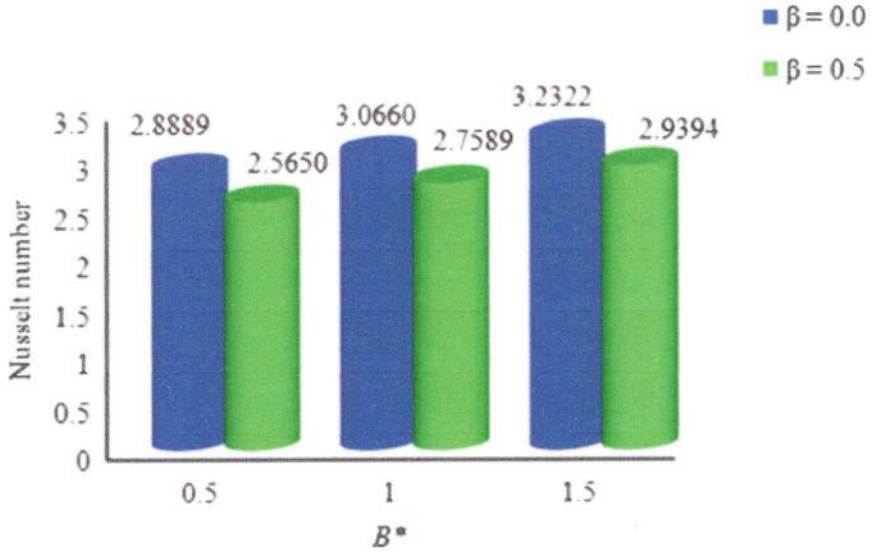


Fig. 10 Nusselt number via B^*

References

1. Williamson RV (1929) The flow of pseudoplastic materials. Ind Eng Chem 21(11):1108–1111. https://doi.org/10.1021/ie50239a035
2. Hamid A, Khan M (2018) Numerical investigation on heat transfer performance in time-dependent flow of Williamson fluid past a wedge-shaped geometry. Res Phys 9:479–485. https://doi.org/10.1016/j.rinp.2018.01.025
3. Khan M, Hamid A (2018) Numerical investigation on time-dependent flow of Williamson nanofluid along with heat and mass transfer characteristics past a wedge geometry. Int J Heat Mass Transf 118:480–491. https://doi.org/10.1016/j.ijheatmasstransfer.2017.10.126
4. Subbarayudu K, Suneetha S, Wahidunnisa L, Bala Anki Reddy P (2018) Impact of chemical reaction on radiating Falkner-Skan flow over a wedge moving in a Carreau nanofluid with convective condition. Int J Tech Innov Modern Eng Sci IJTIMES 4(6):1353–1362
5. Bala Anki Reddy P, Suneetha S, Bhaskar Reddy N (2017) Numerical study of magnetohydrodynamics (MHD) boundary layer slip flow of a Maxwell nanofluid over an exponentially stretching surface with convective boundary condition. Propul Power Res 6(4):259–268. https://doi.org/10.1016/j.jppr.2017.11.002

6. Hayat T, Qayyum S, Alsaedi A, Shafiq A (2016) Inclined magnetic field and heat source/sink aspects in flow of nanofluid with nonlinear thermal radiation. Int J Heat Mass Transf. 103:99–107. https://doi.org/10.1016/j.ijheatmasstransfer.2016.06.055
7. Ahmad R, Khan WA (2014) Numerical study of heat and mass transfer MHD viscous flow over a moving wedge in the presence of viscous dissipation and heat source/sink with convective boundary condition. Heat Transf Asian Res 43(1):17–38. https://doi.org/10.1002/htj.21063
8. Khan M, Hamid A (2017) Influence of non-linear thermal radiation on 2D unsteady flow of a Williamson fluid with heat source/sink. Res Phys 7:3968–3975. https://doi.org/10.1016/j.rinp.2017.10.014
9. Kandasamy R, Muhaimin I, Mohammad R (2016) Single-walled carbon nanotubes on MHD unsteady flow over a porous wedge with thermal radiation with variable stream conditions. Alexandria Eng J 55:75–285. https://doi.org/10.1016/j.aej.2015.10.006
10. Hayat T, Awais M, Asghar S (2013) Radiative effects in a three-dimensional flow of MHD Eyring-Powell fluid. J Egypt Math Soc 21:379–384. https://doi.org/10.1016/j.joems.2013.02.009
11. Pandey AK, Kumar M (2017) Chemical reaction and thermal radiation effects on boundary layer flow of nanofluid over a wedge with viscous and Ohmic dissipation. St. Petersburg Polytech Univ J Phys Math. 3(4):322–332. https://doi.org/10.1016/j.spjpm.2017.10.008
12. Khan M, Azam M, Alshomrani AS (2017) Unsteady slip flow of Carreau nanofluid over a wedge with nonlinear radiation and new mass flux condition. Res Phys 7:2261–2270. https://doi.org/10.1016/j.rinp.2017.06.038
13. Kasmani RM, Sivasankaran S, Bhuvaneswari M, Siri Z (2015) Effect of thermal radiation and suction on convective heat transfer of nanofluid along a wedge in the presence of heat generation/absorption. AIP Conf Proc 1682:020008. https://doi.org/10.1063/1.4932417
14. Khan M, Azam M, Alshomrani AS (2017) Effects of melting and heat generation/ absorption on unsteady Falkner-Skan flow of Carreau nanofluid over a wedge. Int J Heat Mass Transfer. 110:437–446. https://doi.org/10.1016/j.ijheatmasstransfer.2017.03.037
15. Patil PM, Kumbarwadi N, Shashikant A (2018) Effects of MHD mixed convection with non-uniform heat source/sink and cross-diffusion over exponentially stretching sheet. Int J Numer Methods Heat Fluid Flow 28(6):1238–1255. https://doi.org/10.1108/hff-04-2017-0149
16. Jain S, Choudhary R (2018) Dufour-Soret and thermophoretic effects on magnetohydrodynamic mixed convection casson fluid flow over a moving wedge and non-uniform heat source/sink. Int J Fluid Mech Res 45(1):51–74. https://doi.org/10.1615/interjfluidmechres.2018020450
17. Alam MS, Islam T, Rahman MM (2015) Unsteady hydromagnetic forced convective heat transfer flow of a micropolar fluid along a porous wedge with convective surface boundary condition. Int J Heat Tech 33(2):115–125. https://doi.org/10.18280/ijht.330219

Numerical Investigation of Non-Fourier Flux Theory with Chemical Action on Maxwell Radiating Nanoliquid: A Biomedical Application

Suneetha Sangapatnam, Subbarayudu Ketineni, Ali J. Chamkha, and Bala Anki Reddy Polu

Abstract In the modern critique, we deliberated a theoretical model of blood with carbon nanotubes (CNT's)—ejected in a Maxwell fluid with dissipative nanoparticles through binary chemical reaction lying on a stretching sheet by means of aligned field of magnetism. A customized Arrhenius function is imposed for energy activation. A non-linear radiation and a heat source/sink which is not uniform are incorporated in the energy equation which named as Cattaneo–Christov model of heat diffusion. Convective slip and suction are also added. Single and multiple walled nanotubes of carbon are employed with human blood as working liquid. A non-linear system is obtained for the considered problem, and an attempt is made by using Runge–Kutta fourth order through shooting (RK4S) method—bvp4c codes in MATLAB. The results are discussed and plotted in graphs for embedded parameters of concern. Higher activation energy improves the concentration, and a rise in chemical reaction rate constant raises Sherwood number. This study is thoughtful for medical surgeons during surgery in regulating the blood flow.

Keywords Cattaneo–Christov heat flux · SWCNT and MWCNT's · Activation energy · Binary chemical reaction · Human blood · Non-uniform heat source/sink

Nomenclature

g'	Acceleration due to gravity
T_∞	Ambient fluid temperature
T_f	Hot fluid temperature

S. Sangapatnam (✉) · S. Ketineni
Department of Applied Mathematics, Yogi Vemana University, Kadapa 516005, India
e-mail: suneethayvu@gmail.com

A. J. Chamkha
Mechanical Engineering Department, Prince Mohammad Endowment for Nanoscience and Technology, Prince Mohammad Bin Fahd University, Al-Khobar 31952, Saudi Arabia

B. A. R. Polu
Department of Mathematics, School of Advanced Sciences, VIT, Vellore 632014, India

B. Rushi Kumar et al. (eds.), *Advances in Fluid Dynamics*, Lecture Notes in Mechanical Engineering, https://doi.org/10.1007/978-981-15-4308-1_61

h_f	Convective heat transfer coefficient
Ec	Eckert number
M	Magnetic parameter
E	Non-dimensional activation energy
Pr	Prandtl number
$\lambda*$	Thermal buoyancy parameter
Nr	Solutal buoyancy parameter
q_r	Radiative heat flux
Sc	Schmidt number
S	Suction/injection parameter
T	Temperature
$\bar{k}_{\text{CNT}}$	Thermal conductivities of CNT's
$\bar{k}_f$	Thermal conductivity of the host fluid
$\bar{k}_{\text{nf}}$	Thermal conductivity of the nanofluid
Rd	Radiation parameter
B_0	Uniform magnetic field strength
U_w	Velocity at wall
u	Velocity component along the x-axis
v	Velocity component along y-axis
A	Velocity slip factor
v_w	Wall mass flux
T_w	Wall temperature
C_w	Wall concentrate
Σ	Non-dimensional chemical reaction rate constant
θ_w	Temperature ratio parameter
μ_f	Fluid viscosity
μ_{nf}	Nanofluid viscosity
χ	Nanoparticles fraction
ρ_f	Fluid density
ρ_{CNT}	Thermal conductivities of CNT's
$(\rho C_p)_f$	Fluid heat capacitance
$(\rho C_p)_{\text{nf}}$	Nanofluid heat capacitance
$(\rho C_p)_{\text{CNT}}$	CNT's heat capacity
ρ_{nf}	Density of the nanofluid
$\sigma**$	Electric conductivity
α_{nf}	Thermal diffusivity of nanofluids
ξ	Aligned magnetic field parameter

1 Introduction

With the enormous awareness of current engineering technology, a new material known as nanomaterial that had got extensive enactment in fields like industry, biomedicine, electronics and transportation [1]. Nanofluid is a fluid having nano-sized metallic or non-metallic particles. Carbon atoms are arranged in empty cylindrical forms which are known as Carbon nanotubes, and the walls are in hexagonal shape of graphite. Furthermore, depending upon the number of graphene sheets rolled concentrically, single-wall and multi-wall carbon nanotubes are prepared. Fluid mechanics is the branch of physics concerned with the mechanics of fluids which are in movement. Here, blood is treated as a liquid that helps the bioengineers to model an upgraded synthetic organ and discovering remedies related to the human body diseases. Fourier did the introductory work for describing the flow temperature in parabolic equations and got a negative feature which discloses a small interruption throughout the medium. So, several investigators make an effort to alter the classical Fourier's law. Among them, Cattaneo [2] was one who productively modified the law by attaching the heat relaxation time which let the movement of heat by the employment of transmission of heat waves with unchanging speed. Christov [3] renovated the Maxwell–Cattaneo law with time derivative to get material invariance. Bala Anki Reddy and Suneetha [4] disclosed the fluid temperature and the heat relaxation time which are encountered in nature. Kolin [5] was the first person who has given the concept of electromagnetic fields in medical research. A force branded as Lorentz force has been generated by both magnetic and electric fields which has empathy to oppose the motion of the liquid (blood). By applying external magnetic field, the diseases like cardiovascular, haemorrhages and hypertension can be treated and have many real applications such as MRI, cancer therapy. Some authors [6, 7] suggested that when a human system is rendered to a magnetic flux externally, it starts to slow down the blood flow. The impact of radiation on blood flow has many uses in medical treatment methods. With the help of electromagnetic radiation, oncologist treats the cancerous tissues (Szasz [8]) by overheating them. Many investigators [9–11] explored the characteristics of non-Newtonian fluids where the heat radiation is not linear. Non-linear radiation is apt for peak and small temperature variations of surface and the fluid far from the surface. MHD flow over a stretching surface with Maxwell nanofluid was numerically explained by Reddy et al. [12]. Blood flow through a vessel with slip velocity near the wall was developed by Misra and Kar [13]. Gebhart [14] was first who revealed the significance of dissipation in convection. The process in which a part of kinetic energy converts into thermal energy by the viscosity of the fluid in motion is an irreversible process known as viscous dissipation. Reddy et al. [15] conducted a numerical experiment on the magneto-hydrodynamic flow of blood over a porous inclined plate with dissipation. By generating heat in the fluid mass, the temperature circulation can be changed which affects the rate of particle deposition. At present, we consider source/sink of heat which is not uniform. Some related studies on this were carried out by several investigators [16–20]. Svante Arrhenius was the first person who proposed the term activation energy in 1889. He narrated

it as the least energy required to start the reaction. In 1990, Bestman [21] disclosed binary chemical reaction in a fluid flow. An equation which describes the association with the activation energy and the reaction rate is referred as the Arrhenius equation. The Arrhenius equation is $K = B_1(T - T_\infty)^m \, e^{\left(\frac{-E_a}{k(T-T_\infty)}\right)}$ where K—reaction rate, B_1—exponential factor, E_a—the activation energy, T—temperature of the fluid and $k = 8.61 \times 10^{-5}$ eV/K is the Boltzmann constant. Actually, when temperature rises regularly, the rate of reaction rises. A reaction that occurs in two steps which is familiar in both (liquid and vapour) deposition processes is known as a binary chemical reaction, and some of its applications are varnishing of metallic objects and manufacturing of electronic tools investigated by Shafique et al. [22]. Few existing reviews aforementioned topic is revealed in Refs. [23, 24]. The literature survey shows that there are many investigations done on nanofluids with C-CHF model on stretching plane. Still there is no work has been explored to discuss the aligned magneto-radiating fluid on blood. To fill the gap in this regard, current attempt is done to analyze the effect on aligned magneto-hydrodynamic 2D Maxwell nanofluid with CNT's on blood flow past a stretching sheet with non-linear heat radiation of non-Fourier flux theory. The specific attention of the present effort is to inspect the comparable solutions of the non-linear partial differential equations for some values of the parameters by using the shooting method.

2 Description of the Problem

Let us consider the Maxwell nanofluid past a stretchable plane with blood flow. In this autopsy, SWCNT's and MWCNT's are used. The physical characteristics of the host fluid and CNT's are drafted in Table 1. In this autopsy, Cattaneo—Christov heat flux model (C-CHFM) is considered. The primary fluid is taken as blood which is viscous in nature. The problem is characterized under the action of viscous dissipation, activation energy, binary chemical reaction, thermal radiation which is not linear, non-uniform heat source/sink and aligned magnetic field. Sheet stretches in the route of x-axis and erects to the y-axis. The magnetic flux B is employed vertically to the sheet. The stimulated magnetic field is tiny as a result a very minute Reynolds number exist. $U_w(x) = cx$ $(c > 0)$ be the velocity along the stretching direction. Temperature is synchronized by convection and depicted in

Table 1 Thermo-physical characteristics of base fluids and CNTs [25]

Physical properties	Host fluid (human blood)	Nanoparticles	
		SWCNT	MWCNT
C_p	3594	425	796
ρ	1053	2600	1600
κ	0.492	6600	3000
$\beta \times 10^{-5}$	0.18	2.6	2.8

Fig. 1 Flow framework

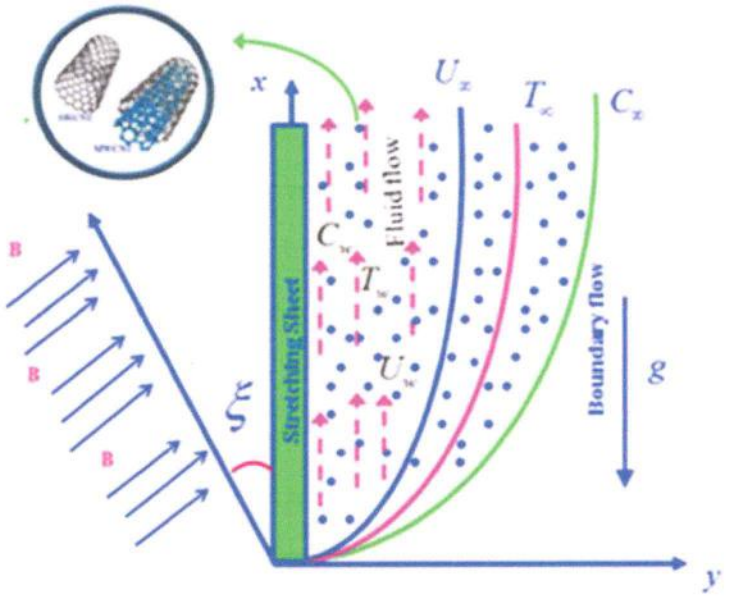


Fig. 1. The flow under these attentions can be put into the ensuing form:

$$\partial_x u + \partial_y v = 0 \tag{1}$$

$$u\,(\partial_x u) + \lambda_1\left(u^2(\partial_{xx} u) + v^2(\partial_{yy} u) + 2uv(\partial_{xy} u)\right) + v(\partial_y u)$$
$$= \frac{1}{\rho_{\mathrm{nf}}}\left(\mu_{\mathrm{nf}}(\partial_{yy} u) + (\rho\beta)_f g'(T - T_\infty) - (\rho\beta^*)_f g'(C - C_\infty) - \sin^2\xi\sigma B_0^2(x)u\right) \tag{2}$$

$$\left(\rho C_p\right)_{\mathrm{nf}}\left(u\,(\partial_x T) + v\,(\partial_y T)\right) = -\nabla\cdot q_0 - \frac{1}{\upsilon}\left(\partial_y q_r\right) + \frac{\upsilon}{c_p}\left(\partial_y u\right)^2 + q''' \tag{3}$$

$$u(\partial_x C) + v\left(\partial_y C\right) = D\left(\partial_{yy} C\right) - k_r^2\left(\frac{T}{T_\infty}\right)^m (C - C_\infty)e^{-\frac{E_a}{kT}} \tag{4}$$

The expression $k_r^2\left(\frac{T}{T_\infty}\right)^m e^{-\frac{E_a}{kT}}$ in Eq. (4) designates the modified Arrhenius equation, reaction rate—k_r^2, the fixed rate constants—m, $-1 < m < 1$.

The C-CHF is expressed as

$$q_0 + \lambda^*\left(\partial_t q_0 + V'\cdot\nabla q_0 - q_0\cdot\nabla V' + \left(\nabla\cdot V'\right)q_0\right) = -\bar{k}_f(\nabla\cdot T) \tag{5}$$

where λ^*—flux relaxation time and V'—velocity vector. Equation (5) is transformed into Fourier's law for $\lambda^* = 0$, $\nabla . V' = 0$, and for incompressible fluid, Eq. (5) receipts the outline

$$q_0 + \lambda^*\left(\partial_t q_0 + V'\cdot\nabla q_0 - q_0\cdot\nabla V'\right) = -\bar{k}_f\,(\nabla\cdot T) \tag{6}$$

The energy equation after eliminating q_0 from Eqs. (3) and (6) is

$$u(\partial_x T) + \lambda^*\Big(\big(u(\partial_x T) + v(\partial_y T)\big)^2 + u\big((\partial_x u)(\partial_x T) + (\partial_x v)(\partial_y T)\big) + v\big((\partial_y v)(\partial_y T) + (\partial_y u)(\partial_x T)\big)\Big) + v(\partial_y T) = \alpha_{\mathrm{nf}}(\partial_{yy} T) - \frac{1}{\upsilon}(\partial_y q_r) + \frac{\upsilon}{c_p}(\partial_y u)^2 + q''' \tag{7}$$

The non-uniform source/sink of heat q''' is modelled as

$$q''' = \frac{kU_w}{x\upsilon}\left[A * (T_w - T_\infty) f' + B * (T - T_\infty)\right]$$

where A^* and B^* denote the space- and temperature-dependent coefficients. For $A^* > 0$ and $B^* > 0$, internally heat is generated, and for $A^* < 0$, $B^* < 0$, heat is absorbed internally.

The heat flux q_r is given by means of the Rosseland approximation

$$q_r = -\left(\frac{4}{3\,K^*}\right)\mathrm{grad}(\sigma^* T^4) \tag{8}$$

where K^*—the absorption coefficient, e_b—the emission from a blackbody and $\sigma^* = 5.6697 \times 10^{-8}\ \mathrm{Wm^{-2}\,K^{-4}}$ be the Stefan–Boltzmann constant.

The term T^4 is a function of temperature and can be extended as Taylor series in terms of T_∞ and estimated by ignoring terms with higher order.

$$T^4 = T_\infty^4\{1 + (\theta_w - 1)\theta\}^4 \tag{9}$$

where $\theta_w = \frac{T_w}{T_\infty}$, $\theta_w > 1$ be the wall temperature ratio parameter.

Xue launched a model which depends on Maxwell theory and reimburses the effect of the space distribution on CNT's. In this paper, Xue model is used as follows:

$$\frac{\bar{k}_{\mathrm{nf}}}{\bar{k}_f} = \frac{1 - \chi + 2\chi\left(\frac{\bar{k}_{\mathrm{CNT}}}{\bar{k}_{\mathrm{CNT}} - \bar{k}_f}\right)\ \log\frac{\bar{k}_{\mathrm{CNT}} + \bar{k}_f}{2\bar{k}_f}}{1 - \chi + 2\chi\left(\frac{\bar{k}_f}{\bar{k}_{\mathrm{CNT}} - \bar{k}_f}\right)\ \log\frac{\bar{k}_{\mathrm{CNT}} + \bar{k}_f}{2\bar{k}_f}} \tag{10}$$

which is interpreted as:

$$\left.\begin{aligned} \frac{\rho_{\mathrm{nf}}}{\rho_f} = (1 - \chi) + \frac{\chi\rho_{\mathrm{CNT}}}{\rho_f}\ ,\ \frac{(\rho C_p)_{\mathrm{nf}}}{(\rho C_p)_f} = (1 - \chi) + \frac{\chi(\rho C_p)_{\mathrm{CNT}}}{(\rho C_p)_f} \\ \mu_{\mathrm{nf}} = (\upsilon\rho)_{\mathrm{nf}},\ \mu_{\mathrm{nf}} = \mu_f(1 - \chi)^{-2.5}\ ,\ \bar{k}_{\mathrm{nf}} = \big(\alpha(\rho C_p)\big)_{\mathrm{nf}} \end{aligned}\right\} \tag{11}$$

and undergoes the boundary conditions:

$$y = 0 : u = U_w(x) + A\left(\partial_y u\right),\ v = -v_w,\ -k\left(\partial_y T\right) = h_f(T_f - T),\ C = C_w$$

$$y \to \infty : u \to 0\ ,\ T \to T_\infty\ ,\ C \to C_\infty \tag{12}$$

Using the similarity transformations,

$$\eta = \sqrt{\frac{c}{\nu}}\, y,\ \psi(x, y) = \sqrt{c\nu}\, x f(\eta), \quad \theta(\eta) = \frac{T - T_\infty}{T_w - T_\infty},\ \ \phi(\eta) = \frac{C - C_\infty}{C_w - C_\infty}$$
$$u = cxf'(\eta),\ v = -\sqrt{c\nu} f(\eta) \tag{13}$$

Adopting Eqs. (10, 11, 13) in Eqs. (1, 2, 7, 4), we have

$$d_{\eta\eta\eta} f + (1-\chi)^{2.5}\left\{\left(1 - \chi + \chi\frac{(\rho\beta)_{\mathrm{CNT}}}{(\rho\beta)_f}\right)(\lambda\theta - Nr\phi) - \sin^2\xi M^2\left(d_\eta f\right)\right\}$$
$$-(1-\chi)^{2.5}\left(1 - \chi + \chi\frac{\rho_{\mathrm{CNT}}}{\rho_f}\right)\left\{\left(d_\eta f\right)^2 - f\left(d_{\eta\eta} f\right)\right.$$
$$\left.+\alpha\left(f^2\left(d_{\eta\eta\eta} f\right) - 2f\left(d_\eta f\right)\left(d_{\eta\eta} f\right)\right)\right\} = 0 \tag{14}$$

$$\frac{1}{\mathrm{Pr}}\left\{\left(d_{\eta\eta}\theta\right)\left\{\frac{k_{\mathrm{nf}}}{k_f} + \frac{4}{3}\mathrm{Rd}[(\theta_w - 1)\theta + 1]^3\right\} + 4\mathrm{Rd}[(\theta_w - 1)\theta + 1]^2(\theta_w - 1)\left(d_\eta\theta\right)^2\right\}$$
$$+\left\{1 - \chi + \chi\frac{(\rho c_p)_{\mathrm{CNT}}}{(\rho c_p)_f}\right\}\left\{f\left(d_\eta\theta\right) - \gamma\left(f\left(d_\eta f\right)\left(d_\eta\theta\right) + f^2\left(d_{\eta\eta}\theta\right)\right)\right\}$$
$$+\mathrm{Ec}\left(d_{\eta\eta} f\right) + A * \left(d_\eta f\right) + B * \theta = 0 \tag{15}$$

$$d_{\eta\eta}\phi + \mathrm{Sc}\ f\ (d_\eta\phi) - \ \mathrm{Sc}\ \sigma\ \phi\ [\theta(\theta_w - 1) + 1]^m e^{-\ \frac{E}{\theta(\theta_w - 1) + 1}} = 0 \tag{16}$$

Together with the boundary conditions

$$f(\eta) = S,\ d_\eta f(\eta) = 1 + \delta\, d_{\eta\eta} f(0),\ d_\eta\theta(\eta) = -Bi(1 - \theta(\eta)), \phi\,(\eta) = 1 \text{ at } \eta = 0,$$
$$d_\eta f(\eta) = 0,\ \ \theta(\eta) = 0\,,\ \ \phi(\eta) = 0\ \ \text{at } \eta = 0 \text{ at } \eta \to \infty \tag{17}$$

where

$$\mathrm{Sc} = \frac{\upsilon}{D},\ \sigma = \frac{k_r^2}{c},\ E = \frac{E_a}{kT_\infty},\ \lambda = \frac{\mathrm{Gr}_x}{\mathrm{Re}_x^2},\ \mathrm{Gr}_x = \frac{(\rho\beta)_f g'(T_w - T_\infty)x^3}{\upsilon^2\rho_f},$$

$$Nr = \frac{\mathrm{Gc}_x}{\mathrm{Re}_x^2}, \mathrm{Gc}_x = \frac{(\rho\beta^*)_f g'(C_w - C_\infty)x^3}{\upsilon^2\rho_f},\ \mathrm{Re}_x^2 = \frac{U_w^2 x^2}{\upsilon^2}, M = B_0\sqrt{\frac{\sigma}{a\rho_f}}\,x,$$

$$\alpha = \lambda_1 c,\ \gamma = \lambda^* c, \mathrm{Rd} = \frac{4\sigma^* T_\infty^{*^3}}{kk_1},\ \mathrm{Ec} = \frac{U_w^2}{C_p(T_w - T_\infty)},\ \mathrm{Pr} = \frac{(\mu C_p)_f}{k},$$

$$S = \frac{v_w}{a\upsilon_f},\ \delta = A\sqrt{\frac{c}{\upsilon}},\ Bi = \left(\frac{h_f}{\overline{k}_f}\right)\sqrt{\upsilon_f/c}$$

3 Quantities of Interest

The quantities of interest for considering flow are surface drag force, local Nusselt number and Sherwood number, which are as follows:

$$C_{f_x} = \frac{\tau_w}{\rho_f U_w^2},\quad Nu_x = \frac{xq_w}{\overline{k}_f(T_w - T_\infty)} \text{ and } \mathrm{Sh}_x = \frac{xq_m}{D(C_w - C_\infty)} \tag{18}$$

where τ_w(skin friction of the wall), q_w(heat flux of the wall) and q_m(mass flux of the wall) which are specified as

$$\tau_w = \mu_{\mathrm{nf}}\left(\partial_y u\right)_{y=0},\ q_w = -x\overline{k}_{\mathrm{nf}}\left(\partial_y T\right)_{y=0} + \left(q_r\right)_{y=0} \text{ and } q_m = -D\left(\partial_y C\right)_{y=0} \tag{19}$$

In view of Eqs. (18) and (19), the dimensionless surface drag force, local Nusselt number and local Sherwood number are given by

$$C_f \mathrm{Re}_x^{1/2} = \frac{1}{(1-\chi)^{2.5}}\left(d_{\eta\eta} f(0)\right),$$

$$Nu_x \mathrm{Re}_x^{-1/2} = -\left\{\frac{\overline{k}_{\mathrm{nf}}}{\overline{k}_f} + \frac{4}{3}\mathrm{Rd}[(\theta_w - 1)\theta(0) + 1]^3\right\}\left(d_\eta\theta(0)\right)$$

$$\text{and } \mathrm{Sh}_x \mathrm{Re}_x^{-1/2} = -d_\eta\phi(0), \tag{20}$$

wherever $\mathrm{Re}_x = \frac{U_w x}{\upsilon}$ signifies Reynolds number.

4 Results and Discussion

Blood flow (host fluid) of MHD-based CNT's on C-CHFM with non-linear radiant heat along with binary chemical changes on Maxwell nanofluid covering the stretching sheet. In this segment, we inspect the physical outcomes of sundry parameters with respect to the velocity $f'(\eta)$, temperature $\theta(\eta)$ and species distribution $\phi(\eta)$. This segment contains the effects of dimensionless parameters like M, θ_w, Pr, Sc, Ec, σ, Rd, E which are demonstrated in Figs. 2, 3, 4, 5, 6, 7, 8 and 9. The outcomes are obtained for two diverse cases of CNT's, predominantly, SWCNT's and MWCNT's (blue coloured solid line denotes SWCNT's and green coloured dashed lines denotes MWCNT's) for blood flow. In Table 1, the numerical standards of CNT's and host fluid are revealed. The Prandtl number of blood is engaged as 21,and it behaves as non-Newtonian due to the existence of red blood cells. The variation of other parameters are constant, i.e., $M = 0.5$, $\lambda = 0.5$, $Nr = 0.5$, $\gamma = 0.1$, $Sc = 0.5$,

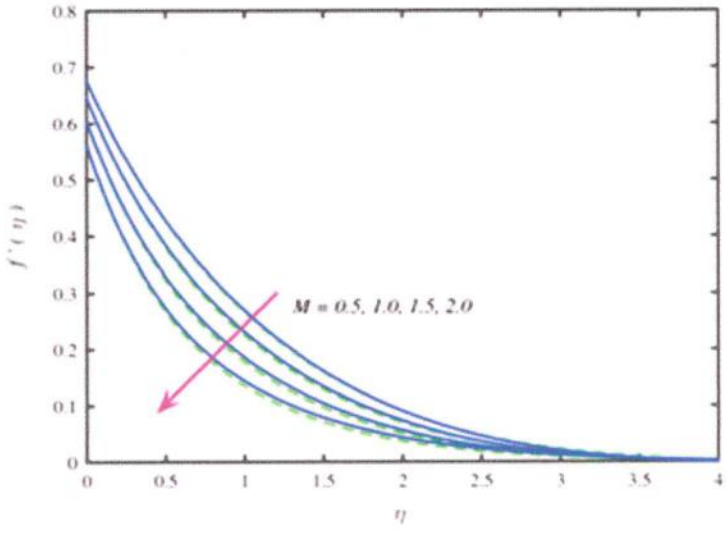


Fig. 2 M versus $f'(\eta)$

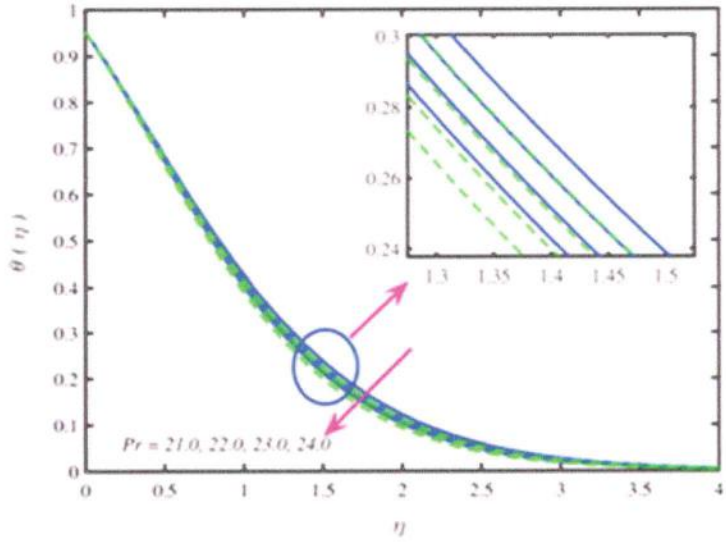


Fig. 3 Pr versus $\theta(\eta)$

Fig. 4 *Sc* versus ϕ (η)

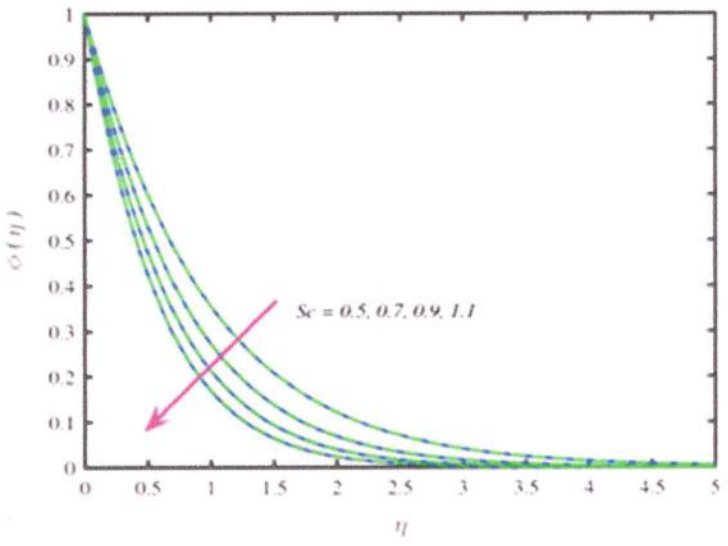


Fig. 5 θ_w versus θ (η)

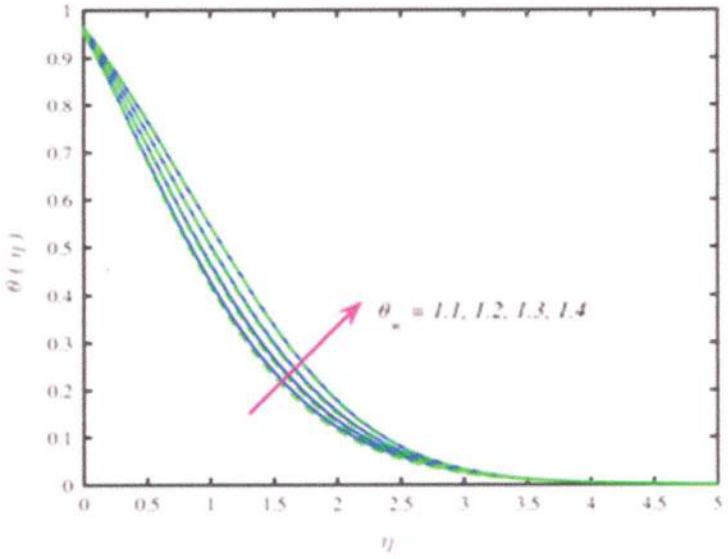


Fig. 6 Rd versus $\theta(\eta)$

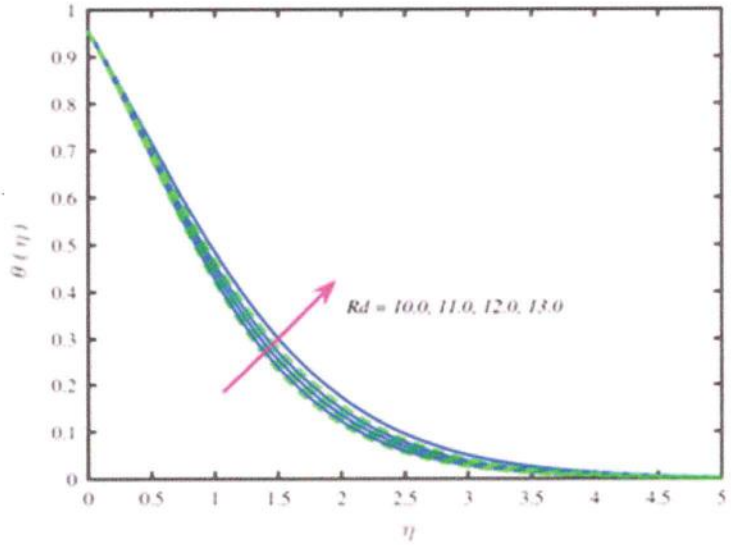


Fig. 7 E versus $\phi(\eta)$

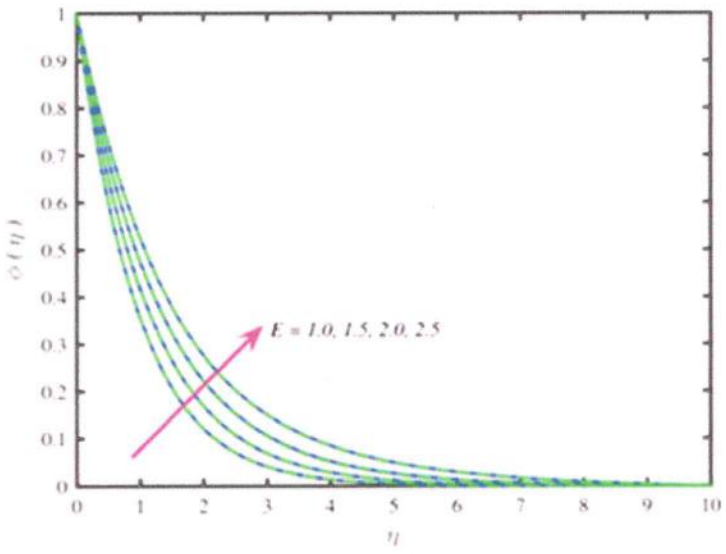


Fig. 8 Ec versus θ (η)

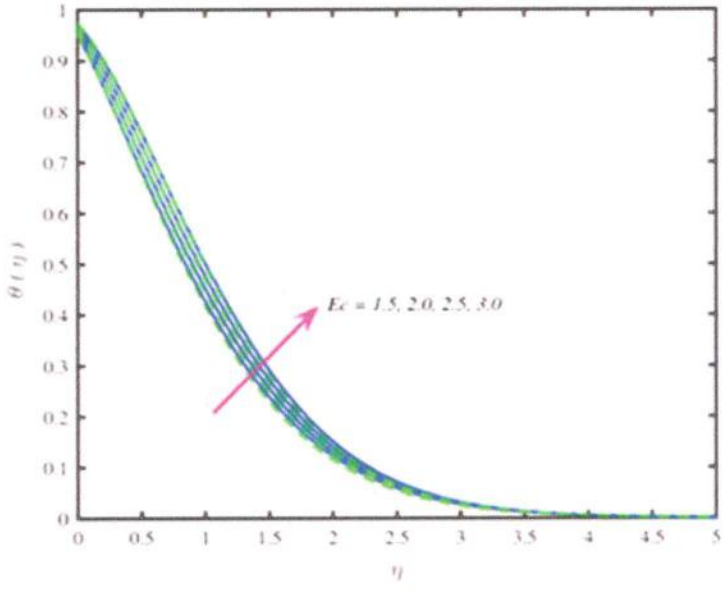
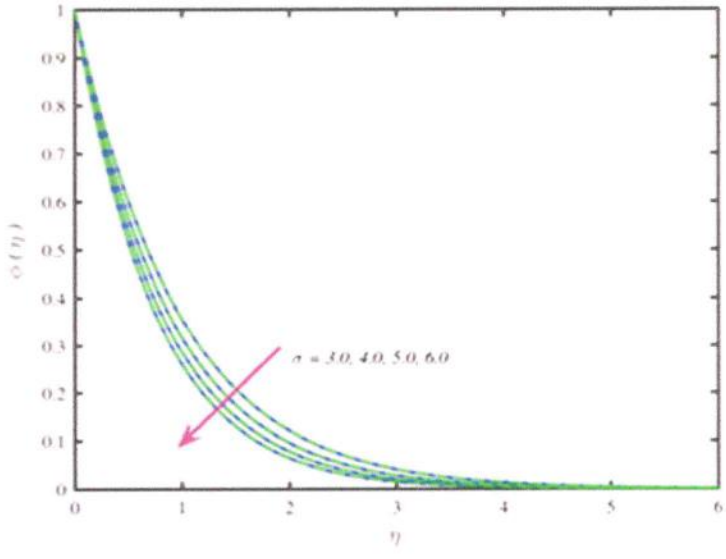


Fig. 9 σ versus $\phi(\eta)$



Ec = 1.5, $\theta_w = 1.1$, Bi = 10, $E = 1.0$, $\delta = 0.5$, $S = 0.5$, $A^* = 0.05$, $B^* = 0.05$, Rd = 10.0, $\sigma = 3.0$, $\chi = 0.06$, $\xi = \frac{\pi}{4}$, unless otherwise specified. Table 2 describes the deviations of skin friction for different parameters. The skin friction decreases with growing of M and ξ, and a reverse trend for Ec and χ. Table 3 displays the variations in rate of heat transfer for different values of M, Pr, Ec and χ. Heat transfer rate accelerates with Pr and decelerates with M, Ec and χ. Table 4 provides the sample values of mass transfer for several values of embedding parameters. Mass transfer declines for M, whereas it inclines with Sc, θ_w and χ. The upshot of M on velocity is perceived in Fig. 2. As M is grown, the velocity of the fluid diminishes (for both types of CNT's), and a decrease in the width of the velocity boundary layer is seen. Physically, a force called as Lorentz force opposes the movement and boosts up the molecules to collide. This force slows down the flow and is accountable in velocity decrement. Analysis of Pr on temperature is drafted in Fig. 3. Physically, the temperature and the width of the temperature boundary layer are counter in nature with

Table 2 Deviations in skin friction coefficient and various dimensionless parameters

M	Ec	χ	ξ	$f''(0)$	
				SWCNT	MWCNT
0.2	0.02	0.06	$\frac{\pi}{4}$	−0.6096	−0.6310
0.3	0.02	0.06	$\frac{\pi}{4}$	−0.6162	−0.6378
0.4	0.02	0.06	$\frac{\pi}{4}$	−0.6253	−0.6472
0.2	0.03	0.06	$\frac{\pi}{4}$	−0.6092	−0.6307
0.2	0.04	0.06	$\frac{\pi}{4}$	−0.6089	−0.6305
0.2	0.02	0.07	$\frac{\pi}{4}$	−0.5926	−0.6215
0.2	0.02	0.08	$\frac{\pi}{4}$	−0.5658	−0.6076
0.2	0.02	0.06	$\frac{\pi}{3}$	−0.6122	−0.6337
0.2	0.02	0.06	$\frac{\pi}{2}$	−0.6149	−0.6365

Table 3 Deviations in the rate of heat transfer and various dimensionless parameters

M	Pr	Ec	χ	$-\theta'(0)$	
				SWCNT	MWCNT
0.2	21.0	0.02	0.06	7.3704	8.0949
0.3	21.0	0.02	0.06	7.3513	8.0748
0.4	21.0	0.02	0.06	7.3253	8.0471
0.2	22.0	0.02	0.06	7.7201	8.4573
0.2	23.0	0.02	0.06	8.0652	8.8149
0.2	21.0	0.03	0.06	7.3468	8.0708
0.2	21.0	0.04	0.06	7.3232	8.0467
0.2	21.0	0.02	0.07	5.3761	6.6444
0.2	21.0	0.02	0.08	1.9658	4.4405

Table 4 Deviations in the rate of mass transfer and various dimensionless parameters

M	Sc	θ_w	χ	$-\phi'(0)$	
				SWCNT	MWCNT
0.2	0.6	1.1	0.06	1.1088	1.1067
0.3	0.6	1.1	0.06	1.1081	1.1059
0.4	0.6	1.1	0.06	1.1070	1.1048
0.2	0.7	1.1	0.06	1.2179	1.2155
0.2	0.8	1.1	0.06	1.3218	1.3192
0.2	0.6	1.2	0.06	1.1366	1.1340
0.2	0.6	1.3	0.06	1.1671	1.1641
0.2	0.6	1.1	0.07	1.1139	1.1107
0.2	0.6	1.1	0.08	1.1209	1.1156

Pr. The reduction in temperature profile for high Pr involves low heat conductivity which results in low fluid temperature for both SWCNT's and MWCNT's. As Sc is inversely associated with the mass diffusion coefficient D, as a result, larger values of Sc denote smaller D and for that leads to thinner concentration at the boundary layer. Thus, the nanoparticle concentration depreciates for both types of CNT's by the elevated values of Sc which is portrayed in Fig. 4. As values of θ_w mounts, a climb in temperature is seen in Fig. 5, and for that reason, growing θ_w results in elevation of wall temperature that successively yields a wider penetration depth for temperature when compared to ambient temperature, consequently fluid temperature enriches. Figure 6 depicts the impression of Rd on temperature and examined that the temperature inflates by raising the values of Rd. The reason behind is the mean absorption coefficient downwards for an upwards in Rd. In point of physics, at radiation, more heat absorbed by the working fluid consequently shows a rise in temperature. Further, the thickness of the thermal boundary layer was built up strongly by raising the values of non-linear radiation parameter. Activation energy E is plotted in Fig. 7 which is evident that as E enlarges the concentration would be larger. To initiate a larger chemical reaction, a huge amount of energy is needed. With the increasing values of E, the Arrhenius function decreases, and as a consequence, the chemical action raises the concentration. With more activation energy and less temperature, it results to a minor reaction rate that decelerates the chemical action. Therefore, the concentration of species increases. To explore the behaviour of Ec on the temperature profiles is plotted in Fig. 8. As Ec rises, the heat of the fluid also rises which leads to solidify the thermal boundary layer which is constant with heat generation due to the frictional property of the fluid. The heat generated by viscous dissipation owed to haul among the fluid particles, and this additional heat results an enhancement in temperature of the initial fluid for both single- and multi-walled CNT's. Figure 9 depicts the impact of reaction rate constant σ on concentration. When we gradually increase σ, the concentration becomes thin out. A favourable destructive reaction rises which consecutively results in a fall in concentration. Due to this concentration,

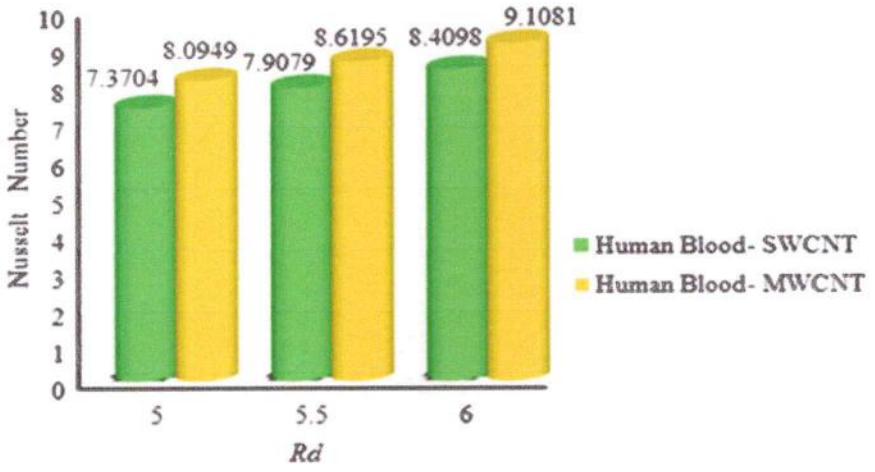


Fig. 10 *Rd* versus Nusselt number

profile decreases, and same consequence is seen for both CNT's. Figure 10 illustrates the variation in local Nusselt number for different values of non-linear thermal radiation. It is clear that escalating values of Rd improves the heat transformation rate for both cases. The enhancement for MWCNT's is slightly more when compared with SWCNT's. The effect of θ_w on local Nusselt number is demonstrated in Fig. 11 and is detected that rising values of θ_w raises the local Nusselt number for both circumstances. The effect of A^* and B^* on local Nusselt number is demonstrated in Figs. 12 and 13. It is noted that rising values of A^* and B^* fall the local Nusselt number for both SWCNT's and MWCNT's. The increment for MWCNT's is more than with SWCNT's. Figure 14 exemplifies the effect of Sherwood number on chemical reaction rate constant. The outcomes show a rise in σ which raises Sherwood number for both SWCNT's and MWCNT's. Figure 15 exemplifies the effect of Sherwood number on Activation Energy. The figure shows a rise in E which has a fall in the Sherwood number for both conditions.

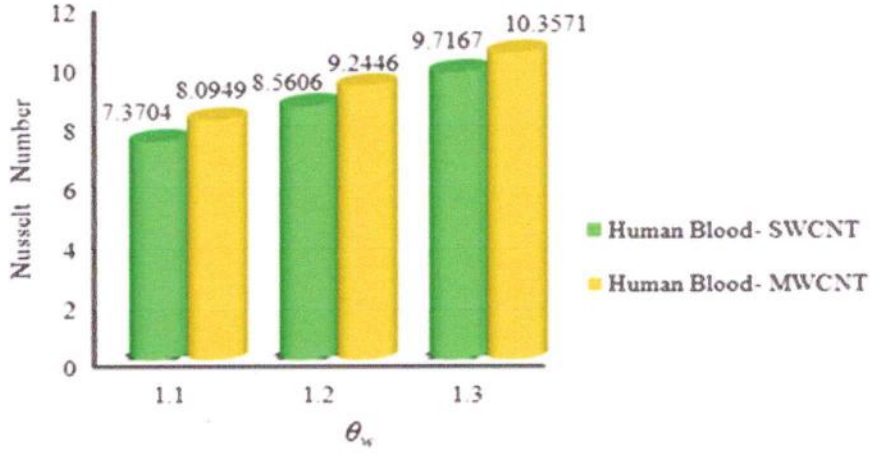


Fig. 11 θ_w versus Nusselt number

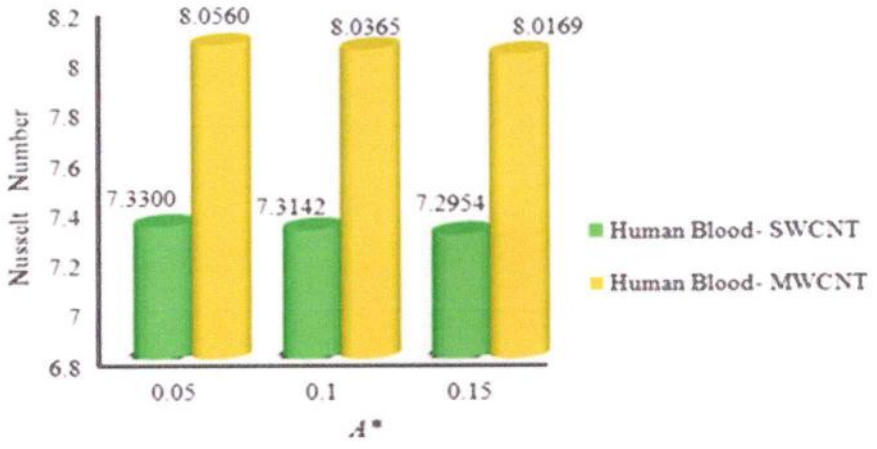


Fig. 12 A^* versus Nusselt number

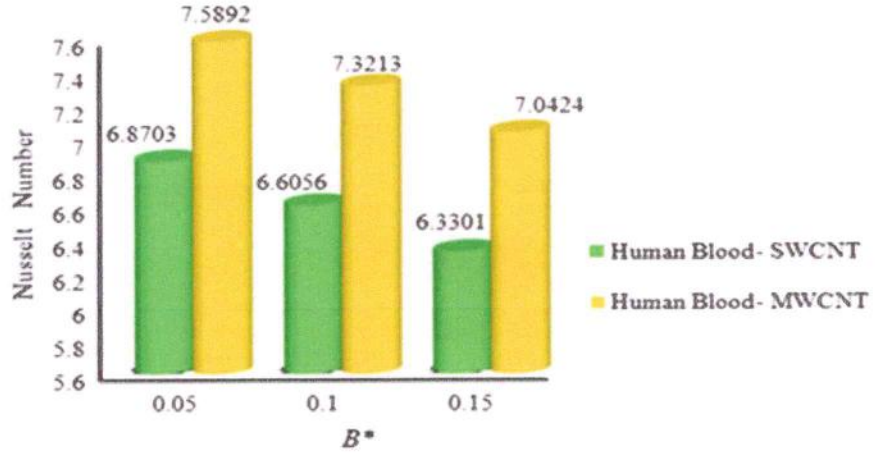


Fig. 13 B^* versus Nusselt number

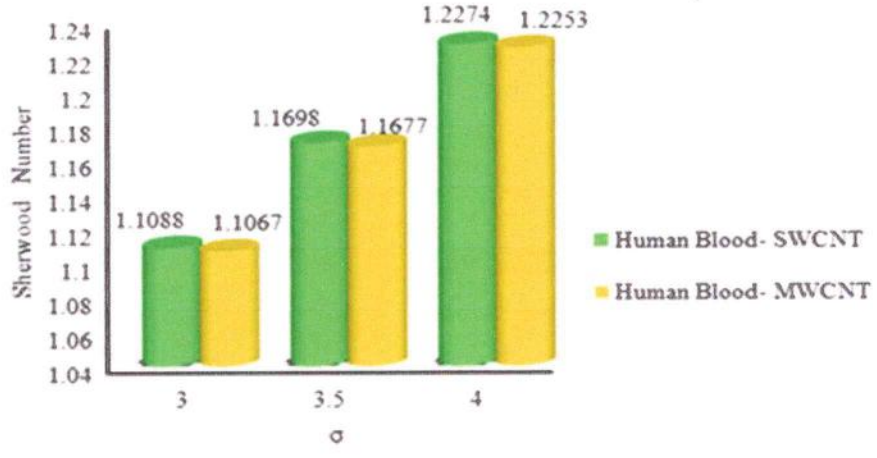


Fig. 14 σ versus Sherwood number

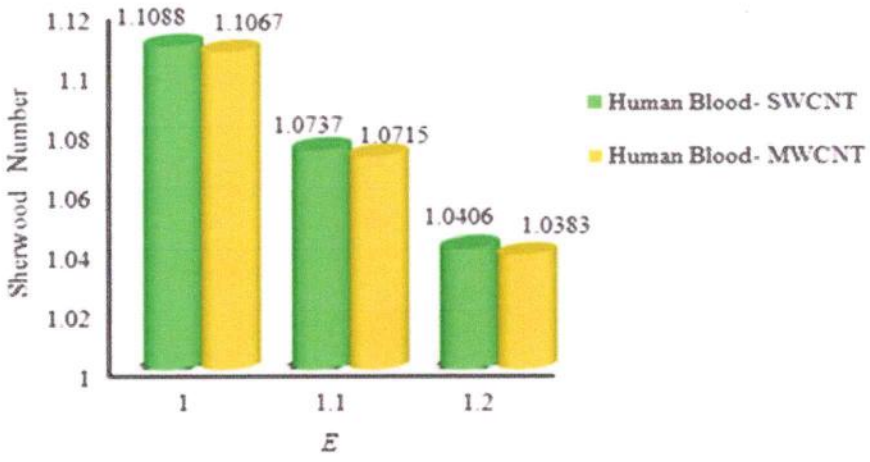


Fig. 15 E versus Sherwood number

5 Final Conclusions

The current communication scrutinizes a theoretical model of blood with carbon nanotubes (CNT's)—ejected in a Maxwell fluid with nanoparticles through binary chemical reaction lying on a stretching sheet by means of aligned magnetic field. The strategic upshots of this framework are outlined below

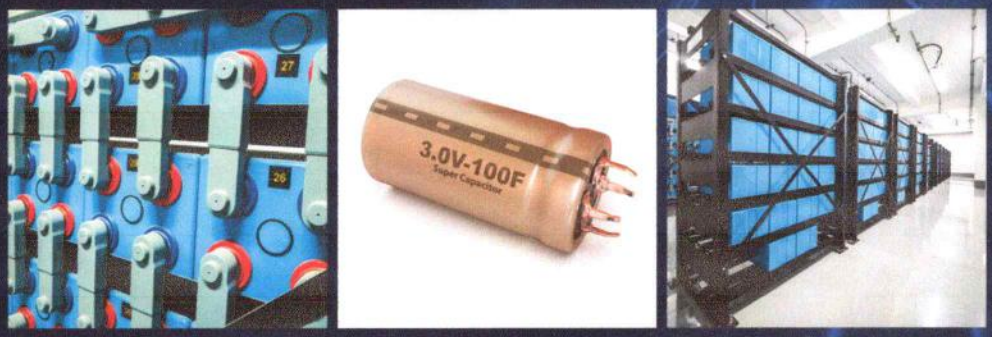
- Increasing values of Rd,θ_w, Ec *and* χ, lead to stronger temperature distribution.
- The higher value of Sc, reaction rate parameter and concentration decreases.
- The fluid concentration rises with E.
- A rise in σ raises Sherwood number.
- A rise in E has a fall in the Sherwood number.

References

1. Baughman RH, Zakhidov AA, De Heer WA (2002) Carbon nanotubes-the route toward applications. Science 297(5582):787–792. https://doi.org/10.1126/science.1060928
2. Cattaneo C (1948) Sulla conduzionedelcalore, AttiSemin. Mat Fis Univ Modena Reggio Emilia 3:83–101
3. Christov CI (2009) On frame indifferent formulation of the Maxwell-Cattaneo model of finite speed heat conduction. Mech Res Commun 36:481–486. https://doi.org/10.1016/j.mechrescom.2008.11.003
4. Bala Anki Reddy P, Suneetha S (2018) Impact of Cattaneo-Christov heat flux in the Casson fluid flow over a stretching surface with aligned magnentic field and homogeneous heterogeneous chemical reaction. Front Heat Mass Transfer 10(7). https://doi.org/10.5098/hmt.10.7
5. Kolin (1936) Electromagnetic flow meter: principle of method and its applications to blood flow measurement. In: Proceedings of the society for experimental biology and medicine, vol. 35, pp. 53–56

6. Sinha A, Misra JC, Shit GC (2016) Effect of heat transfer on unsteady MHD flow of blood in a permeable vessel in the presence of non-uniform heat source. Alexandria Eng J 55(3):2023–2033. https://doi.org/10.1016/j.aej.2016.07.010
7. Sud VK, Sekhon GS (1989) Blood flow through the human arterial system in the presence of a steady magnetic field. Physiol Med Biol 34(7):795–805
8. Szasz A (2007) Hyperthermia, a modality in the wings. J Cancer Res Ther 3(1):56–66
9. Shehzad SA, Hayat T, Alsaedi A, Obid MA (2014) Nonlinear thermal radiation in three-dimensional flow of Jeffrey nanofluid: a model for solar energy. Appl Math Comput 248:273–286. https://doi.org/10.1016/j.amc.2014.09.091
10. Hayat T, Imtiaz M, Alsaedi A, Kutbi MA (2015) MHD three-dimensional flow of nanofluid with velocity slip and nonlinear thermal radiation. J Magn Magn Mater 396:31–37. https://doi.org/10.1016/j.jmmm.2015.07.091
11. Hayat T, Muhammad T, Alsaedi A, Alhuthali M (2015) Magnetohydrodynamic three-dimensional flow of viscoelastic nanofluid in the presence of nonlinear thermal radiation. J Magn Magn Mater 385:222–229. https://doi.org/10.1016/j.jmmm.2015.02.046
12. Bala Anki Reddy P, Suneetha S, Bhaskar Reddy N (2017) Numerical study of MHD Boundary Layer Slip Flow of a Maxwell Nanofluid over an exponentially stretching surface with convective boundary condition. Propulsion Power Res **6**(4):259–268 (2017). https://doi.org/10.1016/j.jppr.2017.11.002
13. Misra JC, Kar BM (1989) Momentum integral method for studying flow characteristics of blood through a stenosed vessel. Biorheology **26**(1):23–25 (1989). https://doi.org/10.3233/BIR-1989-26102
14. Gebhart B (1962) Effects of viscous dissipation in natural convection. J Fluid Mech 14(2):225–232. https://doi.org/10.1017/S0022112062001196
15. Reddy SRR, Bala Anki Reddy P, Suneetha S (2018) Magneto hydro dynamic flow of blood in a permeable inclined stretching viscous dissipation, non-uniform heat source/sink and chemical reaction. Front Heat Mass Transfer 10(22). https://doi.org/10.5098/hmt.10.22
16. Gireesha BJ, Mahanthesh B, Rashidi MM (2015) MHD boundary layer heat and mass transfer of a chemically reacting Casson fluid over a permeable stretching surface with non-uniform heat source/sink. Int J Indus Math 7(3):247–260
17. Mabood F, Ibrahim SM, Rashidi MM, Shadloo MS, Lorenzini G (2016) Non-uniform heat source/sink and Soret effects on MHD non-Darcian convective flow past a stretching sheet in a micropolar fluid with radiation. Int J Heat Mass Transf 93:674–682. https://doi.org/10.1016/j.ijheatmasstransfer.2015.10.014
18. Ali N, Ullah Khan S, Sajid M, Abbas Z (2016) MHD flow and heat transfer of couple stress fluid over an oscillatory stretching sheet with heat source/sink in porous medium. Alexandria Eng J 55(2):915–924. https://doi.org/10.1016/j.aej.2016.02.018
19. Srinivas S, Reddy PBA, Prasad BSRV (2014) Effects of chemical reaction and thermal radiation on MHD flow over an inclined permeable stretching surface with non-uniform heat source/sink: an application to the dynamics of blood flow. J Mech Med Boil 14(5):1450067. https://doi.org/10.1142/S0219519414500675
20. Mohammadein SA, Raslan K, Abdel-Wahed MS, Abedel-Aal Elsayed M (2018) KKL-model of MHD CuO-nanofluid flow over a stagnation point stretching sheet with nonlinear thermal radiation and suction/injection. Results Phys 10:194–199. https://doi.org/10.1016/j.rinp.2018.05.032
21. Bestman AR (1990) Natural convection boundary layer with suction and mass transfer in a porous medium. Int J Eng Res 14:389–96
22. Shafique Z, Mustafa M, Mushtaq A (2016) Boundary layer flow of Maxwell fluid in rotating frame with binary chemical reaction and activation energy. Results Phys 6:627–633. https://doi.org/10.1016/j.rinp.2016.09.006
23. Lu D, Ramzan M, Ahmad S, Dong Chung J, Farooq U (2017) Upshot of binary chemical reaction and activation energy on carbon nanotubes with Cattaneo-Christov heat flux and buoyancy effects. Phys Fluids 29:123103 (2017)

24. Dhlamini M, Kameswaran PK, Sibanda P, Motsa S, Mondal H (2018) Activation energy and binary chemical reaction effects in mixed convective nanofluid flow with convective boundary conditions. J Comput Design Eng 6:149–158. https://doi.org/10.1016/j.jcde.2018.07.002
25. Khalid A, Khana I, Khan A, Shafied S, Tlilie I (2018) Case study of MHD blood flow in a porous medium with CNTS and thermal analysis. Case Stud Thermal Eng 12:374–380. https://doi.org/10.1016/j.csite.2018.04.004



Oxide Free Nanomaterials for Energy Storage and Conversion Applications

Edited by
Prabhakarn Arunachalam, Theerthagiri Jayaraman
Abdullah M. Al-Mayouf, Myong Yong Choi
and Madhavan Jagannathan

ELSEVIER

Chapter 15

Oxides free nanomaterials for (photo)electrochemical water splitting

Lakshmana Reddy Nagappagari[a,b], Santosh S. Patil[a,b], Kiyoung Lee[a,b], and Shankar Muthukonda Venkatakrishnan[c]

[a]*School of Nano & Materials Science and Engineering, Kyungpook National University, Sangju, Gyeongbuk, South Korea,* [b]*Research Institute of Environmental Science & Technology, Kyungpook National University, Daegu, South Korea,* [c]*Nanocatalysis and Solar Fuels Research Laboratory, Department of Materials Science & Nanotechnology, Yogi Vemana University, Kadapa, Andhra Pradesh, India*

Chapter outline

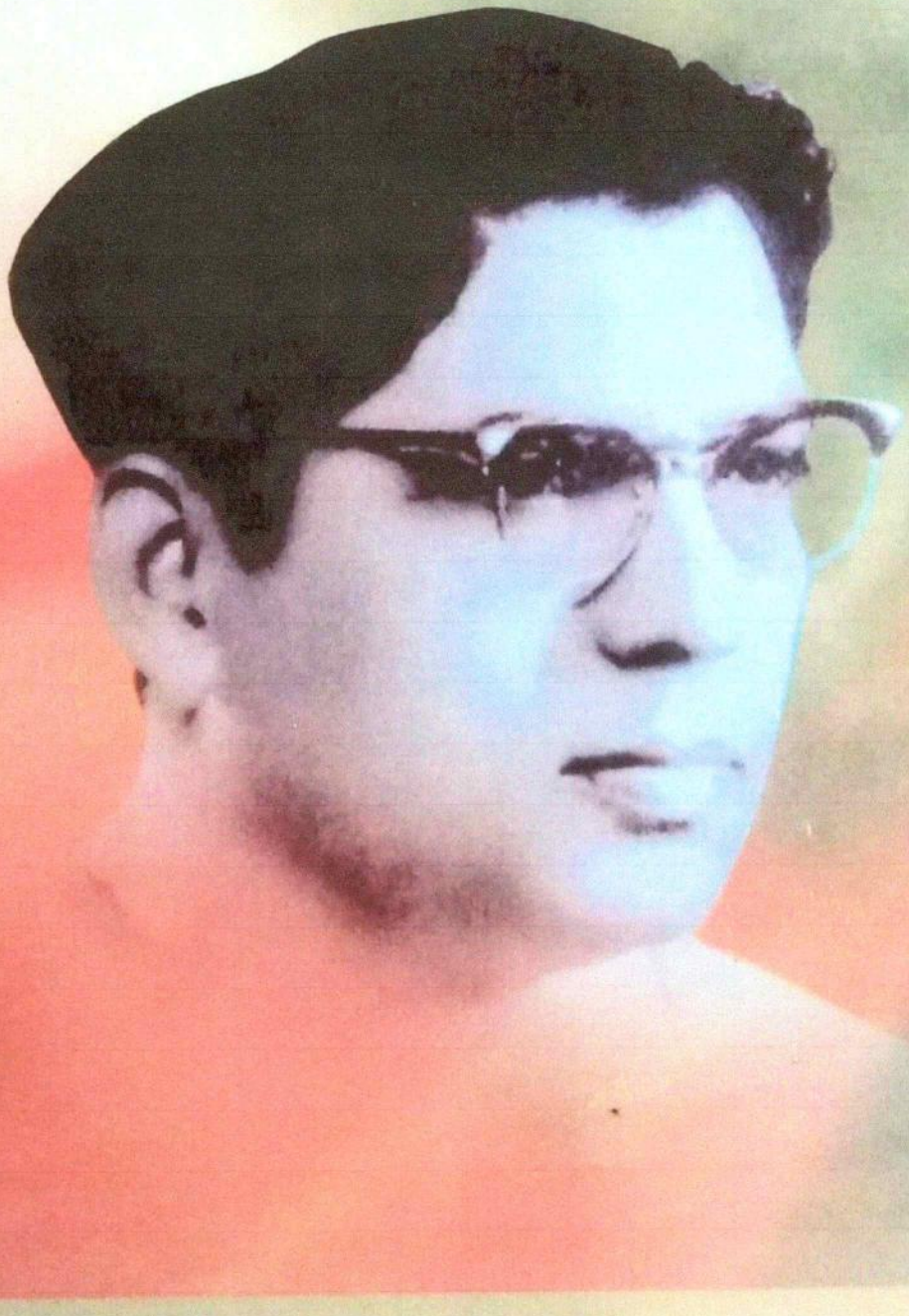
1. General introduction

Owing to the rapid end of fossil fuels and environmental threats, the development of clean and renewable alternatives to fossil fuels has become an important task. Among the various energy sources, hydrogen (H_2) has attracted significant attention because of its high gravimetric energy density beyond that of known fuels, compatibility with electrochemical processes, and energy

Oxide Free Nanomaterials for Energy Storage and Conversion Applications.
https://doi.org/10.1016/B978-0-12-823936-0.00018-8

తిలక్ సాహిత్యం - సందేశం

(శతజయంతి సప్తాహం - అంతర్జాతీయ సదస్సు వ్యాసాలు)



యోగివేమన విశ్వవిద్యాలయం, కడప

మరియు

ఆంధ్రప్రదేశ్ ఉన్నత విద్యామండలి, అమరావతి

TILAK SAHITYAM - SANDESAM

(International Webinar Proceedings)

Honoray Editor:

Prof. M. Surya Kalavathi

Vice-Chancellor, Yogi Vemana University, Kadapa-516 001

Main Editor:

Prof. D. Vijaya Raghava Prasad

Registrar, Yogi Vemana University, Kadapa-516 001

Editor:

Dr. N. Eswara Reddy

Associate Professor & Head

Department of Telugu, Yogi Vemana University, Kadapa -516 001

Co-Editors:

Dr. P.C. Venkateswarlu

Associate Professor, ORI, S.V.University, Tirupati -517 501

Dr. Sri Ganesh

Language Scientist, Haidleberg University, Germany.

Assistant Editor:

Dr. T. Venkataswamy

Assistant Editor, Centre for Publications

Dravidian University, Kuppam - 517 426

No. of Pages: xviii + 238

First Edition : 2021

No. of Copies : 500

Price: Rs.250/-

For Copies:

1) The Registrar

Yogi Vemana University, Kadapa-516001

ISBN: 978-81-921672-3-7

Printing :

Vijayavani Printers

Chowdepalli - 517 257

విషయ సూచిక

ఈ పుస్తకంలో ఉన్న వ్యాసాలలోని అభిప్రాయాలు అయా వ్యాసకర్తలవే.
- సంపాదకులు

యోగి వేమన విశ్వవిద్యాలయం, కడప

&

ఆంధ్రప్రదేశ్ రాష్ట్ర ఉన్నత విద్యామండలి

సంయుక్త నిర్వహణ

"తిలక్ శతజయంతి సప్తాహం"

(అంతర్జాతీయ అంతర్జాల సదస్సు)

14-20 డిసెంబరు, 2020

ఆహ్వానం

ప్రారంభ సమావేశం

తేది: 14.12.2020 సమయం: ఉదయం 10.30

అధ్యక్షులు : ఆచార్య మునగాల సూర్యకళావతి
ఉపకులపతి, యోగి వేమన విశ్వవిద్యాలయం, కడప.

ముఖ్య అతిథి : ఆచార్య కె. హేమచంద్రా రెడ్డి
ఛైర్మన్, ఆంధ్రప్రదేశ్ రాష్ట్ర ఉన్నత విద్యామండలి.

కీలకోపన్యాసం : శ్రీ వాడ్రేవు చినవీరభద్రుడు, ఐ.ఏ.ఎస్.
కమిషనర్, పాఠశాల విద్య, ఆంధ్రప్రదేశ్.

ప్రత్యేక అతిథి : ఆచార్య తుమ్మల రామకృష్ణ
ఉపాధ్యక్షులు, ద్రావిడ విశ్వవిద్యాలయం, కుప్పం.

విశిష్ట అతిథి : ఆచార్య రాచపాళెం చంద్రశేఖర రెడ్డి
అధ్యక్షులు, ఆంధ్రప్రదేశ్ అభ్యుదయ రచయితల సంఘం.

సదస్సు నిర్వహణ : ఆచార్య తప్పెట రామప్రసాద రెడ్డి
తెలుగు శాఖ, యోగి వేమన విశ్వవిద్యాలయం, కడప.

డా. ఎన్. ఈశ్వర రెడ్డి
సదస్సు సంచాలకులు, తెలుగు శాఖాధ్యక్షులు
యోగి వేమన విశ్వవిద్యాలయం, కడప-516005

మొదటి సమావేశం

14.12.2020; సోమవారం; సాయంత్రం 5.00 గం॥లకు

అధ్యక్షులు : **ఆచార్య మేడిపల్లి రవికుమార్,** తెలుగు అధ్యయన శాఖ
శ్రీవేంకటేశ్వర విశ్వవిద్యాలయం, తిరుపతి.
అంశం : తిలక్ కవిత్వం-మానవతావాద దృక్పథం

పత్ర సమర్పకులు : **ఆచార్య కిన్నెర శ్రీదేవి,** తెలుగు అనువాద అధ్యయన శాఖ
ద్రావిడ విశ్వవిద్యాలయం, కుప్పం.
అంశం : తిలక్ కథలు - స్త్రీ పురుష సంబంధాలు

డా॥ డి. నల్లన్న, సంస్కృత విద్యాపీఠం, తిరుపతి.
అంశం : సాలెగూడు నాటకం

డా॥ జె. వెంకట రమణ
తెలుగు శాఖ, మధురై కామరాజ్ విశ్వవిద్యాలయం, మధురై.
అంశం : సుశీల పెళ్ళి (నాటకం)

రెండవ సమావేశం

15.12.2020; మంగళవారం; సాయంత్రం 5.00 గంటలకు

అధ్యక్షులు : **ఆచార్య దార్ల వెంకటేశ్వరరావు, తెలుగు శాఖ,**
హైదరాబాద్ కేంద్రీయ విశ్వవిద్యాలయం, హైదరాబాద్.
అంశం : తిలక్ కవిత్వతత్త్వం

పత్ర సమర్పకులు : **ఆచార్య విస్తాలి శంకర రావు,** శాఖాధ్యక్షులు
తెలుగు శాఖ, మద్రాసు విశ్వవిద్యాలయం, చెన్నై.
అంశం : అమృతం కురిసిన రాత్రి - వస్తు విశ్లేషణ

డా॥ పి. రమాదేవి
తెలుగు శాఖ, యోగి వేమన విశ్వవిద్యాలయం, కడప.
అంశం : తిలక్ కథలు - పాత్రచిత్రణ

డా॥ బూసి వెంకటస్వామి

సంపాదకులు, భావవీణ, పెదసందిపాడు.

అంశం : తిలక్ కథలు – మానవ సంబంధాలు

మూడవ సమావేశం

16.12.2020; బుధవారం; సాయంత్రం 5.00 గంటలకు

అధ్యక్షులు : ఆచార్య జి. బాలసుబ్రహ్మణ్యం, వైస్ ప్రిన్సిపాల్

శ్రీకృష్ణదేవరాయ విశ్వవిద్యాలయం, అనంతపురం.

అంశం : తిలక్ కవిత్వం – శిల్పం

పత్ర సమర్పకులు : డా॥ పి.ఆర్. హరినాథ్

ప్రాంతీయ విద్యాకేంద్రం, మైసూరు.

అంశం : తిలక్ కవిత్వం – ఆలంకారిక వైవిధ్యం

డా॥ తరపట్ల సత్యనారాయణ, తెలుగు శాఖ

ఆదికవి నన్నయ విశ్వవిద్యాలయం, రాజమహేంద్రవరం.

అంశం : ప్రభాతము – సంధ్య: తిలక్ సందేశం

డా. ఎం. ఎం. వినోదిని

తెలుగు శాఖ, యోగి వేమన విశ్వవిద్యాలయం, కడప.

అంశం : తిలక్ కథలు – కథన శైలి

నాలుగో సమావేశం

17.12.2020; గురువారం; సాయంత్రం 5.00 గంటలకు

అధ్యక్షులు : ఆచార్య కె. మధుజ్యోతి, తెలుగు శాఖ,

శ్రీ పద్మావతి మహిళా విశ్వవిద్యాలయం, తిరుపతి.

అంశం : తిలక్ కథలు–మనస్తత్వ విశ్లేషణ

పత్ర సమర్పకులు : **ఆచార్య ఎం. రామనాథం నాయుడు,** శాఖాధ్యక్షులు,
తెలుగుశాఖ, కర్ణాటక సార్వత్రిక విశ్వవిద్యాలయం,మైసూరు.
అంశం : తిలక్ కవిత్వం - అభ్యుదయ దృక్పథం

డా॥ పి. విజయకుమార్, తెలుగు శాఖ,
ఆం.ప్ర. కేంద్రీయ విశ్వవిద్యాలయం, అనంతపురం.
అంశం : తిలక్ కవిత్వం అనుభూతి - అభివ్యక్తి

డా॥ ఎం. ఓబులేసు
తెలుగు శాఖ, రాయలసీమ విశ్వవిద్యాలయం, కర్నూలు.
అంశం : గోరువంకలు - వస్తువిశ్లేషణ

ఐదో సమావేశం

18.12.2020; శుక్రవారం; సాయంత్రం 5.00 గంటలకు

అధ్యక్షులు : **ఆచార్య కె. ఆశాజ్యోతి**
శాఖాధ్యక్షులు, తెలుగు అధ్యయన శాఖ,
బెంగుళూరు విశ్వవిద్యాలయం, బెంగళూరు.
అంశం : తిలక్ కథలు - వస్తువిశ్లేషణ

పత్రసమర్పకులు : **ఆచార్య ఎన్.వి. కృష్ణారావు,** శాఖాధ్యక్షులు,
ఆచార్య నాగార్జున విశ్వవిద్యాలయం, గుంటూరు.
అంశం : తిలక్ కవిత్వం - నవ్యత

డా॥ పి.సి. వెంకటేశ్వర్లు, ప్రాచ్య పరిశోధన సంస్థ
శ్రీ వేంకటేశ్వర విశ్వవిద్యాలయం, తిరుపతి.
అంశం : తిలక్ కథలు - శిల్ప సౌందర్యం

డా॥ టి. వెంకటస్వామి
ప్రచురణల కేంద్రం, ద్రావిడ విశ్వవిద్యాలయం, కుప్పం.
అంశం : తిలక్ రచనలు-ఏకపాత్ర

ఆరో సమావేశం

19.12.2020; శనివారం; సాయంత్రం 5.00 గంటలకు

అధ్యక్షులు : **ఆచార్య పి.పద్మ**, పీఠాధ్యక్షులు, మానవశాస్త్రాల పీఠం
యోగివేమన విశ్వవిద్యాలయం, కడప.
అంశం : **తిలక్ కవిత్వం - పాశ్చాత్య ప్రభావం**

పత్రసమర్పకులు : **డా॥ మూల మల్లికార్జున రెడ్డి**
లలితకళల శాఖ, యోగివేమన విశ్వవిద్యాలయం, కడప.
అంశం : **ఇరుగు - పొరుగు, పొగ నాటికలు**

డా॥ జి. పార్వతి
తెలుగు శాఖ, యోగివేమన విశ్వవిద్యాలయం, కడప.
అంశం : **తిలక్ నాటికలు - వస్తువిశ్లేషణ**

డా॥ గంపా వెంకటరామయ్య
ఢిల్లీ విశ్వవిద్యాలయం, ఢిల్లీ
అంశం : **తిలక్ కథలు: రీడర్ రెస్పాన్స్ సిద్ధాంతం**

ఎ. రాజయ్య
పరిశోధకులు, శ్రీ వేంకటేశ్వర విశ్వవిద్యాలయం, తిరుపతి.
అంశం : **తిలక్ లేఖా సాహిత్యం**

ముగింపు సమావేశం

14-20 డిసెంబరు, 2020

తేది: 20.12.2020 సమయం: సాయంత్రం 5.00 గం॥కు

అధ్యక్షులు : ఆచార్య జి. సాంబశివా రెడ్డి, ప్రాచార్యులు
యోగి వేమన విశ్వవిద్యాలయ కళాశాల, కడప.

ముఖ్య అతిథి : ఆచార్య సుధీర్ ప్రేమ్ కుమార్
కార్యదర్శి, ఆంధ్రప్రదేశ్ రాష్ట్ర ఉన్నత విద్యామండలి

సమాపనోత్సవ సందేశం : ఆచార్య ఆర్వీయస్. సుందరం
ప్రముఖ సాహితీవేత్త, మైసూరు.

గౌరవ అతిథి : ఆచార్య డి. విజయరాఘవ ప్రసాద్
కులసచివులు, యోగి వేమన విశ్వవిద్యాలయం, కడప.

విశిష్ట అతిథి : డా॥ ఎల్.వి. కృష్ణా రెడ్డి, కులసచివులు,
విక్రమ సింహపురి విశ్వవిద్యాలయం, నెల్లూరు.

ప్రత్యేక అతిథులు : డా॥ శ్రీగణేశ్ తొట్టెంపూడి
సైంటిస్ట్, హైడల్‌బర్గ్ విశ్వవిద్యాలయం, జర్మనీ.

డా॥ వైదేహి శశిధర్
న్యూజెర్సీ, అమెరికా.

సదస్సు నివేదిక : డా. ఎన్. ఈశ్వర రెడ్డి, తెలుగు శాఖాధ్యక్షులు
యోగివేమన విశ్వవిద్యాలయం, కడప.

సదస్సు నిర్వహణ : డా. ఎం. ఎం. వినోదిని
తెలుగు శాఖ, యోగి వేమన విశ్వవిద్యాలయం, కడప.

238 A

12. దేవరకొండ బాలగంగాధర తిలక్ సాహిత్యంపై పాశ్చాత్య ప్రభావం : ఒక విశ్లేషణ

– ఆచార్య పి. పద్మ

ఆధునికం (modern) అనగానే పాశ్చాత్య (Western) పదంగా గోచరించే అంతగా పాశ్చాత్య ప్రభావం ఇరవై శతాబ్దంలో భారతీయ సాహిత్యంపై పడింది. ఈ పదం సాహిత్యంతోపాటు జీవన విధానానికి కూడా వర్తిస్తుంది. ఆధునిక కవిత్వ లక్షణాలు శతాబ్దాల ముసుపే తెలుగు కవుల చేతన, కొండ కుప్పల దీపిక, గురజాడ వంటి వారి పద్యాలలో కనిపించినప్పటికీ బ్రిటీష్‌వారి పరిపాలనా కాలంలో ఆ లక్షణాలు ఎక్కువగా సమాజంలోనూ, రచనలలోనూ ప్రాముఖ్యత పొంది ప్రచారంలోకి వచ్చింది. కృష్ణశాస్త్రి, శ్రీశ్రీ, తిలక్ ఆధునిక ఆంధ్ర కవిత్వాన్ని మలుపు తిప్పిన నాయకులు. దేవరకొండ బాలగంగాధర్ తిలక్ (1921–1966) రాసిన భావ కవిత్వం (1935–1946) అభ్యుదయ కవిత్వం (1954–1966) ఆధునిక యుగంలో వచ్చినది కావున తిలక్‌పైన ప్రాశ్చాత్య ప్రభావం ప్రత్యక్షంగా, పరోక్షంగా ఎలా పడిందో ఈ పత్రంలో క్లుప్తంగా పరిశీలింపబడినది. తిలక్ కథలు, నాటికలు, లేఖలు, అనువ్యాసాలు రచించినప్పటికీ తనకు బాగా పేరు తెచ్చిపెట్టినది, అతని మరణానంతరం సాహిత్య అకాడమీ వారు ప్రచురించిన పచన కవితా సంపుటి అమృతం కురిసిన రాత్రి (1968). ప్రస్తుత పత్రంలో విశ్లేషించిన అంశాలు అందులోని కొన్ని కవితలపై కేంద్రీకృతమైనవి. బ్రిటీష్ పరిపాలనా సమయంలో భారతదేశంలో వచ్చిన మార్పులు, 20వ శతాబ్దంలో ప్రపంచంలో వచ్చిన మార్పులు తిలక్‌ని ఎలా ప్రభావితం చేశాయో, తిలక్ సాహిత్యంపై కన్పించిన ప్రాశ్చాత్యప్రభావం వివిధ రూపాలలో-పదాలు, పదబంధాలు(Words and phrases), స్వీకరణ(adoption), ప్రభావం (influence). అనుకరణ (imitation), అనువాదం (translation and trans-creation), చివరగా (inter-textuality) కనిపించేవి వాటిని ఈ పత్రంలో క్లుప్తంగా విశ్లేషించబడినది.

* * *

పాశ్చాత్య ప్రభావాన్ని చాటుకున్నా, 'పరదేశ స్తుతితో స్వకీయ సంస్కృతి విస్మరించ కూడదని" (కవివాక్కు) తిలక్ నిర్ణయించుకున్నాడు.

భారత స్వాతంత్ర్యోద్యమం, జాతీయవాదం, దేశభక్తి, తత్వశాస్త్రం, గాంధీ, వివేకానందుల బోధనలు మరవలేని భారతదేశపు చరిత్ర, సంస్కృతి ఆధునిక సాహిత్యంలో "భారతీయతను" శక్తివంతంగా రచనల్లో ఉంచగలిగాడు తిలక్.

తూర్పు-పశ్చిమ సాహిత్యాలలో ఉన్న గొప్పదనాలను తన కవిత్వంలో ఇమడ్చుకొని, తన కాలంలో అందరికంటే ముందుకు నడిచిన తిలక్, ముందుగానే గతించినా, ఎల్లప్పుడు కొత్తగా అనిపించే తన కవిత్వంతో సమకాలీనత సంతరించుకొని అమరుడైనాడు.

ఆధార గ్రంథాలు:

1. Prof. G.N. Reddy, The **Influence of English on Telugu literature** (1800 - 1950), unpublished thesis from S.V. University, (A.P.)
2. N'gugi Wa Thiongo **Education for a National Culture** UFAHAMU Vol. XII, No. 2 (1983) P 24.
3. T.S. Eliot, "Tradition and Individual Talent". **The Sacred Wood,** 1920
4. Dr. Velchala Konda Rao, **The Night Nectar Rained;** Viswanadha Sahithya Peetam, 2005, (A Translation of Tilak's "Amrutham Kurisinia Ratri, 90 poems into English)
5. దేవరకొండ బాలగంగాధర తిలక్ లభ్య రచనల సంకలనం - ఎమెస్కో, 2013.

15. తిలక్ కథలు – పాత్రచిత్రణ

– డా॥ పాలెం రమాదేవి

దేవరకొండ బాలగంగాధర తిలక్ కవిత్వంతో పాటు కథలు, నాటకాలు, నాటికలు, లేఖలు, లఘు వ్యాసాలు రచించాడు. తిలక్ తన కవిత్వం ద్వారా పాఠకుల్ని ఎంత మెప్పించాడో కథల ద్వారా కూడా అంతే మెప్పించాడు. పరిపక్వత, నిపుణత, సంపూర్ణత ఈ మూడు పుష్పలంగా ఉన్న కథకుడు తిలక్ అని విమర్శకుల అభిప్రాయం. తిలక్ తన కథల ద్వారా సమాజంలో మృగ్యమైపోతున్న మానవతా విలువల్ని, మనిషిలోని దురాశ, మోసం, స్వార్థం మొదలైన గుణాల్ని, సాంప్రదాయానికి మతానికి ఇచ్చిన ప్రాధాన్యం ఈ సమాజం మానవత్వానికి ఇవ్వడం లేదన్న సత్యాన్ని తెలియజేశాడు. సమకాలీన సమస్యలను కథల్లో ఎంతో ఉదాత్తంగా ప్రస్తావిస్తాడు.

కథకు శీర్షిక, ఎత్తుగడ, ముగింపు, సంభాషణలు ఎంత ముఖ్యమో పాత్రచిత్రణ కూడా అంతే ముఖ్యం. కథల్లో రెండు రకాలుంటాయి. 1) నిర్మాణం ప్రధానం నడిచే కథలు 2) పాత్రచిత్రణ మీద శ్రద్ధ పెట్టే కథలు. కథ ఈ రెండింటిలో ఏ కోవకు చెందినదైనా ఆ కథలో కొన్ని మానవ పాత్రలు ఉండడం తప్పనిసరి. మనుష్యుల సంతోషాలు, భయాలు, బాధలు, కోపాలు, పరాజయాలు, ఆశలు, అనుభూతులు, ఉద్వేగాలు, స్వార్థం మొదలైన లక్షణాలతో కూడిన పాత్రచిత్రణ పాఠకుల్ని ఆకట్టుకుంటుంది. కథకు మానవీయ కోణం అద్ది, పాఠకులను కథలో లీనమయ్యేలా చేసేవి అందులోని పాత్రలే.

పాత్ర చిత్రణకు రెండు పద్ధతులున్నాయి. ఒకటి కథకుడు తనకు తెలిసిన వ్యక్తుల ఆధారంగా పాత్రల్ని రూపొందించడం, రెండవది పూర్తిగా కథకుడి ఊహ నుండి పాత్రలను రూపొందించడం. వీటిలో ఏ పద్ధతి అవలంభించినా చివరికా పాత్ర ఎలా రూపొందిదన్నదే ముఖ్యం.

తిలక్ ఏ రచన తీసుకొన్నా మౌలికంగా ఆయన హృదయంలో, ఆలోచనలలో నిరంతరం స్రవించే కవితాధార అంతర్లీనంగా స్రవిస్తుంటుంది. తిలక్ కథలలో మంచి

ఆపద వస్తే ఆదుకోవాలన్న కనీసం మానవత్వం కూడా మరిచి పోయిన విశ్వాసఘాతకులు రామచంద్రం, నాగభూషణం. మంచి, చెడు అనేది మనిషికి సంఘంలో ఉన్న హోదాను బట్టిరాదు. వ్యక్తి ప్రవర్తనని బట్టి నిర్ణయం అవుతుంది. సమాజంలో పెద్ద మనుషులుగా చెలామణి అవుతున్నవారు నలుపుకు ప్రతి నిధులైతే అడవిలో జీవిస్తున్న ఆ అమాయకులు తెలుపుకు ప్రతినిధులుగా చెప్పవచ్చు.

"ఊరి చివర ఇల్లు" కథలో రమ, జగన్నాథం, ముసలామె అనే మూడుపాత్రలు ఈ కథలో తిలక్ పాత్రలు, పాత్రలస్వభావాలు, పరిసరాలు, వేషధారణ కళ్ళకు కట్టినట్లు వర్ణించారు. ఊరి చివర ఉన్న పాత ఇంటిలో మూడుపాత్రల మధ్య ఓ వర్షాకాలపు రాత్రి జరిగిన సంఘటనల సమాహారమే ఈ కథ. ఒక కథ పాఠకుల్ని ఆకర్షించాలంటే రచయిత ఆ కథ జరిగే పరిసరాల్ని, పాత్రల వేషభాషల్ని వర్ణిస్తే కథ చదివేవారు ఆ పరిసరాలలోకి వెళ్ళి కథలో మమేకం అవుతారు. ఈ కథ మొదట్లో ఊరి చివర ఉన్న ఇంటిని, ఆ ఇంటటి పరిసరాలను, ఆ యింటి మండులాలో కూర్చోని ఉన్న యువతిని ఆ అమ్మాయి ప్రవర్తనను వర్ణించిన తీరు ఆమె మీద పాఠకులకు గౌరవం ఏర్పడే విధంగా ఉంటుంది. కథలో తిలక్ ఎంత చెప్పాడో ఇంకా అంత పాఠకుల ఊహకు వదిలేస్తాడు. ఈ కథలో రమ పాత్రపై గౌరవభావం ఉండేలా తీర్చిదిద్దారు. ముసలామె మాటల ద్వారా రమ ఏ విధంగా జీవిస్తుందో మనకు అర్థమవుతుంది. వర్షంలో ఆదారిన వెళ్తున్న జగన్నాథాన్ని పిలిచి ఆదరించి ఆశ్రయమిస్తుంది. ఆ రాత్రి వారి మధ్య జరిగిన సంభాషణ ద్వారా రమ జీవితంలో జరిగిన సంఘటనల గురించి తెలుసుకున్న జగన్నాథం. ఆమెను పెళ్లి చేసుకోవాలనుకుంటాడు. కానీ ఆ మాటలన్నీ చాటుగా విన్న ముసల్ది రమ పెళ్లి చేసుకొని వెళ్లిపోతే తనకు ఆధారం ఉండదన్న ఆలోచనలో జగన్నాథం మనసు విరిచేస్తుంది. కానీ చివరికి జగన్నాథం రమ మంచితనం తెలుసుకుంటాడు. ఇవన్నీ రచయిత ఎక్కడా చెప్పదు. పాఠకుడి ఊహకే వదిలిపెడ్తాడు. ఈ కథ, ఈ కథలోని పాత్రలు కొన్న రోజులు పాటు మనలను వెంటాడుతూనే ఉంటాయి. తిలక్ గారి కథలు చదివాక మనసు కదలక పోవడం గాని, కథ గురించి మళ్లీ ఆలోచించకపోవడం గాని ఉండదు. కథ, కథలోని పాత్రలు కొన్ని రోజులపాటు మనల్ని వెంటాడుతూనే ఉంటాయి. అది కథకుడిగా తిలక్ విశిష్టత.

ఆధార గ్రంథాలు

1. దేవరకొండ బాలగంగాధర్ తిలక్-లభ్య రచనల సంకలనం.

16. తిలక్ నాటికలు - సామాజిక నేపథ్యం

- డా॥ మూల మల్లికార్జునరెడ్డి

దేవరకొండ బాలగంగాధర్ తిలక్ రూపొందించిన ఇరుగు-పొరుగు, పొగ అనే రెండు నాటికల గురించి సంక్షిప్తంగా విశ్లేషణ చేస్తాను. ఆయన సాలెగూడు, సుశీలపెళ్లి అనే నాటకాలు, ఇరుగు-పొరుగు, సుచిత్ర ప్రణయం, సప్తశిల, పొగ అనే నాటికలు, భరతుడు (ఏకపాత్రాభినయం) రాశారు. మరికొన్ని నాటికల్ని కూడా రాసినట్లు అర్థమవుతుంది. వాటిలో సప్తశిల, భరతుని ఏకపాత్ర ఈ రెండు పౌరాణికాలు కాగా, మిగిలినవన్నీ సాంఘిక నాటకాలు, నాటికలు. అందువల్ల సాంఘిక నాటకంపై కొంత ఉపోద్ఘాతం అవసరం.

వాస్తవ దృక్పథానికి, సాంఘిక చైతన్యానికి మూలమైంది సాంఘికనాటకం. సమకాలీన సమాజంలో ప్రతి సమస్యకు ప్రతిస్పందించేది, ప్రతి సంఘటనను ప్రతిస్పందింపజేసేది సాంఘిక నాటకమే! సాంఘిక నాటకమెప్పుడూ సమకాలీన సమాజాన్ని అన్వేషిస్తూనే సమాజ శ్రేయస్సుకు పాటు పడుతుంది. స్వాతంత్ర్యానికి ముందు సంఘ సమస్యలను ప్రతిపాదించిన సాంఘిక నాటకం స్వాతంత్ర్యం తర్వాత మధ్యతరగతి వ్యక్తుల జీవన సమస్యలను చిత్రించింది. రానురాను సాంఘిక నాటకాల్లో పెక్కు సమస్యలు ప్రస్తావించబడ్డాయి.

1928-29 సంవత్సరాల్లో బళ్లారి రాఘవ విదేశీపర్యటన చేసి పాశ్చాత్య నాటక రీతుల్ని ఆకళింపు చేసుకొని తెలుగు నాటకరంగంలో కూడా నూతనమైన విధానాన్ని ఆవిష్కరించారు. ప్రజల్ని చైతన్యవంతుల్ని చేయడానికి సాంఘిక నాటకాలే ఉపకరిస్తాయని ఉద్ఘాటించారు. అప్పటినుండి సాంఘికనాటకాల్ని ఎక్కువగా రాశారు. ఆక్రమంలో ఇప్పటిదాకా సంఘసంస్కరణ, దేశభక్తి, హేతువాదం, మూఢ విశ్వాసాలు, బాల్య, వృద్ధ వివాహాలు, కన్యాశుల్కం, వరకట్నం, స్త్రీ అభ్యున్నతి, లంచగొండితనం, కులమతాల ప్రసక్తి, వేశ్యావృత్తి, మద్యపానం, నిరుద్యోగం, రైతు సమస్యలు, ఆర్థిక అసమానతలు, భూస్వామిక వ్యవస్థ, విద్య, వైద్య, న్యాయ, పోలీస్ వ్యవస్థలు, స్త్రీ, దళిత, మైనారిటీ

[illegible] వెళ్ళి కష్టపడి బ్రతుకుదామంటాడు. ప్రియంవద సరేననడంతో నాటిక [illegible]

ఏ రచయితైనా ఒక నాటకాన్నో, నాటికనో రాసేటప్పుడు సమకాలీన వ్యవస్థలో [illegible] లోపాల్ని ప్రతిబింబింపజేసే ప్రయత్నం చేస్తాడు. ఒక అంశాన్ని [illegible] ఉంచుకొనే పాత్రను సృష్టిస్తాడు. తిలక్ ఈ నాటికలో ప్రియంవద [illegible] విలాస జీవితానికలవాటు పడితే జరగబోయే పరిణామాన్ని చిత్రించారు. [illegible], వ్యభిచారం, జూదం ఈ మూడూ ఎంతటి మేధాసంపన్నుడినైనా ఏ స్థితికి [illegible] కవి పాత్రద్వారా విశదపరిచాడు.

ఆధునిక మానవుని అంతరంగానికి, చిత్రమైన వ్యక్తిత్వానికి, అల్లకల్లోల జీవితానికి [illegible] దర్పణంవంటిది. ఆర్థిక అంతరాలు, విపరీత వైరుధ్యాలు, ఉన్నత వర్గాలవారి [illegible] నిశితంగా పరిశీలించి తిలక్ 'పొగ' నాటిక రాశారు. ఈ సమాజాన్ని [illegible] శాసిస్తుందని, అది పొగలా కమ్ముకొని మానవత్వమే లేకుండా చేస్తుందనే [illegible] 'పొగ' అనే పేరు పెట్టారని మనకు తెలుస్తుంది.

ఏ నాటకానికైనా బలమైనశక్తినిచ్చేది సంఘర్షణే! ఈ సంఘర్షణకు ప్రాణం పోసేది [illegible] కొంతమంది రచయితలు ఈ సమస్యకు పరిష్కారాన్ని అన్వేషిస్తే మరికొంతమంది [illegible] సమస్యగానే ఉంచి సమాజానికే వదిలి వేస్తారు. తిలక్ ఈ నాటికలో [illegible] పరిష్కారాన్నిచూపించి ప్రబోధాత్మకంగా తీర్చిదిద్దడంలో సఫలీకృతులయ్యారు.

నాటిక ప్రారంభంలో తిలక్ " ఈ నాటిక ప్రదర్శనకు వీలుగా ఉంటుందని [illegible] నమ్మకం లేదు. వీలుగాఉన్నా వేయగల సాహసం ఎవరికైనా ఉంటుందన్న [illegible] నమ్మకం అసలే లేదు" అన్నారు. నాటికలో సుదీర్ఘమైన సంభాషణలున్నాయి. అవి [illegible] చోదితంగా, సంక్షిప్తంగా ఉండి ఉంటే ఈ నాటికను అద్భుతంగా ప్రదర్శించవచ్చు. [illegible] సరే ఇంతమంచి నాటికలు రచించిన తిలక్‌గారికి కవిగా, కథా రచయితగా [illegible] వచ్చినంత గుర్తింపు ఆయన నాటికలకు రాకపోవడం శోచనీయం.

17. తిలక్ నాటికలు - వస్తు విశ్లేషణ

- దా॥ జి. పార్వతి

ఆధునిక తెలుగు సాహిత్యంలో విరబూసిన మల్లెపువ్వులాంటి స్వచ్ఛమైన కవిత్వాన్ని అందించిన కవి దేవరకొండ బాలగంగాధర్ తిలక్. అందుకే కుందిర్తి ఆంజనేయులు "మావాడు మహాగట్టవాడు" అని తిలక్‌ను గురించి అభిప్రాయపడుతాడు. దానికి కారణం తాను జీవించింది కొంతకాలమే. అయితే అందులోను సగభాగమే కవిగా సాహిత్యాన్ని సృష్టించాడు. ఆ సాహిత్యం తెలుగు భాష నిలిచి ఉన్నంత దాకా నిలిచి ఉంటుంది. ఆధునిక పాఠకునికి ఏంకావాలో పట్టుకొన్నాడు. అందుకే ఛందస్సులోనే కవిత్వానికి అందం ఉందని భ్రమపడే లోకానికి వచన కవితా రచనలు రాసి వాటిలో అనుభూతి తత్వాన్ని దర్శింపజేసి విజయం సాధించాడు. ఆయన నాటకాలు, నాటికలు, కథలు, కవిత్వం, లేఖా సాహిత్యం, వ్యాసాల ఉన్నా ఆయన కవితలకు అధిక ప్రాధాన్యం తెలుగు సాహితీలోకంలో ఉంది. ఆయన రాసిన అమృతం కురిసిన రాత్రిలో ఒక్క వాక్యమైనా రాన సాహితీకారుడు గానీ, సాహిత్య విద్యార్థిగానీ ఉండడు. ఆయన అచ్చమైన భావకవి. అసలు సిసలైన అభ్యుదయ కవి. రెండూఉద్యమాలు ఆయన సృజన సాహిత్యం సాక్షీభూతంగా నిలుస్తుంది. ఆయన రాసిన కవిత్వంలో భావకవితా భావన ఎక్కువగా ఉంటూ, అనుభూతి సాంద్రత అధికంగా ఉంటే, ఆయన రాసిన నాటకాల్లో, నాటికల్లో అభ్యుదయ భావనాజాలం కొబ్బరాకుల మాటున సూర్యకాంతిలాగా ప్రతి చోట దోబూచులాడుతోంటుంది. ఈ ప్రస్తుత పరిశోధన పత్రంలో తిలక్ నాటికల్లో వస్తు విశ్లేషణకు పరిమితమై ఈ వ్యాసం ముందుకు సాగుతుంది.

తిలక్ నాటికల్లో సుచిత్ర ప్రణయం, సుప్తశిల, పొగ, పాదుకా పట్టాభిషకమందలి "భరతుని ఏకపాత్రాభినయం", ఇరుగు పొరుగు అనే ఐదునాటికలను ఈ వ్యాసంలో విశ్లేషించడం జరిగించే ఈ ఐదు నాటికలను కూడా రెండు కోణాల్లో అధ్యయనం చేయవచ్చు.

కాకుండా సౌందర్య పిపాసిగా చూపించాడు. కఠోర నియమాలు కలిగిన తాపస జీవనం కన్న స్వేచ్ఛ, సౌందర్య ఆరాధన ముఖ్యమని అహల్య గుణాలుగా వర్ణించాడు. నాగరిక మానవులకన్నా, గిరిజనులు ఇంకా స్వేచ్ఛగా బ్రతుకుతున్నారని చూపాడు.

అహల్య, ఇంద్రుల పరిష్వంగాన్ని, చూసిన గౌతముడు ఆమెసుశిలగా అయిపొమ్మని శపించి తర్వాత "అమూల్యమైన ఒక రత్నాన్ని రాయిగా మార్చివేశానా?" అని పశ్చాత్తాప పడతాడు. ఇంద్రుడు కూడా 'ఈ నిర్భాగ్య నిర్భర ప్రియుడు మాత్రం వేయి కళ్ళతో నిరంతాశ్రు సేచనతో నిన్నెల్ల వేళలా అభిషేకిస్తాడని" పశ్చాత్తాప పడుతాడు. అహల్య జీవితం అలా ఇద్దరికీ దూరం అయింది.

తిలక్ రాసిన 'సుశీల పెళ్ళి' అనే నాటికలో కూడా ఇలాంటి కథా వస్తువు అంటే ఆధునిక కాలంలో భర్తకు, ప్రియుడికి దూరం అయిన సుశీల వ్యక్తిత్వం కూడా కనిపిస్తుంది.

ఈ విధంగా తిలక్ నాటికల్లో కథావస్తువు విశ్లేషణ సాగుతుంది. అన్ని నాటికల్లో కూడా నాటిక లక్షణాలు సంపూర్ణంగా ఉన్నాయి. ప్రతి నాటిక కూడా ఏదో ఒక చక్కటి సందేశాన్ని ఇస్తుంది. ప్రతి పాత్ర సజీవ శిల్పంలా భాసిస్తుంది. అభ్యుదయాన్ని ప్రతి నాటికలో కనబరిచాడు తిలక్.

24. తిలక్ కథలు - కవితాత్మక శైలి

- డా॥ వినోదిని మదాసు

తిలక్ అనగానే తెలుగు పాఠకులకి 'అమృతం కురిసిన రాత్రి' గుర్తొస్తుంది. వచన కవితా ఉద్యమం బలంగా ఉన్న కాలంలో తెలుగు కవిత్వంలో ప్రవేశించి తెలుగు కవిత్వంపై తనదైన ముద్రవేసినవాడు తిలక్.

కవిత్వంలో తిలక్ మూడు ముఖాలతో కన్పిస్తాడు. ప్రక్రియ పరంగా ఆనాటికి తెలుగు కవిత్వాన్ని ఏలుతున్న ఆధునిక వచన కవిత్వాన్ని వాహికగా చేసుకున్నాడు.

భావజాలపరంగా ఆనాటికి దేశం మొత్తం మీద అత్యంత చైతన్యవంతమైన ఆలోచనలను విస్తరింపజేస్తున్న అభ్యుదయ భావజాలం అందిపుచ్చుకున్నాడు.

శిల్పపరంగా, అభివ్యక్తిపరంగా భావకవిత్వంలోని రమణీయతను, సొగసుని, లాలిత్యాన్ని తన కవిత్వ నైపుణ్యంగా చేసుకున్నాడు.

తిలక్ కవిత్వం తెలుగు పాఠకులకు అత్యంత చేరువయ్యింది. వచన కవిత్వంలో శ్రీశ్రీ తర్వాత ఎక్కువమంది పాఠకులకు తెల్సిన కవి తిలక్. అటువంటి తిలక్ కవిత్వంతోపాటు కథలు కూడా రాశాడు.

తిలక్ కవిత్వం రాసినా, కథ రాసినా మనిషిని కేంద్రం చేసుకున్నాడు. కవిత్వంలో కొంత రొమాంటిక్ మార్గాన్ని అనుసరించిన తిలక్ కథా సాహిత్యం దగ్గరకొచ్చేసరికి ఊహా ప్రపంచాన్ని వదిలి వాస్తవ ప్రపంచాన్ని ఆలంబనగా చేసుకున్నాడు.

తిలక్ కథలు పేద, మధ్య తరగతి జీవితాలకు సంబంధించిన సమస్యలను ప్రతిబింబించాయి. మధ్యతరగతి జీవితాలను ప్రధానంగా శాసించేది ఆర్థిక వ్యవస్థ. ఆర్థిక పరిస్థితుల ప్రభావంతో కుటుంబాల్లో వచ్చే అనేక సమస్యలు కుటుంబ సభ్యుల మధ్య అశాంతిని, అలజడిని కలగజేస్తాయని - దీని పర్యవసానంగా మనుషుల ప్రవర్తన మారిపోతుందని తిలక్ తన కథల్లో పాత్రల ద్వారా చెప్పాడు.

ఒక అవ్యక్తాన్ని అనుభూతిస్తారు. ఇలా ప్రతీకాత్మకంగా చెప్పడంలో తిలక్ నైపుణ్యం కనిపిస్తుంది.

తిలక్ కథలు శిల్పపరంగా ప్రతిభావంతమైనవి. రమణీయ భాష, అద్భుతమైన భావుకతతో పాటు సామాజిక చింతన గలవి. శాంతిని కోరుకున్నవి.

నిజానికి తిలక్ కవిత్వం తిలక్ కథల గొప్పతనాన్ని మరుగున పరిచింది. తిలక్ కవిత్వాన్ని పక్కన పెట్టి కథకుడిగా గనక తిలక్‌ని చూసినట్లయితే తిలక్ ఉత్తమ కథకుడు. భావజాలపరంగా, శిల్పపరంగా ఉన్నతమైన ఆధునికమైన కథలు రాసినవాడని మనకు అర్థం అవుతుంది.

26. తిలక్ సాహిత్యం-సందేశం

- దా॥ ఎన్. ఈశ్వర రెడ్డి

పరిచయం

దేవరకొండ బాలగంగాధర తిలక్ ఆధునిక తెలుగు సాహిత్య చరిత్రలో ఒక మధురకవి. కవిత్వాన్ని - జీవితాన్ని సమానంగా ప్రేమించిన అమరకవి తిలక్, మానవ స్వభావంలోని కుళ్ళు కుతంత్రాలను కుమ్మేస్తూనే, స్వచ్ఛమైన అమృతప్రేమను పంచిన గొప్ప రచయిత తిలక్. మనసుకు - మనసుకు మధ్య భావోద్రేక వారధులు కట్టి హృదయ సంగీతాన్ని వినిపించిన సుమధుర భాషాజ్ఞాని తిలక్.

జననం, విద్యాభ్యాసం

1921 ఆగష్టు 1న మందపాక తణుకు తాలూకా పశ్చిమ గోదావరి జిల్లాలో జన్మించిన తిలక్, వారి నాన్న సత్యనారాయణమూర్తి గారి హయాంలోనే తణుకుకు వచ్చి, అక్కడే స్థిరపడ్డారు. తల్లి రామసోదెమ్మ. స్వాతంత్ర్య సమరయోధుడైన బాలగంగాధర్ తిలక్‌పై ఉన్న వీరాభిమానాన్ని ప్రకటించుకోవడానికి సత్యనారాయణమూర్తి తన ఆరవ సంతానమైన తిలక్‌కు ఆ పేరు పెట్టాడు. ఎందుకంటే, సత్యనారాయణమూర్తి కూడా గొప్ప దేశభక్తుడు కాబట్టి.

తణుకు బోర్డు స్కూల్లో తిలక్ పాఠశాల విద్యను పూర్తిచేసి, ఇంటర్మీడియట్ కోసం మద్రాసు వెళ్ళాడు. లయోలా కళాశాలలో చేరి, అనారోగ్య కారణాలతో అర్ధాంతరంగా చదువుమానేసి ఇల్లు చేరినాడు. విశాఖపట్నం ఎ.వి.ఎన్. కళాశాలలో చేరి, అనేక కారణాలతో అక్కడ కూడా చదువు కొనసాగించలేకపోయాడు.

పాఠశాలలో చదివిన రోజుల్లో తెలుగు అధ్యాపకుడిగా ఉండిన పెన్మత్స సత్యనారాయణరాజు తిలక్‌కు సాహిత్య గురువు. గురువు ప్రోత్సాహంతో 11 సంవత్సరాల వయసులోనే తొలికథ రాశాడు తిలక్. తెలుగు, సంస్కృత, ఆంగ్లభాషల్లో ప్రావీణ్యం సంపాదించిన తిలక్‌కు ఈ మూడు భాషలు రచనకు బాగా ఉపకరించాయి.

ఎం.ఎన్. రాయ్‌ను అభిమానించిన తిలక్ నవ్యకవిత్వ దారిలో నడిచాడు. జాతీయ, అంతర్జాతీయ సమాజాలను రాజకీయ దృక్కోణంలో అర్థం చేసుకొని, తన సృజనలో స్వేచ్ఛకు ప్రాధాన్యం ఇచ్చాడు. ఇజాలకు, వర్గాలకు, పార్టీలకు అతీతంగా

ఒక్క అధరం మీదికి హాస్యాన్ని రప్పించగలిగితే జీవితం ధన్యమౌతుందని నా ఉద్దేశ్యం" (9.5.1961-మాణిక్యాంబకు రాసిన లేఖ) అనటం వెనుక తిలక్ మనస్తత్వాన్ని, జీవిత సార్థకతను అర్థం చేసుకోవచ్చు. తిలక్ లేఖలు ఆయనను మానవతావాదిగా, మంచి విమర్శకుడిగా, గొప్ప నిజాయితీ పరుడిగా నిలబెడతాయి.

ముగింపు

'మనోంతరాల నుండి అనుభూతిని తోడి తేవడంలో తిలక్‌ది ఒక ప్రత్యేక స్థానం. అనుభూతిని ఎక్కడా అస్పష్ట గగనంలో కరిగిపోనివ్వడు. హృదయపు దిశల చివరల సన్నని మబ్బులుగా వ్రేలాడే అనుభూతుల్ని విశాల పరిధిలోనికి గొనివచ్చి ఘనీభవింపజెయ్యాలని' (అనుభూతివాది తిలక్ - వ్యాసం; అద్దేపల్లి రామమోహనరావు -తిలక్‌సాహిత్య సందర్శనం)చేసిన ప్రయత్నం తిలక్‌ను అమృతతత్వకవిగా నిలబెట్టింది.

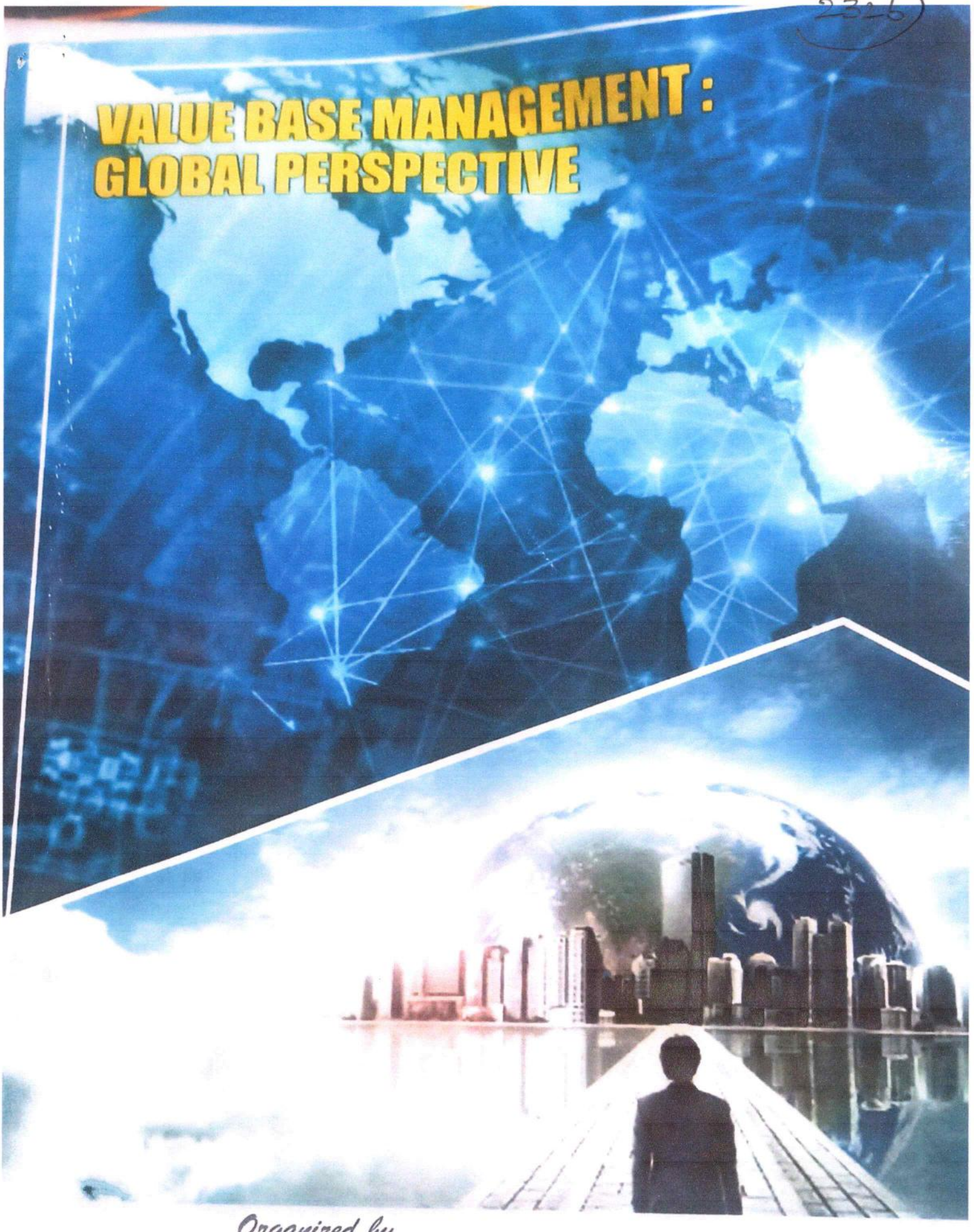
"కవిత్వానికి ఒక తాత్విక స్థాయిని తెచ్చిన కవి, ఈ నాగరికత అంతా, ఈ చరిత్ర అంతా, ఈ పరిణామమంతా 'నిరంతర నూతన పరిశోధన, సత్య సౌందర్యాన్వేషణ, ఒక శిఖరారోహణ' అని తేల్చుకున్న కవి, ఎన్నడూ దేనితోనూ అలసిపోడు, విసిగిపోడు, అట్లా సాగుతూనే ఉంటాడు. ఆ అర్థంలో తిలక్‌కు మరణం లేదు. నవనవాలైన ఊహావర్ణవాల మీద ఉదయించే సూర్యకాంతిలో ఆయన ప్రభావాన్ని చూస్తూనే ఉంటాయి" (శిఖారారోహణ (వ్యాసం) - తిలక్ సాహిత్య సందర్శనం) అంటున్న వరవరరావు మాటలు అక్షరసత్యాలు.

తిలక్ సాహిత్య సందేశం చాలా గొప్పది. తిలక్ జీవితం 'శంకరాచార్యుడు, షెల్లీ, రూపర్ట్ బ్రూక్, డిలన్ థామస్, స్వామి వివేకానంద, మొదలైన ధ్రువతారల హ్రస్వాయుష్కుల సరసన చేరినా, అతని సాహిత్య సందేశం మాత్రం తెలుగు యుగాల్లో సుదీర్ఘ ఆయుష్షుతో దీర్ఘ శ్వాస తీసుకుంటుందని చెప్పడం అతిశయోక్తి కాదు.

ఆధార గ్రంథాలు

1. దేవరకొండ బాలగంగాధర - లభ్య రచనలు సంకలనం (2013)
2. తిలక్ సాహితీ సందర్శనం - సం॥ కె. శరచ్చంద్ర జ్యోతిశ్రీ (2016)
3. ఆధునిక తెలుగు సాహిత్యంలో విభిన్న ధోరణులు-సం॥ కె.కె.రంగనాథాచార్యులు (1982)
4. సాహిత్యం - మౌలిక భావనలు - పాపినేని శివశంకర్ (2002)
5. అమృతవర్షిణి - ఆవంత్స సోమసుందర్ (1984)
6. ఆధునికాంధ్ర కవితా సమీక్ష - కాకర్ల వెంకటరామ నరసింహం (1982)

VALUE BASE MANAGEMENT : GLOBAL PERSPECTIVE



Organized by

Dept. of Commerce & Business Administration
ANU Ongole Campus,
ONGOLE.

Edited by
Dr. B. PADMAJ

VALUE BASE MANAGEMENT: GLOBAL PERSPECTIVE

Publishing Editor:
Dr.B. Padmaja

ISBN: 978-1-67813-892-9
VOL-2, EDITION-1, 2021.

Published by:
Dept. of Commerce and Business Administration,
ANU Ongole Campus,
Ongole.
Price: Rs. 500
International ISBN:

A Collection of Research Papers submitted to UGC Sponsored Two Day National Seminar held on 23rd & 24th March – 2021.

Organized by:
Dept. of Commerce and Business Administration,
ANU Ongole Campus,
Ongole

Disclaimer

The authors are solely responsible for the contents of papers compiled in this volume. Publishers or editors do not take any responsibility for the same in any manner.

CHAPTERS

MSME SECTOR LIFELINE OF INDIAN ECONOMY

M.MURALI
Research Scholar
Department of Commerce
YogiVemanaUniversity, Kadapa (AP)

Prof.S.RAGHUNATH REDDY
Professor, Department of Commerce
Yogi Vemana University, Kadapa (AP)

ABSTRACT

The Micro, Small and Medium Enterprises(MSME) are crucial for the economic development of any country and play a pivotal role specifically for developing countries as they regulate economic activity and generate employment thus significantly contribute in poverty reduction. After agriculture, this sector is the second largest employer in India. Indian MSME sector has emerged as dynamic and highly vibrant sector of the economy. MSME, not only play significant role in generating large employment by investing less capital as compared to large industries but also help to develop non- farm sector by increasing industrialization in rural areas. The sector acts as the instrument of inclusive growth empowering the most vulnerable and marginalized groups. The main objectives of the paper are to explore the growth in the number of MSME units, GDP contribution, employment and exports of Indian MSME sector, to analyze the relationship between growth of MSME sector and fulfilment of Sustainable Development Goals (SDGs) 2030, to see the contribution of MSME sector in creating green jobs in India and to highlight the problems of MSME sector. This paper is based on the secondary data extracted from various reports and research papers related to MSME. The time period from 2006-2007to2019-2020 has been taken into consideration. MSME sector is the significant contributor in GDP.

Keywords: Micro, Small and Medium Enterprises, Sustainable Development Goals, Economic Development, Inclusive Growth.

Introduction

The world is battling with horrors like the **COVID-19**, which has left the entire world to a standstill. MSME is the maximum hit sector due to this global pandemic. So, considering this fact that the MSME sector is the lifeline of the Indian economy, the government announced immediate relief measures to re-energise this sector. Before going to the relief packages. The Micro, Small and Medium Enterprises (MSME) is a very important aspect of the Indian economy. This sector is considered as the job creator and plays a crucial role in providing large scale employment and industrialization of rural and backward areas. **Micro, Small and Medium Enterprises Development (MSMED) Act, 2006** which was notified on October 2, 2006, deals with the definition of MSMEs. The MSMED Act, 2006 defines the Micro, Small and Medium Enterprises based on

- The investment in plant and machinery for those engaged in manufacturing or production, processing or preservation of **goods** and

- The investment on equipment for enterprises engaged in the provision of services

To revive the Indian economy amid Covid-19 pandemic the government announced economic package under **ATMANIRBHAR BHARAT ABHIYAAN** which involves bold reforms to boost businesses with the major focus on Micro, Small and Medium Enterprises (MSME) sector. There are a total of 7 reforms announced for the sector. These are:

- Rs 3 lakh crores Collateral free Automatic Loans
- Rs 20,000 crore Subordinate Debt for MSMEs
- Rs 50,000 crore equity infusion through MSME Fund of Funds
- Revised definition of MSMEs
- Global tender to be disallowed up to Rs 200 crores
- Other interventions for MSMEs

Revised Definition of MSME

As per the new definition of MSMEs announced in May 2020, the investment and additional criteria of turnover introduced. On 1st June 2020, the Union Cabinet by Prime Minister Narendra Modi officially revised the MSME definition.

The distinction between manufacturing and services has been done away with.

Existing MSME Classification

Criteria: investment in plant& Machinery or Equipment

Classification	Micro	Small	Medium
Manufacturing Enterprises	Investment < Rs.25 lakhs	Investment < Rs.5 lakhs	Investment < Rs lakhs
Service Enterprises	Investment < Rs.10 lakhs	Investment < Rs.2 lakhs	Investment < Rs lakhs

Revised MSME Classification

Criteria: investment in plant& Machinery or Equipment

Classification	Micro	Small	Medium
Manufacturing Enterprises & Service Enterprises	Investment < Rs.1 Crore And Turnover < 5 Crore	Investment<Rs.10 Crore And Turnover < 50 Crore	Investment < Rs.50 Crore And Turnover < 250 Crore

According to above table, investment and turnover of micro units have increased to Rs 1 crore and Rs. 5 crores, respectively, definition of small units has increased investmento Rs.10 crore and turnover to Rs. 50 crore and investment and turnover of medium enterprises have enhanced to Rs. 20 crore and Rs. 100 crores, respectively. On 1st June, 2020, government again revised the MSME definition for medium enterprises i.e., investment of Rs. 50 crores and turnover of Rs. 250 crores.

Research methodology

Significance of MSMEs

- The Micro, Small and Medium Enterprises (MSMEs) sector contributes significantly to the Indian Economy in terms of Gross Domestic Product (GDP), Exports and Employment generation.
- With around 63.4 million units throughout the geographical expanse of the country, MSMEs contribute around 6.11% of the manufacturing GDP and 24.63% of the GDP from service activities as well as 33.4% of India's manufacturing output.
- In India at present, the MSMEs are employing around 120 million persons and contribute around 45% of the overall exports from India.
- Due to this, the MSME sector is called the growth engine of the Indian economy

Role of MSMEs in Indian Economy

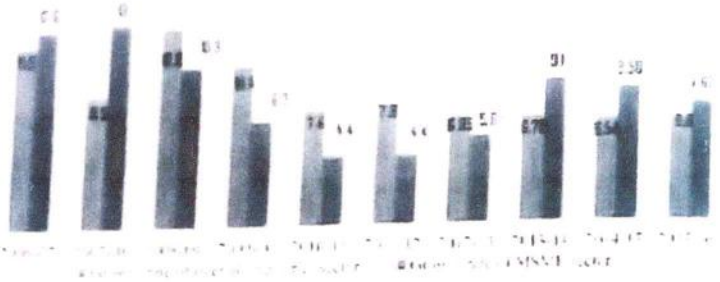
1. **Generate Large-Scale Employment** – Enterprises which are inclusive in this sector require low capital to start a new start-up venture, so it creates new employment opportunities for the youths. MSMEs play an important role in large scale employment creation.

2. **Economic Growth and exports** – It is the most significant driver in contributing the 6.11% of the manufacturing GDP and 24.63% of the GDP from service activities as well as 33.4% of India's manufacturing output. MSMEs act as ancillary industries for large-scale industries since they provide the latter with raw materials, important components etc.

3. **Backbone in the mission of "Make in India"** – MSMEs have earned an irreplaceable position in the nation's economic mix over the years. The initiative was taken by the Prime Minister of India "Make in India: has been made easy with MSME. Since the Make in India movement encourages firms to manufacture or develop their products within the country and attract investment opportunities, MSME's can actualize the benefits through the initiative.

Performance of Micro, Small and Medium Enter prices (MSMEs):

Presently, India is regarded as one of the fastest growing economies at the global level. In Indian economy, Micro, Small and Medium Enterprise (MSME) sector has made significant contribution in employment generation, total exports and economic growth which in turn has led to the emergence of this sector as the crucial sector of the economy. This sector can provide immense benefits ifitable to realize its full potential by providing



Growth rate of micro, small and medium enterprises (MSME) sector and overall industrial sector during 2006-2007 to 2015-2016 (in Percentage).

MSME sector is viewed as a critical pillar in accomplishing sustainable development goals. In accordance with the idea, "Small Business, Big Impact," Micro Small Medium Enterprises indirectly or directly contribute to achieving the Sustainable Development Goals.

MSME sector helps in achieving

- First goal of continual development by lowering the proportion of women, men and children of any age living in poverty through employment creation and economic development. In order to accomplish the
- Second goal of sustainable development, MSMEs help to make upmost of the world's food manufacturers and ensure sustainable food production arrangements.
- Third goal of MSMEs are viewed as important drivers of employment and entrepreneurship for youth and grown-ups and thus achieving,
- Fourth goal of ensuring quality education. MSME sassumes keyroleinreducinggender equality by ensuring women's effective and maximum participation in trade and business.

Nearly 40% of small-scale businesses are owned and managed by women, which means that Micro Small Medium Enterprises assume an important role in minimizing the gender disparity. With favorable policies in place, MSMEs help in achieving greater levels of economic output as key drivers of growth, expansion, technological advancement and innovation and thus contributing to achieve sustainable development goal.

Conclusion

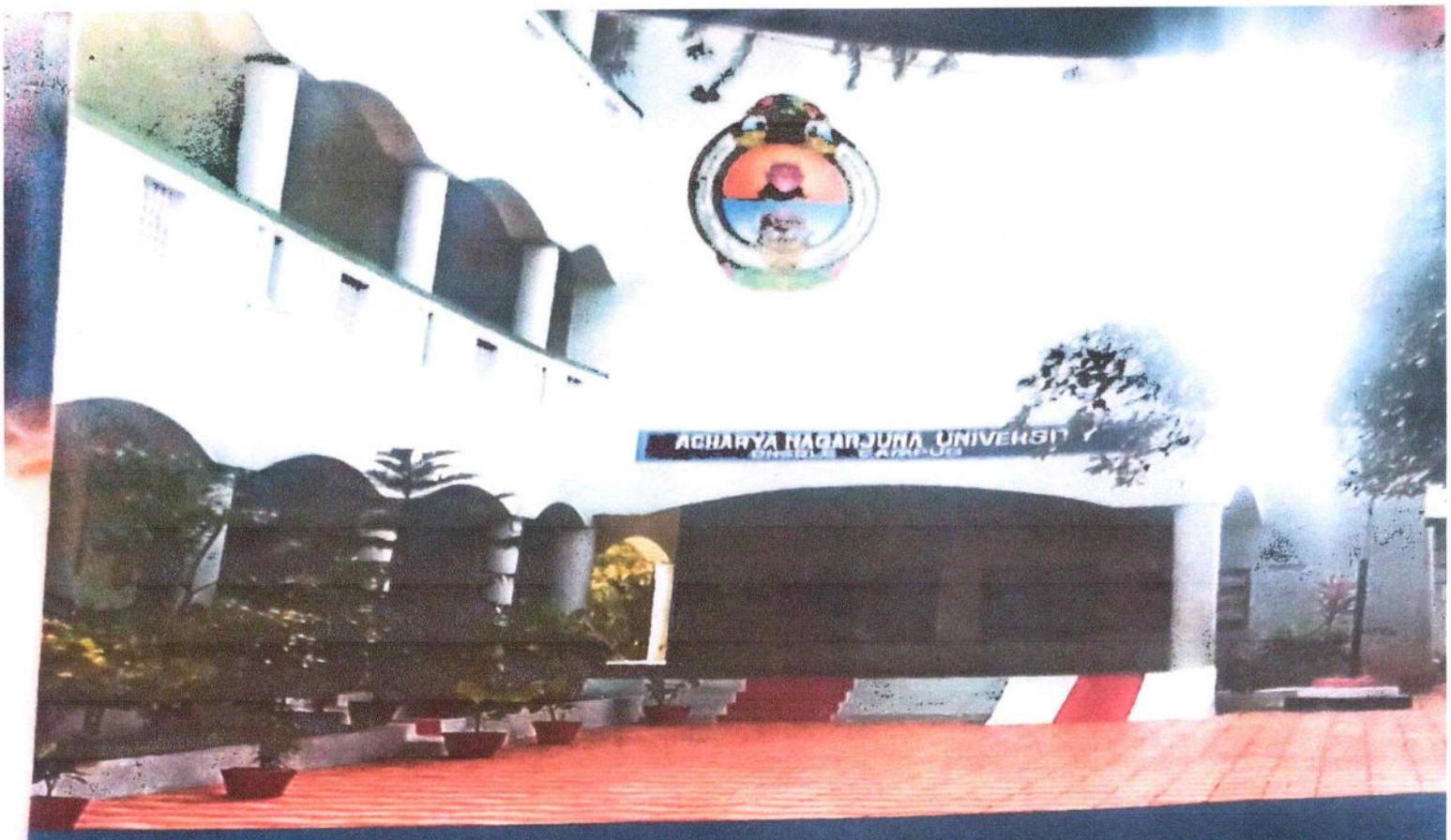
MSME is a lifeline of Indian economy as they provide employment and reduce regional dependency. MSMEs can be [illegible] and hope for Indian Economy soon. It also creates opportunities to banks for giving more credit to enterprises to MSME sector. The MSMEs are very helpful to remove the regional imbalances if it is established in the underdeveloped areas. The MSMEs are provide us more employment per unit. If this contribution is to be sustained, then their uniqueness needs to be nurtured overtly and explicitly.

REFFERENCE:

1 Central Statistical Office (CSO) Ministry of Static Report

2 The Economic Times (2021) featured Articles from The Economic Times

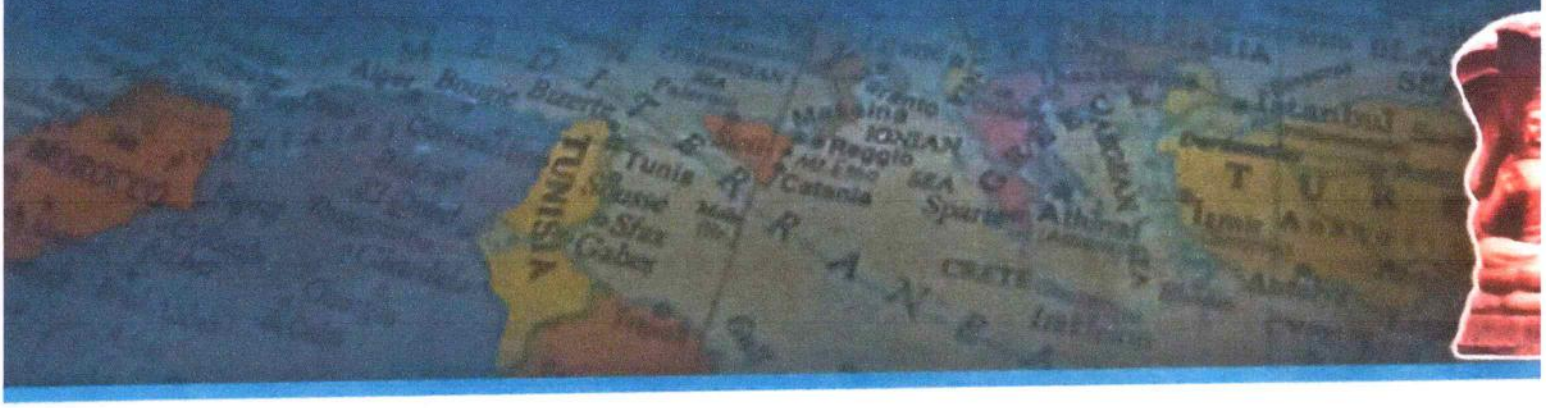
3 MSME data:2020-21



Editor in Chief:

Dr. B. Padmaja, Assistant Professor, Department of Commerce
Business Administration, ANU Ongole Campus, Ongole. She recei
MBA (Nagarjuna University), MHRM (Pondicherry University)
qualified UGC NET examinations in the year 2008 and obtained M.
research on "Impact on outdoor advertising on cellular industry in
from Bharathidasan University and Ph.D research on "Organizati
Climate and Human Resource Dimension- A study with referenc
Andhra Pradesh Southern Power Distribution Company Lim
Prakasam District, A.P".

Her research areas are Human Resource Management and Industrial Relations. Sh
participated National and International seminars and 38 research papers were publis
in various reputed journals. And she has to her credit 15 years of teaching experienc
P.G. Level.



PUBLISHED BY

Dept. of Commerce and Business Administration,
ANU Ongole Campus,
Ongole.

: Rs. 500/-

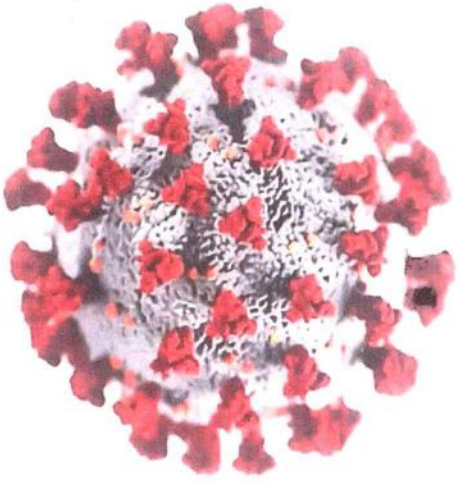
IDEAL COLLEGE OF ARTS AND SCIENCES

(Dr P.V.N. Raju Vidya Pranganam)
Autonomous & NAAC 'B' Grade
Samalkot Road, Kakinada, E.G.Dt. (AP)- 533 001

Two Day National Seminar on

IMPACT OF COVID-19 ON THE MIGRANT LABOUR IN INDIA

26th, 27th Feb, 2021



COVID-19

Organized by

DEPARTMENTS OF SOCIAL SCIENCES

Editors
Dr. G.Steeven Raju
Dr.K.Swamiji

Likhitha Publications

Impact of COVID-19 on the Migrant Labour in India

Editors

Dr. G.Steeven Raju

Dr.K.Swamiji

First Edition, February, 2021

ISBN: 978-81-947061-4-4

Published by LIKHITHA PUBLICATIONS

Publisher's Address 4-105/1, Srinivasanagar,
Kakinada-533005,
Andhra Pradesh (India)
Email:likhithapublications18@gmail.com
Website: www.ijar.org.in/lp
Contact: 9948440288

Printed by Typeset and Design by
SS Xerox &Print
Old CBI junction
Visakhapatnam- 530 017,
Andhra Pradesh (India)

CONTENTS

Impact of coronavirus pandemic on Indian MSME Sector

Prof. S.Raghunath Reddy
Dean, Faculty of Commerce, Yogi Vemana University, Kadapa - (AP)

M.Murali
Research Scholar Department of Commerce, Yogi Vemana University, Kadapa – (AP)

ABSTRCT:
The coronavirus pandemic has been a body blow not only to the human population but to economies around the world. With the fourth highest number of Covid-19 infections as of June 30, India is no different. It announced an unprecedented and absolute nation-wide lockdown to control the spread of the virus on March 24. This brought the economy to a virtual standstill. Micro, Small and Medium Enterprises (MSMEs) were hit the hardest. Since April-end, lockdown restrictions have been gradually eased and industries have resumed work. But in the face of a galloping pandemic, the worst is far from over. The MSME sector, for instance, continues to struggle with cash flow, slowing demand and rising unemployment.

Introduction:
MSME sector in India is second largest employment generator after agriculture, and acts as a breeding ground for entrepreneurs and innovators with considerable support in strengthening business ecosystem. The estimated number of MSMEs in India is 63 million and employs 110 million individuals. Indian MSMEs produce more than 6,000 products for local and global consumption. According to DGCIS data, the value of MSME related products in India is $147,390.08 million and contributed 48.56% of total export during 2017-18. MSMEs exposed to higher level of integration with global value and supply chains are playing critical role in global trade systems. Data from 2019 shows that sector contributed 29% to overall GDP.

Various reports, researches and surveys have proved again and again that this sector act as a catalyst for socio-economic development of the country. All this becomes more important with government's new mission of achieving $5 trillion economy target by 2025. Within this target the role of MSME sector is going play an important role, with expected contribution to GDP above 50% mark. The potential of Indian MSME sector is still untapped and that is one of the reasons why government policies are now more convergent towards building resilient ecosystem with better breadth and depth.

The government changed the criteria for what constitutes a micro, a small and a medium enterprise. It announced new definitions on the basis of investment (in plant, machinery and equipment) and annual turnover. Earlier, definitions were based purely on investment. These are the latest definitions:

- Micro enterprise: Investment up to Rs 1 crore, turnover up to Rs 5 crore
- Small enterprise: Investment up to Rs 10 crore, turnover up to Rs 50 crore
- Medium enterprise: Investment up to Rs 50 crore, turnover up to Rs 200 crore

As per the previous definitions, investment limits were Rs 25 lakh (micro), Rs 25 lakh to Rs 5 crore (small), and Rs 5 crore to Rs 10 crore (medium) for manufacturing units. For service-based units, investment limits were Rs 10 lakh (micro), Rs 10 lakh to Rs 2 crore (small) and Rs 2 crore to Rs 5 crore (medium). The revised definitions have done away with differentiating between manufacturing and service-based MSMEs.

Lock down impact on MSMEs:

- **Financial obligations:**
  Despite the lockdown, these enterprises are obliged to pay salaries, rents and bills and pay their suppliers.
- **Slowing demand:**
  The sector was already struggling with slowing demand in the lead-up to Covid-19. Now, it is in the midst of a full-blown crisis. On the domestic front, people are buying less, and that too only essential goods. This is unlikely to change soon. In a survey of 4,000 consumers by the Retailers Association of India, published in June, 78% said their shopping expenses would decrease post-lockdown. On the export front, there are few fresh orders. This is because the United States and European Union account for a chunk of Indian exports and both have been battered by Covid-19.
- **Lack of finance:**
  Amid slow demand and negative market sentiment, banks are reluctant to lend to MSMEs. This is mainly because the sector has a high ratio of non-performing assets (NPAs) or bad loans. As of January, the bad loan ratio of MSMEs was 12.5%. Besides the lack of fresh funding, businesses are struggling to recover existing payments from clients.

Relief measures sought by MSMEs: Soon after the lockdown announcement, MSMEs sought concessions and relief from the government to tide over the financial crisis. Their demands included:

- Time from banks to pay loan instalments, interest without incurring a penalty and being declared a non-performing asset
- Inclusion in the 15% income tax slab
- 5% interest subvention on working capital
- Reduction in electricity and water tariffs
- Payment of salaries by the government
- Regular payment of account receivables under the Goods and Services Tax (GST) even if MSMEs have not received payments from customers
- Tax accounting reconciliation, assistance on issuance of credit notes under GST, relaxed tax invoicing in the event of cancellations/reductions in orders
- Change in time of supply without fee change to avoid incorrect GST reporting. Time of supply is the time when goods/services are considered supplied and when GST must be paid.

India's Covid-19 response: The government has so far released a Rs 20 lakh crore stimulus package to help individuals and businesses tide over the Covid-19 financial crisis. The Reserve Bank of India (RBI) released the first tranche of relief measures on March 27. Finance Minister Nirmala Sitharaman announced a second tranche on May 13. The following are the main relief measures for MSMEs:

RBI's relief measures

Moratorium on term loan EMIs: The central bank has allowed banks and lending institutions to allow borrowers to defer EMI payments on term loans till August 31. No late fee will be charged and credit scores will remain unchanged. However, interest will be charged on the months EMIs are not paid.

Special Liquidity Facility to SIDBI: The RBI has extended a special refinance facility of Rs 15,000 crore to the Small Industries Development Bank of India (SIDBI) so it can provide liquidity to MSMEs. Soon after, SIDBI announced special liquidity support schemes for small businesses via banks, non-bank financiers and micro finance institutions.

Government's relief measures:

- **Revised definition of MSMEs**:

The finance minister explained that the definitions were revised because the older and lower thresholds had made business owners wary of expanding, believing that they would lose the benefits they enjoyed as MSMEs if they expanded.

- **Rs 3 lakh crore credit guarantee**:

A credit guarantee entitles a business to a loan from a bank or non-banking financial company that will be repaid by the government if left unpaid. Only those businesses with outstanding loans of Rs 25 crore and turnovers under Rs 100 crore are eligible. They can avail a loan of up to 20% of their outstanding credit as on February 29, 2020. The loan has a tenure of four years, with a 12-month moratorium (which means payments will start only after a year). It is collateral-free, does not charge a guarantee fee, and comes with 100% credit guarantee cover. It can be availed up to October 31, 2020. This is expected to benefit 45 lakh enterprises, according to Sitharaman.

- **Rs 20,000 crore subordinate debt scheme:**

This makes loans available to MSMEs that were struggling with loan payments before the Covid-19 crisis. But the government guarantee here is partial. The government expects this measure to help 2 lakh businesses.

- **Fund of Funds with Rs 50,000-crore corpus:**

The purpose of this fund is to finance "viable" MSMEs and help them grow. The government's share in the fund is Rs 10,000 crore and it expects to collect the rest from institutions such as the Life Insurance Corporation of India and the State Bank of India.

Industry response to Covid-19:

In March, the Confederation of Indian Industries (CII) – a non-government, industry-led organisation with 9,100 members drawn from the public and private sectors, including MSMEs – announced measures for MSMEs. These included a CII COVID-19 CODE and a CII COVID Rehabilitation and Relief Fund to help the sector stay in business and avoid laying off workers. The CII also asked member companies to produce sanitizers, ventilators and medicines on a no-profit basis.

Conclusion:

To what extent did the relief measures help MSMEs? While it might be too early to tell, a survey with a small sample size, conducted by Skoch Consultancy Services in association with the non-profit Federation of Indian Micro and Small & Medium Enterprises in May, provides some clues. Of the 200 respondents, 34% found the government's stimulus package useful while 44% did not. In addition, 77% said the immediate challenge for MSMEs was to meet fixed expenses such as paying salaries and vendor bills. And, 86% favoured direct cash support. Experts agree. They say the

government is increasing the burden on businesses by providing loans instead of upfront liquidity. Another survey, conducted by the All India Manufacturers Organisation and published in June, found that 35% of MSMEs had gone out of business and that the relief measures had either not reached them or had been inadequate. Of those hopeful of getting back on their feet, 46% said recovery would take three months while 26% said it was only possible by the year-end. With the situation as it is, unemployment has naturally followed. The number of MSMEs cutting all jobs in May rose to 6% from 4% in April. Adding to the gloom, India's overall economic situation remains grim. In June, the International Monetary Fund said India's GDP would contract by 4.5% in 2020-2021. This was a revision of its April forecast of 1.9% positive growth.

REFERENCE:

1.The Economic Times (2021) featured Articles from The Economic Times
2.All India Manufactures Organisation Survey
3.Skoch Consultancy Services in association with the non-profit Federation of Indian Micro and Small & Medium Enterprises
4.MSME data:2020-21

About the Editors

Dr G.Steeven Raju, M.A.,PGDCRS.,M.Phil.,Ph.D. UGC-NET, AP-SET has been working as a Lecturer and Head of the Department of Economics, ideal Collage of Arts and Sciences (Autonomous),Kakinada, Andhra Pradesh, India. He awarded Ph.D from Andhra University, Visakhapatnam. He has more than 20 years of teaching and more than 5 years of Research Experience. He has published more than 20 research papers in various Journals, Periodicals and Seminar Volumes. He has been attended/presented papers in several international and national Seminars and Workshops. He has administrative experience by working in the college. Dr Steeven Raju also been acting as an Editor of International Journal of Academic Research (ISSN:2348-7666).

Dr. K. Swamiji, M.A (Pol) MA. (Pub.Add), Ph.D., was joined as Lecturer in Political Sciences, Ideal College of Arts and Sciences "A", Kakinada Since 20.08.2016. He is the ALUMNI of the Department of Political Sciences AUMSN PG Center, Kakinada. He awarded Ph.D. on his research work "Democratic Decentralization for the Empowerment of weaker section in India a core study in Andhra Pradesh 21.05.2019. He published 4 Research papers in various National and International Journals. He acted as convener in Two Seminars organized by the Department. He is the member of various administrative committees of the College.

Likhitha Publications
4-105/1, Srinivasanagar, Kakinada-533 005
Andhra Pradesh (India)
e-mail:drtvramana@yahoo.co.in

ISBN:978-81-947061-4-4

ISBN:978-81-947061-4-4

Price: Rs. 1050/-

230 h

Elsevier
Radarweg 29, PO Box 211, 1000 AE Amsterdam, Netherlands
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States

Notices
Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress

ISBN: 978-0-12-820532-7

Publisher: Susan Dennis
Acquisitions Editor: Kostas KI Marinakis
Editorial Project Manager: Emerald Li
Production Project Manager: Debasish Ghosh
Cover Designer: Greg Harris

Typeset by MPS Limited, Chennai, India

CHAPTER 9

Materials and features of ferroelectric photocatalysts: the case of multiferroic $BiFeO_3$

U. Bharagav[1], N. Ramesh Reddy[1], K. Pratap[2], K.K. Cheralathan[3], M.V. Shankar[1], P.K. Ojha[4] and M. Mamatha Kumari[1]

[1]Nanocatalysis and Solar Fuels Research Laboratory, Department of Materials Science & Nanotechnology, Yogi Vemana University, Kadapa, India, [2]Centre for Advanced Studies in Electronics Science and Technology (CASEST), School of Physics, University of Hyderabad, Hyderabad, India, [3]Department of Chemistry, School of Advanced Sciences, Vellore Institute of Technology, Vellore, India, [4]Naval Materials Research Laboratory (NMRL), Ambernath, India

9.1 Introduction

Ferroelectrics are a class of materials which exhibits reversible polarization on application of an electric field. The first ferroelectric material was discovered 100 years ago, that is, Rochelle salt which exhibits the sudden electric polarization (Si et al., 2019). Ferroelectrics are famous for their extensive properties such as narrow bandgap values, spontaneous electric polarization, superior magnetic properties, and they had several applications in capacitors, storage memories, wave guides, optical memory display, displacement transducers, etc. The list of ferroelectrics contains titanates ($BaTiO_3$, $PbTiO_3$, and $SnTiO_3$) (Alammar, Hamm, Wark, & Mudring, 2015), niobates ($LiNbO_3$, $KNbO_3$, $NaNbO_3$, and $AgNbO_3$) (Zlotnik, Tobaldi, Seabra, Labrincha, & Vilarinho, 2016), tantalates ($LiTaO_3$, $KTaO_3$, $NaTaO_3$, and $AgTaO_3$) (Yogamalar, Kalpana, Senthil, & Chithambararaj, 2018), and perovskites containing iron, that is, $BiFeO_3$ and $LaFeO_3$.

In the field photocatalysis, narrow bandgap with suitable energy band potential and stability of the catalyst plays a crucial role. $BiFeO_3$ is gaining more and more attention because of its visible-active bandgap for photocatalytic applications, this is the major reason behind choosing perovskite materials as catalysts (Yogamalar et al., 2018). However, it also has some limitations as other photocatalysts do, but majority of the characteristic properties were preferable for making an efficient catalytic material (Lin et al., 2014). $BiFeO_3$ in short BFO is one of the promising candidates for the photocatalytic applications (Yao, Wenchao

Photocatalytic Systems by Design.
DOI: https://doi.org/10.1016/B978-0-12-820532-7.00003-5

Elsevier
Radarweg 29, PO Box 211, 1000 AE Amsterdam, Netherlands
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States

Notices
Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress

ISBN: 978-0-12-820532-7

Publisher: Susan Dennis
Acquisitions Editor: Kostas KI Marinakis
Editorial Project Manager: Emerald Li
Production Project Manager: Debasish Ghosh
Cover Designer: Greg Harris

Typeset by MPS Limited, Chennai, India

CHAPTER 10

Metal organic framework-based photocatalysts for hydrogen production

Lakshmana Reddy Nagappagari[1], Kiyoung Lee[1] and Shankar Muthukonda Venkatakrishnan[2]

[1]School of Nano & Materials Science and Engineering, Kyungpook National University, Sangju, South Korea, [2]Nano Catalysis and Solar Fuels Research Laboratory, Department of Materials Science & Nanotechnology, Yogi Vemana University, Kadapa, India

10.1 Introduction of metal-organic frameworks

In the recent years, the organic photochemistry has become a mature science and has been achieving a remarkable properties or chemical reactions upon light absorption (Noh & Jung, 2016). The discovery of porous materials in 1990s namely porous coordination polymers (PCPs) or metal-organic frameworks (MOFs), which resulted from the coordination of organic and inorganic materials, has grabbed significant interest among the researchers. MOFs consist of extremely large surface areas (1000−10,000 m^2/g) due to ultrahigh porosity and the size of their pores ranges from the micro- to mesoporous regime (Stock & Biswas, 2012; Zhu & Xu, 2014). As depicted in Fig. 10.1, the structures of MOFs are composed of organic ligands (or linkers) and the metal clusters can serve as connecters (Cao, 2016). Due to a high degree of variability of the inorganic and organic components, there is a large library of esthetically pleasing structures that have vast applications, such as clean energy storage (methane and hydrogen), photocatalysis (Zhang & Lin, 2014), CO_2 capture, organic transformations (Chughtai, Ahmad, Younus, Laypkov, & Verpoort, 2015), and various separation processes (Li, Kuppler, & Zhou, 2009).

10.1.1 Historical developments

MOFs represent a special group of compounds that arise through the linking of metal ions by coordinate bonds to either organic or inorganic ligands. These polymers comprise various structures like one-, two-, or three-dimensional networks. Some of the examples of—with networks of Cu, Zn, Ag, and Cd—the late transition metals are represented in Fig. 10.2, and these coordination polymer structures could be determined only with the advantage of single-crystal X-ray diffraction. MOFs are not new since it was coined in

Photocatalytic Systems by Design.
DOI: https://doi.org/10.1016/B978-0-12-820532-7.00007-2

Subramanian Balakumar
Valérie Keller
M.V. Shankar *Editors*

Nanostructured Materials for Environmental Applications

Springer

Contents

230f

Chapter 19
Metal Nitrides and Graphitic Carbon Nitrides as Novel Photocatalysts for Hydrogen Production and Environmental Remediation

Sudesh Kumar, Kakarla Raghava Reddy, Ch. Venkata Reddy, Nagaraj P. Shetti, Veera Sadhu, M. V. Shankar, Vasu Govardhana Reddy, A. V. Raghu, and Tejraj M. Aminabhavi

19.1 Introduction

In the twenty-first century, humans are facing serious problems to provide renewable and clean energy to our modern society. Photocatalysis has been studied and is probable to gross an abundant influence on eco-friendly emissions and renewable energy. Photocatalytic hydrogen generation technology from water is the greatest encouraging method to grasp an economy of hydrogen due to usage of solar energy (its clean and enduring energy source); it is an ecologically harmless method

S. Kumar
Department of Chemistry, Banasthali Vidyapeeth, Vanasthali, Rajasthan, India

K. R. Reddy (✉)
School of Chemical and Biomolecular Engineering, The University of Sydney, Sydney, NSW, Australia

C. V. Reddy (✉)
School of Mechanical Engineering, Yeungnam University, Gyeongsan, South Korea

N. P. Shetti
Department of Chemistry, K. L. E. Institute of Technology, Hubli, Karnataka, India

Visvesvaraya Technological University, Belgaum, Karnataka, India

V. Sadhu
School of Physical Sciences, Kakatiya Institute of Technology and Science (KITS), Warangal, Telangana, India

M. V. Shankar
Nanocatalysis and Solar Fuels Research Lab, Department of Materials Science and Nanotechnology, Yogi Vemana University, Kadapa, Andhra Pradesh, India

S. Balakumar et al. (eds.), *Nanostructured Materials for Environmental Applications*, https://doi.org/10.1007/978-3-030-72076-6_19

132. Boppella, R., Yang, W., Tan, J., Kwon, H.-C., Park, J., & Moon, J. (2019). Black phosphorus supported Ni_2P co-catalyst on graphitic carbon nitride enabling simultaneous boosting charge separation and surface reaction. *Applied Catalysis B: Environmental, 242*, 422–430.
133. Sun, S., Li, J., Cui, J., Gou, X., Yang, Q., Jiang, Y., Liang, S., & Yang, Z. (2019). Simultaneously engineering K-doping and exfoliation into graphitic carbon nitride (g-C_3N_4) for enhanced photocatalytic hydrogen production. *International Journal of Hydrogen Energy, 44*, 778–787.
134. Bai, J., Yin, C., Xu, H., Chen, G., Ni, Z., Wang, Z., Li, Y., Kang, S., Zheng, Z., & Li, X. (2018). Facile urea-assisted precursor pre-treatment to fabricate porous g-C_3N_4 nanosheets for remarkably enhanced visible-light-driven hydrogen evolution. *Journal of Colloid and Interface Science, 532*, 280–286.
135. Wang, H., Bian, Y., Hu, J., & Dai, L. (2018). Highly crystalline sulfur-doped carbon nitride as photocatalyst for efficient visible-light hydrogen generation. *Applied Catalysis B: Environmental, 238*, 592–598.
136. Yuan, Y.-J., Shen, Z., Wu, S., Su, Y., Pei, L., Ji, Z., Ding, M., Bai, W., Chen, Y., Yu, Z.-T., & Zou, Z. (2019). Liquid exfoliation of g-C_3N_4 nanosheets to construct 2D-2D MoS_2/g-C_3N_4 photocatalyst for enhanced photocatalytic H_2 production activity. *Applied Catalysis B: Environmental, 246*, 120–128.
137. Wang, J., Yang, Z., Yao, W., Gao, X., & Tao, D. (2018). Defects modified in the exfoliation of g-C_3N_4 nanosheets via a self-assembly process for improved hydrogen evolution performance. *Applied Catalysis B: Environmental, 238*, 629–637.
138. Li, H., Deng, P., & Hou, Y. (2018). Cobalt disulfide/graphitic carbon nitride as an efficient photocatalyst for hydrogen evolution reaction under visible light irradiation. *Materials Letters, 229*, 217–220.
139. Peng, W., Zhang, S.-S., Shao, Y.-B., & Huang, J.-H. (2018). Bimetallic PtNi/g-C_3N_4 nanotubes with enhanced photocatalytic activity for H_2 evolution under visible light irradiation. *International Journal of Hydrogen Energy, 43*, 22215–22225.
140. Liu, Y., Xu, X., Zhang, J., Zhang, H., Tian, W., Li, X., Tade, M. O., Sun, H., & Wang, S. (2018). Flower-like MoS_2 on graphitic carbon nitride for enhanced photocatalytic and electrochemical hydrogen evolutions. *Applied Catalysis B: Environmental, 239*, 334–344.
141. Bhunia, K., Chandra, M., Khilari, S., & Pradhan, D. (2019). Bimetallic PtAu alloy nanoparticles-integrated g-C_3N_4 hybrid as an efficient photocatalyst for water-to-hydrogen conversion. *ACS Applied Materials & Interfaces, 11*, 478–488.
142. Wang, X., Zhao, Z., Shu, Z., Chen, Y., Zhou, J., Li, T., Wang, W., Tan, Y., & Sun, N. (2018). One-pot synthesis of metakaolin/g-C_3N_4 composite for improved visible-light photocatalytic H_2 evolution. *Applied Clay Science, 166*, 80–87.

230e

Chapter 15
Titanate Nanostructures as Potential Adsorbents for Defluoridation of Water

C. Prathibha, Anjana Biswas, and M. V. Shankar

15.1 Introduction

Water is not only an essential component for life but also a basic building block to maintain quality of life. Its purity and availability are inextricably linked to global health and economic development. The presence of several naturally occurring, anthropogenic, and industry-generated ions such as fluoride, arsenic, nitrate, sulfate, iron, manganese, chloride, selenium, heavy metals, and radioactive materials greatly affects the water quality, leading to health problems. The most significant inorganic pollutants in groundwater affecting human health at the global scale, according to the World Health Organization (WHO), are arsenic and fluoride [1]. Fluoride is the only chemical in potable water that can cause varied health effects depending upon its concentration in dissolved form. It is often described as a "double-edged sword" as inadequate ingestion is associated with dental caries, whereas excessive intake leads to dental, skeletal, and soft tissue fluorosis which has no cure. A very small amount of fluoride (0.4–1.0 mg/L) is beneficial for bone and teeth development and dental health. Especially for young children, it promotes calcification of dental enamel and protects teeth against tooth decay. Therefore, it is considered as an essential mineral with a narrow margin of safety. Due to these clinical manifestations caused by drinking fluoride-contaminated water, the WHO has recommended 1.5 mg/L as the maximum contaminant level (MCL) in drinking water. Fluorosis due to excessive concentration of fluoride >1.5 mg/L has been reported in at least 28 countries from South Asia; Africa; the Middle East; North,

C. Prathibha (✉) · A. Biswas
Department of Physics, Sri Sathya Sai Institute of Higher Learning, Anantapur Campus, Anantapur, Andhra Pradesh, India
e-mail: cprathibha@sssihl.edu.in

M. V. Shankar
Nanocatalysis and Solar Fuels Research Laboratory, Department of Materials Science and Nanotechnology, Yogi Vemana University, Kadapa, Andhra Pradesh, India

S. Balakumar et al. (eds.), *Nanostructured Materials for Environmental Applications*, https://doi.org/10.1007/978-3-030-72076-6_15

impregnated coconut shell carbon. *Separation Science and Technology, 42*, 769–788. https://doi.org/10.1080/01496390601070067.

43. Loganathan, P., Vigneswaran, S., Kandasamy, J., & Naidu, R. (2013). Defluoridation of drinking water using adsorption processes. *Journal of Hazardous Materials, 248–249*, 1–19. https://doi.org/10.1016/j.jhazmat.2012.12.043.
44. Lin, J., Wu, Y., Khayambashi, A., Wang, X., & Wei, Y. (2018). Preparation of a novel CeO2/SiO2 adsorbent and its adsorption behavior for fluoride ion. *Adsorption Science and Technology, 36*, 743–761. https://doi.org/10.1177/0263617417721588.
45. Biswas, A., & Prathibha, C. (2020). Fe(III) and Zr(IV) surface functionalized 1-D hydrogen titanate nanotubes for remediating fluoride from water at neutral pH. *Journal of Water Process Engineering, 37*, 101331. https://doi.org/10.1016/j.jwpe.2020.101331.
46. Dou, X., Mohan, D., Pittman, C. U., & Yang, S. (2012). Remediating fluoride from water using hydrous zirconium oxide. *Chemical Engineering Journal, 198–199*, 236–245. https://doi.org/10.1016/j.cej.2012.05.084.
47. Zeng, Y., Xue, Y., Liang, S., & Zhang, J. (2017). Removal of fluoride from aqueous solution by TiO2 and TiO2–SiO2 nanocomposite. *Chemical Speciation and Bioavailability, 29*, 25–32. https://doi.org/10.1080/09542299.2016.1269617.
48. Deng, H., Zhang, K., & Wang, X. (2016). Synthesis of titanate nanoparticles in low temperature hydrolysis and adsorption of arsenate (V) and fluoride. *Desalination and Water Treatment, 57*, 9409–9419. https://doi.org/10.1080/19443994.2015.1030707.
49. Suriyaraj, S. P., Vijayaraghavan, T., Biji, P., & Selvakumar, R. (2014). Adsorption of fluoride from aqueous solution using different phases of microbially synthesized TiO2 nanoparticles. *Journal of Environmental Chemical Engineering, 2*, 444–454. https://doi.org/10.1016/j.jece.2014.01.013.
50. Karthikeyan, M., & Elango, K. P. (2009). Removal of fluoride from water using aluminium containing compounds. *Journal of Environmental Sciences, 21*, 1513–1518. https://doi.org/10.1016/S1001-0742(08)62448-1.
51. Gopal, V., & Elango, K. P. (2010). Studies on defluoridation of water using magnesium titanate. *Indian Journal of Chemical Technology, 17*, 28–33.

Chapter 3
Hierarchical Nanostructures for Photocatalytic Applications

R. Ajay Rakkesh, Durgalakshmi Dhinasekaran, M. V. Shankar, and S. Balakumar

3.1 Basic Concepts of Hierarchical Nanostructures in Photocatalytic Field

Recently, nanosize- and quantum-size-based photocatalysts have attracted immense attention among the material scientist due to their excellent physicochemical properties in solving energy- and environmental-related problems [1–3]. The interaction between light energy and metal oxide semiconductors has generated excitons, and reactive oxygen species provided a sustainable opportunity to decompose any organic matter at micro level. Currently, a broad variety of metal oxide semiconducting materials have been demonstrated for specific as well as multifunctional applications, such as metal oxides with d^0 and d^{10} configurations, semiconductor-based plasmonic nanostructures, metal oxynitrides/sulphides, metal-organic frameworks and perovskite-based photocatalysts [4–8].

R. A. Rakkesh
National Centre for Nanoscience and Nanotechnology, University of Madras, Chennai, Tamil Nadu, India

Department of Physics and Nanotechnology, SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu, India

D. Dhinasekaran
Department of Medical Physics, Anna University, Chennai, Tamil Nadu, India

M. V. Shankar
Department of Materials Science and Nanotechnology, Yogi Vemana University, Kadapa, Andhra Pradesh, India

S. Balakumar (✉)
National Centre for Nanoscience and Nanotechnology, University of Madras, Chennai, Tamil Nadu, India

S. Balakumar et al. (eds.), *Nanostructured Materials for Environmental Applications*, https://doi.org/10.1007/978-3-030-72076-6_3

63. D. Chatterjee & S. Dasgupta, Journal of Photochemistry and Photobiology C, 2005, 6, 186–205, DOI: 10.1016/j.jphotochemrev.2005.09.001.
64. Xu, D., Cheng, B., Cao, S., & Yu, J. (2015). *Applied Catalysis B: Environmental, 164*, 380–388. https://doi.org/10.1016/j.apcatb.2014.09.051.
65. Liu, Y., Wang, R., Yang, Z., Du, H., Jiang, Y., Shen, C., Liang, K., & Xu, A. (2015). *Chinese Journal of Catalysis, 36*, 2135–2144. https://doi.org/10.1016/S1872-2067(15)60985-8.
66. Xiong, T., Zhang, H., Zhang, Y., & Dong, F. (2015). *Chinese Journal of Catalysis, 36*, 2155–2163. https://doi.org/10.1016/S1872-2067(15)60980-9.
67. Yu, C., Bai, Y., He, H., Fan, W., Zhu, L., & Zhou, W. (2015). *Chinese Journal of Catalysis, 36*, 2178–2185. https://doi.org/10.1016/S1872-2067(15)61009-9.
68. Wang, X., Yu, R., Wang, K., Yang, G., & Yu, H. (2015). *Chinese Journal of Catalysis, 36*, 2211–2218.
69. Zhang, X., Zhu, Y., Yang, X., Zhou, Y., Yao, Y., & Li, C. (2014). *Nanoscale, 6*, 5971–5979. https://doi.org/10.1039/C4NR00975D.
70. Ai, Z. H., Zhang, L. Z., Lee, S. C., & Ho, W. K. (2009). *Journal of Physical Chemistry C, 113*, 20896–20902. https://doi.org/10.1021/jp9083647.
71. Ma, B., Guo, J., Dai, W.-L., & Fan, K. (2012). *Applied Catalysis B: Environmental, 123*, 193–199.
72. Shen, Z., Chen, G., Wang, Q., Yu, Y., Zhou, C., & Wang, Y. (2012). *Nanoscale, 4*, 2010–2017. https://doi.org/10.1039/c2nr12045c.
73. Sun, M., Yan, Q., Yan, T., Li, M., Wei, D., Wang, Z., Wei, Q., & Du, B. (2014). *RSC Advances, 4*, 31019–31027. https://doi.org/10.1039/C4RA03843F.
74. Xing, C., Zhang, Y., Wu, Z., Jiang, D., & Chen, M. (2014). *Dalton Transactions, 43*, 2772–2780. https://doi.org/10.1039/C3DT52875H.
75. Dong, F., Sun, Y., Fu, M., Wu, Z., & Lee, S. C. (2012). *Journal of Hazardous Materials, 219*, 26–34.
76. Guzman, S. S., Jayan, B. R., de la Rosa, E., Castro, A. T., Gonalez, V. G., & Yacaman, M. J. (2009). *Materials Chemistry and Physics, 115*, 172–178. https://doi.org/10.1016/j.matchemphys.2008.11.030.
77. Zhu, L., Li, Y., & Zeng, W. (2017). *Applied Surface Science, 427*, 281–287.
78. Xiao, B., Zhao, Q., Xiao, C., Yang, T., Wang, P., Wang, F., Chen, X., & Zhang, M. (2015). *CrystEngComm*. https://doi.org/10.1039/C5CE00870K.
79. Zhu, P., Zhang, J., Wu, Z., & Zhang, Z. (2008). *Crystal Growth and Design, 8*, 3148–3153. https://doi.org/10.1021/cg0704504.
80. Zhang, S. L., Guan, B. Y., Wu, H. B., & Lou, X. W. D. (2018). *Nano-Micro Letters, 10*, 44.
81. Liu, J., Li, J., Wei, F., Zhao, X., Su, Y., & Han, X. (2019). *ACS Sustainable Chemistry & Engineering, 7*, 11258–11266. https://doi.org/10.1021/acssuschemeng.9b00610.
82. Zhang, M., Shao, C., Guo, Z., Zhang, Z., Mu, J., Cao, T., & Liu, Y. (2011). *ACS Applied Materials & Interfaces, 3*, 369–377. https://doi.org/10.1021/am100989a.
83. Wang, S., Guan, B. Y., & Wen, X. (2018). *Journal of the American Chemical Society*. https://doi.org/10.1021/jacs.8b02200.
84. Jung, H., Cho, K. M., Kim, K. H., Yoo, H. W., Saggaf, A. A., Gereige, I., & Jung, H. T. (2018). *ACS Sustainable Chemistry & Engineering*. https://doi.org/10.1021/acssuschemeng.8b00002.
85. K. S. Ranjith, D. R. Kumar, Y. S. Huh, Y. K. Han, T. Uyar & R. T. R. Kumar (2020). https://doi.org/10.1021/acs.jpcc.9b09666.
86. Li, G., Huang, J., Xue, C., Chen, J., Deng, Z., Huang, Q., Liu, Z., Gong, C., Guo, W., & Cao, R. (2019). *Crystal Growth & Design*. https://doi.org/10.1021/acs.cgd.9b00495.
87. Ajay Rakkesh, R., & Balakumar, S. (2015). *Journal of Nanoscience and Nanotechnology, 15*, 4316–4324. https://doi.org/10.1166/jnn.2015.9723.
88. Ajay Rakkesh, R., Durgalakshmi, D., & Balakumar, S. (2015). *AIP Conference Proceedings, 1665*, 050036.
89. Ajay Rakkesh, R., Durgalakshmi, D., & Balakumar, S. (2014). *Journal of Materials Chemistry C, 2*, 6827–6834. https://doi.org/10.1039/C4TC01195C.

Chapter 2
Nanostructured Heterojunction (1D-0D and 2D-0D) Photocatalysts for Environmental Remediation

Lakshmana Reddy Nagappagari, Kiyoung Lee, Ajay Rakesh, Subramanian Balakumar, and M. V. Shankar

2.1 Introduction

Environmental pollution from industries, automobiles, domestic usage, and sewage activities has been constantly increasing day by day due to increasing population and utilization of all these pollution-causing systems [1–3]. Hence these mentioned human activities cause a major impact on water and air, which consequently damage nature and affect human beings very severely. Therefore, there is an urgent need to develop efficient technologies in a sustainable way to cop all these challenges and make pollution-free environment for future generations. In this connection the heterogeneous photocatalysis (PC) and photoelectrocatalysis (PEC) have become emerging technologies for environmental applications [4–6]. Much attention is paid especially on using various types of nanostructured photocatalysts due to their unique nanoscale properties like high surface area, quantum confinement, and a greater number of active sites for redox reactions on the surface of the photocatalysts in the reaction medium [7, 8]. Various types of nanomaterials like 0D, 1D, 2D, and 3D nanostructures (Fig. 2.1) have well focused on the environmental remediation such as organic dye degradation [9, 10], removal of metal ions [11–13], fluoride removal [14–16], organic contaminants [17–19], and other environmental

L. R. Nagappagari · K. Lee
Department of Energy Chemical Engineering, School of Nano & Materials Science and Engineering, Kyungpook National University, Sangju, Republic of Korea

A. Rakesh · S. Balakumar
National Centre for Nanoscience and Nanotechnology (NCNN), University of Madras, Chennai, Tamil Nadu, India

M. V. Shankar (✉)
Nanocatalysis and Solar Fuels Research Laboratory, Department of Materials Science & Nanotechnology, Yogi Vemana University, Kadapa, Andhra Pradesh, India
e-mail: shankar@yogivemanauniversity.ac.in

S. Balakumar et al. (eds.), *Nanostructured Materials for Environmental Applications*, https://doi.org/10.1007/978-3-030-72076-6_2

Pt nanocomposite synthesized via a Green approach. *RSC Advances, 10*(23), 13722–13731. https://doi.org/10.1039/D0RA00541J.

121. Liu, C.-C., Xu, H., Wang, L., & Qin, X. (2017). Facile one-pot green synthesis and antibacterial activities of GO/Ag nanocomposites. *Acta Metallurgica Sinica (English Letters), 30*(1), 36–44. https://doi.org/10.1007/s40195-016-0517-8.
122. Liu, Y., Tian, C., Yan, B., Lu, Q., Xie, Y., Chen, J., Gupta, R., Xu, Z., Kuznicki, S. M., Liu, Q., et al. (2015). Nanocomposites of graphene oxide{,} Ag nanoparticles{,} and magnetic ferrite nanoparticles for elemental mercury (Hg0) removal. *RSC Advances, 5*(20), 15634–15640. https://doi.org/10.1039/C4RA16016A.
123. Rajesh, R., Kumar, S. S., & Venkatesan, R. (2014). Efficient degradation of azo dyes using Ag and Au nanoparticles stabilized on graphene oxide functionalized with PAMAM dendrimers. *New Journal of Chemistry, 38*(4), 1551–1558. https://doi.org/10.1039/C3NJ01050C.

230 b

Chapter 1
Nanostructures in Photocatalysis: Opportunities and Challenges for Environmental Applications

Y. V. Divyasri, Y. N. Teja, V. Nava Koteswara Rao, N. C. Gangi Reddy, Sakar Mohan, M. Mamatha Kumari, and M. V. Shankar

1.1 Introduction

The environment, which is essentially the air, water, and soil, is largely polluted due to the increased population and industrialization. These pollutants are mostly anthropogenic, and they generally include (i) the toxic-organic materials such as dyes, aromatic, and aliphatic molecules; (ii) agricultural wastages such as the pesticides, insecticides, and herbicides; (iii) plastics; (iv) pharmaceutical products and byproducts; (v) inorganic materials such as heavy metals; (vi) toxic gases such as CO, SO_x, and NO_x; and (vii) microorganisms such as bacteria, viruses, and fungi [1–3]. Release of these pollutants into the environment from various sources causes much adverse effects to the ecology, and it will make permanent damages and even more worse adverse effects if these pollutants are accumulated into the environment. Therefore, it is an urgent requirement to address such issues toward destructing and converting these pollutants into nontoxic. Considering current scenario of energy consumption, the world also requires energy- and cost-effective techniques to address the issues in the environmental remediation. In this aspect, photocatalysis is one of the reliable energy- and cost-effective and versatile techniques, which can almost degrade/convert into nontoxic/kill all of the abovementioned various categories of pollutants in the environment [4, 5].

Y. V. Divyasri · N. C. Gangi Reddy
Department of Chemistry, Yogi Vemana University, Kadapa, Andhra Pradesh, India
e-mail: ncgreddy@yogivemanauniversity.ac.in

Y. N. Teja · S. Mohan
Centre for Nano and Material Sciences, Jain University, Bangalore, Karnataka, India
e-mail: m.sakar@jainuniversity.ac.in

V. Nava Koteswara Rao · M. Mamatha Kumari · M. V. Shankar (✉)
Nanocatalysis and Solar Fuels Research Laboratory, Department of Materials Science & Nanotechnology, Yogi Vemana University, Kadapa, Andhra Pradesh, India
e-mail: shankar@yogivemanauniversity.ac.in

S. Balakumar et al. (eds.), *Nanostructured Materials for Environmental Applications*, https://doi.org/10.1007/978-3-030-72076-6_1

124. Zhang, H., Wang, X., Li, N., Xia, J., Meng, Q., Ding, J., & Lu, J. (2018). Synthesis and characterization of TiO_2/graphene oxide nanocomposites for photoreduction of heavy metal ions in reverse osmosis concentrate. *RSC Advances, 8*, 34241.
125. Ghafoor, S., Hussain, S. Z., Waseem, S., & Arshad, S. N. (2018). Photo-reduction of heavy metal ions and photo disinfection of pathogenic bacteria under simulated solar light using photosensitized TiO_2 nanofibers. *RSC Advances, 8*, 20354.
126. Du, Y., Zhang, S., Wang, J., Wu, J., & Dai, H. (2018). Nb_2O_5 nanowires in-situ grown on carbon fiber: A high efficiency material for the photocatalytic reduction of Cr(VI). *Journal of Environmental Sciences, 66*, 358–367.
127. Cui, Y., Li, M., Wang, H., Yang, C., Meng, S., & Chen, F. (2018). In-situ synthesis of sulfur doped carbon nitride microsphere for outstanding visible light photocatalytic Cr(VI) reduction. *Separation and Purification Technology, 199*, 251–259.
128. Huang, Q., Liu, Y., Cai, T., & Xi, X. (2018). Simultaneous removal of heavy metal ions and organic pollutant by BiOBr/ Ti_3C_2 nanocomposite. *Advances in Colloid and Interface Science, 254*, 76–93.
129. She, P., Li, J., Bao, H., Xu, X., & Hong, Z. (2019). Green synthesis of Ag nanoparticles decorated phosphorus doped g-C_3N_4 with enhanced visible-light-driven bactericidal activity. *Journal of Photochemistry and Photobiology A: Chemistry, 384*, 112028.
130. Zhou, Q., Ma, S., & Zhan, S. (2018). Superior photocatalytic disinfection effect of Ag-3D ordered mesoporous CeO_2 under visible light. *Applied Catalysis B: Environmental, 224*, 27–37.
131. Liang, J., Deng, J., Liu, F., Li, M., & Tong, M. (2018). Enhanced bacterial disinfection by Bi_2MoO_6-AgBr under visible light irradiation. *Colloids and Surfaces B: Biointerfaces, 161*, 528–536.
132. Zhang, B., Zou, S., Cai, R., Li, M., & He, Z. (2018). Highly-efficient photocatalytic disinfection of *Escherichia coli* under visible light using carbon supported vanadium tetrasulfide nanocomposites. *Applied Catalysis B: Environmental, 224*, 383–393.
133. Xu, Y., Liu, Q., Liu, C., Zhai, Y., Xie, M., Huang, L., Xu, H., Li, H., & Jing, J. (2018). Visible-light-driven Ag/AgBr/$ZnFe_2O_4$ composites with excellent photocatalytic activity for E. coli disinfection and organic pollutant degradation. *Journal of Colloid and Interface Science, 512*, 555–566.
134. Ma, S., Zhan, S., Xia, Y., Wang, P., Hou, Q., & Zhou, Q. (2019). Enhanced photocatalytic bactericidal performance and mechanism with novel Ag/ZnO/g-C_3N_4 composite under visible light. *Catalysis Today, 330*, 179–188.
135. Yu, P., Zhou, X., Yan, Y., Li, Z., & Zheng, T. (2019). Enhanced visible-light-driven photocatalytic disinfection using AgBr modified g-C_3N_4 composite and its mechanism. *Colloids and Surfaces B: Biointerfaces, 179*, 170–179.
136. Mathew, S., Ganguly, P., Rhatigan, S., Kumaravel, V., Byrne, C., Hinder, S. J., Bartlett, J., Nolan, M., & Pillai, S. C. (2018). Cu-Doped TiO_2: Visible light assisted photocatalytic antimicrobial activity. *Applied Sciences, 8*, 2067.
137. Ma, X., Xiang, Q., Lia, Y., Wen, T., & Zhang, H. (2018). Visible-light-driven CdSe quantum dots/graphene/TiO_2 nanosheets composite with excellent photocatalytic activity for E. coli disinfection and organic pollutant degradation. *Applied Surface Science, 457*, 846–855.
138. Birben, N. C., Tomruk, A., & Bekbolet, M. (2017). The role of visible light active TiO_2 specimens on the solar photocatalytic disinfection of E. coli. *Environmental Science and Pollution Research, 24*, 12618–12627.
139. Iqbal, T., Ali, F., Khalid, N. R., Tahir, M. B., & Ijaz, M. (2019). Facile synthesis and antimicrobial activity of CdS-Ag_2S nanocomposites. *Bioorganic Chemistry, 90*, 103064.
140. Gao, Y., Mahmoudi, B., Fakhri, A., Aghazadeh, H., Hosseini, M., & Ebrahimi, H. A. (2019). Synthesis of MnO_2/$CdTiO_3$ nano-structure for high performance photocatalysis and antimicrobial.application. *Applied Organometallic Chemistry, 33*, e5051.

Subramanian Balakumar
Valérie Keller
M.V. Shankar *Editors*

Nanostructured Materials for Environmental Applications

Springer

Editors
Subramanian Balakumar
NCNSNT
University of Madras
Chennai, India

Valérie Keller
ICPEES
University of Strasbourg
Strasbourg Cedex 2, France

M. V. Shankar
Department of Materials Science
and Nanotech
Yogi Vemana University
Vemanapuram, Andhra Pradesh, India

ISBN 978-3-030-72075-9 ISBN 978-3-030-72076-6 (eBook)
https://doi.org/10.1007/978-3-030-72076-6

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

228a

అమృతవర్షిణి

శతవసంతాల తిలక్

(1921-2021)

కవిసంధ్య
గ్రంథమాల ప్రచురణ

సంపాదకుడు
డా. శిఖామణి

Amruthavarshini - (Satavasantala Tilak)

Edited by Dr. Sikhamani

First Edition : 01-08-2021 తిలక్ శతజయంతి

No. of pages: xxiv + 430

Copies : 500

Price: Rs.350/-

Co-Editor :

Dr. N. Eswara Reddy, Associate Professor & Head
Dept. of Telugu, Yogi Vemana University, Kadapa - 516 001

Published by:

Kavisandhya Granthamala
Yanam and Hyderabad

Copies Can be had:

From all leading Book Shops (like Visalaandhra, Prajasakti, Navachetana, Nava Telangana, Navodaya & Aneka)

Sole Distribution :

Kavisandhya Granthamala
Plot No.61, Siddhartha Nagar, Vengala Rao Nagar, S.R. Nagar Post
Hyderabad - 500 038, Mobile: 9848202526
Email: kavisandhya.yanam@gmail.com
&
H.No.2-1-043, Ambedkar Nagar, Yanam Post, PIN-533464,
East Godavari Dist. Andhra Pradesh.

ISBN: 978-81-921672-4-4

D.T.P.: **Nagasri Graphics**
Kuppam -517 425; Chittoor District, A.P.
Ph.No.08570-517 825; 8500619283

Cover Design by:

Brahmam, Bhavana Graphics, Hyderabad
Mobile: 9848254745

Inner Art by: **Bapu**

Printing at:

M/s Vijayavani Printers,
Chowdepalle - 517 257; Chittoor Dist.A.P.; Ph. No.08581-257234

69. మనిషిని ప్రేమించిన కవి తిలకుడు

- డా॥ ఎన్. ఈశ్వర రెడ్డి

భావాభ్యుదయ కవిగా, అనుభూతివాదిగా, ఇజం అనే ప్రిజమ్‌లో చిక్కుబడిన రచయితగా తెలుగు సాహితీలోకంలో స్వేచ్ఛావిహారం చేసినకవి దేవరకొండ బాలగంగాధర తిలక్. కృష్ణశాస్త్రి భావుకలోకాలలో విహరించి, శ్రీశ్రీలా సమాజంలోని దుర్భరపరిస్థితులపై యుద్ధంచేశాడు. గొప్ప సౌందర్య వంతమైన భావుకత ఒక పక్క, సామాజిక విషాదాలు మరొక పక్క కవిత్వంలో తొంగిచూస్తాయి. 'బాధాసర్ప దష్టులైన మనుషులను ప్రేమించడం తిలక్ కవిత్వంలో స్పష్టంగా కనిపిస్తుంది. శ్రీశ్రీ చెప్పినట్టు 'కవితాసతి నొసట నిత్య రసగంగాధర తిలకం'గా నిలిచిన తిలక్ కవితా చందనశాలలో మానవత్వాన్ని గుభాళింప చేశాడు. 'బ్రతుకు సీమలలోన/పైరునాటగ నేను/ చలువ కన్నీటి మళ్ళకు / చెలువుటందాల విత్తులకు / పరమేశ్వరుని మించి / భిక్ష మడిగిన దేనె / కరుణతో స్వర్లోక పరమనాదమ్ము / ఈ జీవవేణువు నింపవోయీ! ఈ మూగ గొంతులో మీటవోయీ! (మూగనోము, ప్రభాతము-సంధ్య) అని తన కవిత్వానికి సంకల్పం పలుకుతున్న తిలక్, ఆ లక్ష్యాన్ని ఎక్కడా అలక్ష్యం చేయలేదు.

అట్టడుగుమనిషి, బాధలతో బాగా నలిగిపోయిన మనిషిపడే వేదనకు ప్రతిబింబమై నిలిచి 'కదులునా కన్నీట చెదిరిపోయిన పడవ సత్యాలయమ్ములో స్వామి చరణ సన్నిధికి' అంటూ మూగవేదనను వినిపిస్తాడు. 'సడిలేని వేదనకు, వెలలేని యర్పణకు' అక్షర రూపంకూర్చి ఆలోచింపచేస్తాడు. "నీదు కన్నీరు / నిఖిల భాగ్యమ్ము! నిస్త్రాణ జగతికి/ నిషాగొల్పు మధువోయి" (కవి కన్నీరు - ప్రభాతము-సంధ్య) అంటాడు. కవి గుండెలోని కన్నీరు కలం ద్వారా ద్రవిస్తుంది. ఆ కన్నీరు ఒట్టి వైయక్తికం కాదు. దీనుల బాధలను చూసి రోసి పోటెత్తిన చైతన్య తరంగాలు. ఆ స్పందనలు లేకుంటే కవి మనిషి పట్ల ఆత్మీయుడు కాలేడు. పరుల బాధలను మనుసులోకి తీసుకోలేడు. అదే ఆర్ద్రత, అదే స్పందన, అదే వేదన, అదే రోదన. ఇవన్నీ కవిలో నుండి పలకాలంటే అతనిలో కన్నీళ్ళు ఉండి తీరాలి. అదే ద్రవించే మనసు. స్పందించే హృదయం. అలాంటి సున్నితమైన స్పందనలను కవి కోల్పోకూడదని చెప్పడంలో, తిలక్ కవిగా తన వ్యక్తిత్వాన్ని, ఆలోచనా దృక్పథాన్ని ప్రకటించుకున్నాడు. ఆ తత్వంలోంచే అక్షరాలను దయాపారవతాలుగా, విజయ ఐరావతాలుగా, అందమైన ఆడపిల్లలుగా మలిచాడు. 'మేం మనుష్యులం/ మేం మహస్సులం / మాకు దాస్యంలేదు/ మాకు

శాస్త్రం లేదు... మేం పరపీడన సహించం / మేం దివ్యత్వం నటించం' అనగలిగేంత సగటు మనిషి తాలూకు ఆలోచనలోంచి అక్షరాన్ని పండించిన కవి తిలక్.

'...అనంత విశ్వపు గదిలో ఆకలితో ఆడుకుంటూ / ఆకలినే ఆరగిస్తూ ఆవరిస్తూ... కూరుచున్న కబోదికి, పంగుకు, వికలాంగుకు, నిస్సంగుకు, నీర్సాంగుకు' ప్రభుత్వం అండగా నిలుస్తుందా?! అనే ప్రశ్న భిక్షగాళ్ళ జీవితంలోంచి వచ్చింది. 'పేదరికము పెద్ద వింత విద్యాశాల దానియందు లజ్జ కానరాదు' అని జాషువా అంటే, ఆకలే సర్వస్వంగా మిగిలిపోయిన అతిపేదరికం గురించి తిలక్ రాస్తాడు. 'నల్లని మట్టిదిబ్బలా, చెల్లని పెంటకుప్పలా' మారిపోయిన భిక్షకుల శరీరాలు ఛీదరింపులకు గురవుతున్న విషయాన్ని గుర్తుచేస్తూ, 'మాదాకవళం అని మహదానంతో దోసిలి పట్టెను / తలపగిలింది కలచెదిరింది' అంటాడు. పూట గడవని ఆకలి పీడితులు తిలక్ కవిత్వంలో తారసపడతారు.

కూడులేని లోకంగా, గుండెలోతు తాపంగా, సోమయాజి శాపంగా భూమి 'అడుగులోకం' మారిపోయిందని, ఇది అస్తి మూల పంజరాలకు, ఆర్తారవ మందిరాలకు స్థానంగా మారిపోయిన విషాద మానవలోకాన్ని బెంగాల్ కరువు పరిస్థితుల్లో దర్శించిన తిలక్ 'పెద్దలున్న మిద్దెలను, పలకలేని గులకరాళ్ళను' ఎండగడతాడు. అంటే సాయంచేయని ధనవంతులను, కాపాడలేకపోయిన దేవుళ్ళను నిందిస్తాడు. మనిషి పక్కనిలిచి, మనిషివైపు మాట్లాడే కవికి సంపన్నుడైనా, దేవుడైనా ఒక్కటే. న్యాయం, ధర్మం పాటించని ఎవరినీ ఉపేక్షించడు. ఈ క్రమంలో ఈ దేశంలో పొంగే దైన్యాన్ని చిత్రిస్తాడు.

ఆకలితో అల్లాడి మర్రిచెట్టు కింద మరణించిన ముసలివాణ్ణి, నీరంధ్ర వర్షానవంతెన కింద ప్రసవించి మూర్ఛపోయిన నిండు గర్భిణిని, ముంజేతులతో కన్నీళ్ళు తుడుచుకుంటూ తిండిలేక విలపించి నిద్రబోయిన పసిబాలుణ్ణి, పిల్లలకు గంజిపోసి నిరాహారుడై ఆఫీసుకు వెళ్తున్న వృద్ధుడైన ప్యూన్‌ను, క్షయగ్రస్త భార్యను బతికించుకోలేక రోదిస్తున్న భర్తను, ఇంకా ఇంకా కళ్ళముందు మూర్తీభవించిన దైన్యాన్ని, హైన్యాన్ని క్షుభితాశ్రు కల్లోల నీరధుల్ని, గచ్ఛత్ శవాకార వికారుల్ని చూసిన తిలక్ ఇలాంటి పరిస్థితులు కళ్ళముందు ఉంటుంటే, ఈ దేశాన్ని, దీని ఔన్నత్యాన్ని కీర్తించలేనని, కృత్రిమ వేషాన్ని అభినయించలేనని, మనిషిగా తలెత్తుకు తిరగలేనని తెగేసి చెప్తాడు. ఆయనలోకంలో ఒక్క నిరుపేద ఉండకూడదు. ఒక్క మలినాశ్రువు కనిపించకూడదు. ఒక ప్రేగు ఆకలితో అలమటించకూడదు. ఒక పసిపాప పాలకోసం ఏడవకూడదు. ఒక తల్లి కూడా కన్నీళ్ళు పెట్టుకోకూడదు. ఒక క్షత దుఃఖిత రోదన చెందకూడదు.

లాంటి మనుషులున్న సమాజం తిలక్ కల. బాధలు కన్నీళ్ళు లేని మనిషిని చూడడం తన లక్ష్యం.

బల్ల పరుపుగా పరుచుకున్న మధ్య తరగతి జీవితాల్ని గొంగళి పురుగులుగా వర్ణిస్తాడు. సగం తిన్న కలల్ని, సగం చచ్చిన ప్రాణాలను మధ్యతరగతికి ప్రతీకగా చేసి భయాల మాటున ఏడుపు కొండల మాటున 'నలిగిపోతున్న చిన్న చిన్న సంసారుల్ని, వారి వెతల్ని చూపిస్తాడు. ప్రతి చిన్న విషయానికీ అదిరిపడి బెదిరిపోయే తత్వం నుండి మనిషి బయటపడాలని కోరుకుంటాడు.

తన లోకంలోని సామాన్య మనుషులను దీనత్వంలోకి నెట్టేసిన 'పెద్దపులులను, జరీ కండువాలను, విరుదాంకితమైన సువర్ణ పతకదారులను నిలదీస్తాడు. 'బొడ్డుకు బదులు పొట్టను కోసిన అవివేకపు మంత్రసానుల వల్ల 'చరిత్ర శిశువు' నెత్తురుతో ద్రోగాడుతోందని, వక్రించిన వర్తమానానికి మన పెద్ద మనుషులే కారణమంటాడు. మానవ వికాసాన్ని శ్రేయస్సును మరిచి ప్రవర్తిల్లే సైన్సు లేదా శాస్త్రాలు ఎందుకూ కొరగానివిగా మిగులుతాయంటాడు.

భూమి తన చుట్టూ తాను తిరుగుతూ, ధనవంతుడి చుట్టూ తిరగడాన్ని తిలక్ బాగా గ్రహించాడు. ఉత్తర ధ్రువంలా ఆశ, దక్షిణ ధ్రువంలా విధి, రెండింటి మధ్య బంతిలా ఎగిరిపడుతున్న మనిషి ప్రహసనాన్ని కళ్ళారా చూశాడు.

తిలక్ మానవ వికాసాన్ని కోరుతున్నాడు. వినాశాన్ని ప్రతిఘటించాడు. ఈ ప్రతిఘటన ప్రార్థనగా మారింది. అందుకే 'దేవుడా రక్షించు నా దేశాన్ని' అంటూ సగటు మనిషి బ్రతుకు దిగజారిపోవడానికి కారకులైన వారిని ఎత్తిచూపిస్తాడు. 'పవిత్రులు, పతివ్రతలు, పెద్దమనుషులు, రెండు నాల్కల ధోరణిగలవారు, లక్షలాది దేవుళ్ళు, వారి పూజారులు, సిద్ధాంత కేసరులు, సిద్ధులు, శ్రీమత్ గురుపరంపరలు' సాధారణ మానవుణ్ణి నాశనం చేస్తున్న వారిగా గుర్తిస్తాడు. పవిత్రత పేరుతో జనాన్ని విడగొట్టి కుల, మత సంప్రదాయాలను తెచ్చిన వాళ్ళు పతివ్రతల పేరుతో స్త్రీలను సంప్రదాయ ఛట్రంలో ఇరికించినవాళ్ళను, పెద్దమనుషుల పేరుతో దోపిడీలు చేస్తూ శ్రమ జీవుల్ని అణచివేస్తున్న వాళ్ళను, ఏ ఎండకు ఆ గొడుగు పట్టి పబ్బం గడుపుకునేవారిని, మనుషుల కన్నా రాళ్ళు రప్పలకు ప్రాధాన్యం ఇప్పించిన దేవుళ్ళను, పాపం పుణ్యం పేరుతో మనుషులను లోబరుచుకుంటున్న పూజారుల్ని, గొప్ప గొప్ప ప్రసంగాలు చేసి తమకు బానిసలుగా చేసుకుంటున్న మత గురువులను, మహోత్సాలు చూపించినట్టు ఏమార్చే సన్యాసులను, భక్తి ముసుగులో సంపదను పోగేసుకొని పీఠాలు స్థాపించి గురుపరంపరగా జనాన్ని మోసగిస్తున్న పీఠాధిపతులను ఈ దేశ దౌర్భాగ్యానికి కారకులుగా చెప్పడంతో తిలక్‌కు ఈ దేశం పట్ల, సగటు మనిషి పట్ల ఉన్న మానవీయ

దృక్కోణం అర్థమైపోతుంది. ఆకలి బాధలూ, ఆందోళనలూ, సమస్యలూ అన్నీ పైన పేర్కొన్న వారి క్రియల ముందు చిన్నవే అంటాడు. నలువైపులా అంధకారం ఉన్నా మంచి గంధంలాగా పరిమళించే మానవత్వమే మనిషికి గొప్ప అలంకారంగా భావిస్తూ, దాన్ని చెడగొట్టే కుటిల మానవులు మనకు అక్కర్లేదనే సందేశాన్నిస్తాడు.

'మానవుడై నీవు చాచిన హస్తాన్ని
దానవుడై వాడు నరికిన సమస్తాన్ని' అర్థం చేసుకున్న తిలక్ 'స్వార్థం, ద్వేషం, క్రౌర్యం' ప్రేరేపించే నాగరికతను వ్యతిరేకిస్తాడు. సత్యం శాంతి సౌందర్యాలను ఆకాంక్షిస్తూ మానవీయ కవిగా మనిషిని ప్రేమించాడు మన కవి తిలకుడు.

లోకబాల్య తిలక్

"లోకమాన్య" బాలగంగాధర తిలక్‌ను అందరూ ఎరుగుదురు. మన తెలుగు తిలక్‌ను తెలుగు వారిలో ఎంతమంది ఎరుగుదురో చెప్పలేను. అతను చనిపోయినప్పుడు కొన్ని పత్రికలు ఆ వార్త ప్రచురించాయి. కొందరు మిత్రులు గద్యాలలోను, పద్యాల లోను, తమ సంతాపం ప్రకటించారు. ఆ మధ్య ఒక సాహిత్య పత్రిక తిలక్ స్మార కార్థం ఒక సంచిక వెలువరించింది. మళ్ళీ ఇప్పుడీ సంచిక వెలువడుతోంది.

మిత్రుడు శ్రీ కాళిదాసు దీనికి సంపాదకీయం వ్రాయమని అడిగినప్పుడు నేను కొంచెం సంకోచించాను. ఎందుచేతనంటే తిలక్‌ను రెండు మూడుసార్లు కంటే ఎక్కువ పర్యాయాలు నేను కలుసుకోలేదు. అతని రచనలన్నీ చదివానని కూడాచెప్పలేను. 'అయినా నువ్వే ఇది వ్రాసితీరా'లవి మిత్రుడడిగితే సరే అన్నాను.

తీరా వ్రాయాలని కూర్చుంటే ఏమి వ్రాయడానికి తోచలేదు. "లోక బాల్య" అనే బిరుదం మాత్రం స్ఫురించింది. చనిపోయే క్షణందాకా మానవుని బాల్య దశలోని అమాయకత్వాన్ని తిలక్ నిలుపుకున్నాడనే నా ఉద్దేశం. కాని అతని రచనల్లో మాత్రం పరిపుష్టమైన పరిణతి వుంది. ఇంగ్లీషు కవి విలియం బ్లేక్ తన పాటలలో కొన్నిటిని "అమాయకత్వపు పాటలు" అనీ, మరి కొన్నిటిని "అనుభవపు పాటలు" అనీ అన్నాడు. తిలక్ కవితలో ఈ అమాయకత్వమూ, అనుభవమూ రెండూ ఒకేచోట గోచరిస్తాయి.

-శ్రీశ్రీ

నవత సంపాదకీయం నుండి ఏప్రిల్-జూన్, 1968.

2020

Metal-Chalcogenide Based Core/Shell Photocatalysts for Superior Hydrogen Generation

Water splitting into gaseous hydrogen and oxygen utilizing sunlight and photocatalyst is a sustainable way for cleaner energy production. Development of efficient and stable photocatalysts for enhanced rate of H2 generation from water, water containing inorganic or organic sacrificial agents is the current research trend. In order to overcome photocorrossion property of metal chalcogenides, wrapped it with shell made-up of TiO2 or NiO as thin-layer. Parametric studies facilitated identification of best experimental conditions and demonstrated enhanced H2 production besides catalytic stability, Time on steam, recyclability and reusability.

V. Navakoteswara Rao was born on 14th May 1990 in Nagulapadu, Andhrapradesh state. He was graduated MS in Analytical Chemistry April 2014 from Sri Venkateswara University, Tirupati. Further Awarded PhD in the field of design and developments of photocatalyst for efficient H2 efficiency from Yogivemana University, Kadapa, India.

9 786203 930658

V. Navakoteswara Rao, M. V. Shankar

V. Navakoteswara Rao
M. V. Shankar

Metal-Chalcogenide Nanophotocatalysts for Superior Hydrogen Generation

LAP LAMBERT Academic Publishing

Imprint
Any brand names and product names mentioned in this book are subject to trademark, brand or patent protection and are trademarks or registered trademarks of their respective holders. The use of brand names, product names, common names, trade names, product descriptions etc. even without a particular marking in this work is in no way to be construed to mean that such names may be regarded as unrestricted in respect of trademark and brand protection legislation and could thus be used by anyone.

Cover image: www.ingimage.com

Publisher:
LAP LAMBERT Academic Publishing
is a trademark of
Dodo Books Indian Ocean Ltd., member of the OmniScriptum S.R.L Publishing group
str. A.Russo 15, of. 61, Chisinau-2068, Republic of Moldova Europe
Printed at: see last page
ISBN: 978-620-3-93065-8

259-248

MANAGEMENT EDUCATION IN INDIA: ISSUES & CHALLENGES

Editors

Dr. S. Subba Reddy

Dr. A. Amruth Prasad Reddy

2259-248

Management Education in India: Issues & Challenges

First Edition - June 2021

ISBN : 978-93-90631-71-1

Price: ₹ **1250.00**

Paramount Publishing House
A-531, H.No. 4-32-521, Phase-1, Allwyn Colony, Kukatpally, Hyderabad - 500 072.
Ph. : 7799000082.

Sales Offices :
Hyderabad
A-531, H.No. 4-32-521, Phase-1, Allwyn Colony, Kukatpally, Hyderabad - 500 072.
Ph. : 7799000082.

New Delhi
C/14, SDIDC Work Centre Jhilmil Colony, New Delhi-100095. Phone: 011-2162365.
paramountpublishers@gmail.com | alluriasr2005@yahoo.com
Published by Krishna Prasad Alluri for Paramount Publishing House and printed by him at Sai Thirum Printers.

Contents

Chapter- 41

UG Students' Perception on Management Education (M.B.A)

Dr. S. Subba Reddy[1], Mr. Y. Nagendra[2]

[1]Assistant Professor, Department of Business Administration, Y.V. University, Kadapa.
[2]Research Scholar, Department of Business Administration, Y.V. University, Kadapa.

Abstract

It has been observed since a decade the demand for MCA course has been decreased whereas the demand for MBA Couse has got boom. In recent era most of the UG students are showing their keen interest to join into the Management courses irrespective of their UG background. In fact, the reason behind the huge response of admisston into the Management course is due to more job opportunities and also MBA course can create more job providers than job seekers. The present study focus on assessing the perception of UG final year students on Management education.

Keywords: Management Education, Employability skills, Job providers.

I. Introduction

Master of Business Administration (M.B.A) is one of the most popular qualifications in management education and it became almost requisite to everyone who are looking to lead a professional life and to excel in the business world. The ability to think creatively, analytically and strategically, complemented by the intra-personal skills and inter-personal skills encourages the corporate companies to hire MBA graduates. MBA can also help the people who wants to lead independent professional life and have a goal to become job provider rather than job seeker. As we are listening from many decades that our India is the developing country. One the major reason for this is huge unemployment rate. To reduce unemployment rate, definitely there is a need to create more entrepreneurs in rural areas.

Literature Review

C. Karthick & Akhil augustain (2015), doing higher studies would be good for student has they would get more knowledge and personal development would help them to get better job opportunities.

Bhavana R. Shetty & Rajashree Gujarathi (2013), indicated that the student's perceived high quality of education if processes and outputs are satisfactory.

Quacquarelli (2005) indicted that the MBA is a significant investment in one's personal development as it affects the stream of income for an MBA graduate.

ISBN: 978-93-90631-71-1

VI. Suggestions & Conclusion

Suggestions

1. It is recommended to institutions running MBA program need to give awareness to the UG students regarding the fruitful benefits of pursuing MBA.
2. The institutions need to focus on developing the skills required to meet industry expectations.
3. More workshops need to the planned by the institutions to enhance entrepreneurial skills.

Conclusion

From my study I conclude that majority of the UG students are willing to Pursue MBA program irrespective of their degree. Only minor percentage of the students are perceiving that MBA is a professional Course. So proper action to be taken by the institutions offering MBA program.

References

[1] Ainin Sulaiman & Suhana Mohezar, (Jan 2008) " Quality in an MBA programme: students' perceptions" IJME, Vol. 7(2): 01-08

[2] Bhavana R. Shetty & Rajashree Gujarathi, (July 2013), " Students' perception about Management Education in India and USA" MERC Global's International Journal of Management, Vol. 1 (1): 01-14.

[3] C. Karthick & Akhil augustian, (March 2015) " A study on students perception and satisfaction towards MBA program in Coimbatore" IJMCI, Vol. 2 (2):574-577.

[4] Kothari C.R., " Research Methodology" models and techniques, second edition, new age publishers, New Delhi.

[5] www.googlescholar.com

[6] www.scribd.com

[7] www.wikipedia.com

ISBN: 978-93-90631-71-1

Chapter- 37

Scenario of Business and Management Studies in Andhra Pradesh: A Case Study

Shabreen Shaik[1], Dr. P. Saritha[2]

Student, Annamacharya PG College of computer studies, Rajampet, Kadapa
Assistant Professor and Research Supervisor, Department of Business Management,
Yogi Vemana University, Kadapa.
E Mail: shabreenshaik666@gmail.com[1], sarithamsg@yahoo.co.in[2]

Abstract

Andhra Pradesh is blessed with numerous educational institutions and colleges which extend hands for making the state more literate state. Especially there are a greater number of business and management colleges in Andhra Pradesh. Management education provides better communication skills, self confidence, strategic thinking. An MBA (management education) as a professional business degree, it gives a number of benefits both in expected and unexpected ways in life. In fact, those benefits often extend beyond career and professional goals. Hence, majority of the pupils in Andhra Pradesh are choosing management education as promising degree program to ensure a bright future and career. The present study concentrates on the current status of management education in AP. It also discusses the reasons for changing condition of management education in Ap. This paper explores some suggestive measures.

Key words: Management education, professional degree, strategic thinking, bright future and career.

"The Conventional definition of management is getting work done through people, but real management is developing people through work".

Introduction

Management education is important for creating efficient managers, who have excellent administrative, technical, communication and conceptual skills for performing all the functions of management. The value of management to societies is almost incalculable. At present the managers are not able to deal with the problems of business organizations in the real world. The Indian management education is still facing a number of challenges. Management education is the need of the hour today to focus on the quality of management education in the country.

Education is the primary agent of transformation towards sustainable development and increasing people's capacities to transform their visions into reality. In the modern economic scenario all over the world "Management" as a stream of education and training has acquired new dimensions. Management is an exciting field where you can have an immediate impact on

ISBN: 978-93-90631-71-1

Management education need to be holistic, targeted and customized with aim to remove the gap that exist between industry requirements and academic curriculum focusing on attitude, corporate awareness, grooming and developing managerial skills.

Industry interaction has to be strengthened by inviting senior person from industry to deliver lecture and ensuring student get associated with live industry projects. Learning needs to student centric resulting in development in all areas such as analytical reasoning, lateral thinking, and solving case studies and as such. Mentoring and carrier counseling has to be introduced Most B-schools claim to have it but only as a lip service. If Management education in India has to really extend its image on international scenario beyond Aim's, institutes, industry and government has to work in alignment to improve quality of management education.

In order to provide quality management education several efforts are needed to be made by the educational system as a whole and the faculties. It is concluded that if the government considers and implements the above said suggestions, the improvement of quality management education is possible in Andhra Pradesh.

"EDUACTION IS NOT THE LEARNING OF FACTS BUT THE TRAINING OF MINDS TO THINK"

References

[1] Management Education Challenges Ahead-An Indian perspective. NeetaBapori-kar Himalaya Publishing House 2009.

[2] Hindu speaks on education.

[3] Three Pillars of Quality Management Education in India in the 21st Century Vigna Oza and Swaty Parab - International Journal of e-Education, e-Business, e-Management and e-Learning, Vol. 2, No. 1, February 2012.

[4] Concept of Business School Management Education Prepared by Dr.A.Chakravarthy.

[5] Management Education in India: Issues & concerns- Prof. Goutam G. Saha- Journal of information, knowledge and research in business management and administration.

[6] www.google.co.in

[7] www.ugc.ac.in

[8] www.aicte.co.in

[9] www.insightiitb.org

[10] www.livemint.com

ISBN: 978-93-90631-71-1

Chapter- 30

Management Education in India: The Changing Scenario & the Way Forward

S. Ismail[1], Dr. Y. Subbarayudu[2]

[1]Research Scholar, Department of Management Studies, YVU-Kadapa
[2]Assistant Professor, Department of Management Studies, YVU-Kadapa

Abstract

The Indian economy is growing at a fast pace creating considerable opportunities in the field of IT, manufacturing, pharma, etc. But we also have to realize that a rapid economic growth through these sectors can happen only with the help of amply skilled managers, which will give the country a desired impetus for the development of each sector. But the biggest challenge for businesses operating in the dynamic environment of today is the need of competent managers. The Indian government liberalized the business education market over the 1990s resulting in a rapid growth of business schools offering programs at both graduate and post graduate levels. The purpose and value of MBA (Master of Business Administration) degree has always been under the critic's scanner. There are many issues and challenges in Management Education in India. Many studies have also undertaken and addressed on Funding problem, Institutions proliferation, Faculty Vacuum, Curricula, Poor Research and Publication, Geographic Inequalities, Increased Competition, Lack of Indigenous Reference Material, Lack of Industry Linked Training & Mentorship, Quality and Development of Faculty, Selection Process of Students and Ignorance of Business Ethics. But they have not focused on Affiliation System, Classroom Diversity and Industry veterans without a PhD.

Keywords: Management Education, Affiliation System, Classroom Diversity and Industry veterans without a PhD

Introduction

"The Indian economy is growing at a fast pace creating considerable opportunities in the field of IT, manufacturing, pharma, etc. But we also have to realize that a rapid economic growth through these sectors can happen only with the help of amply skilled managers, which will give the country a desired impetus for the development of each sector. This is the reason why more and more business management schools are springing up in the nation. Management education is at its boom in India with more than 1000 business schools offering the same.

Besides, India's new educational policy - Foreign Universities Bill further means a hike in the number of foreign business schools in the country leading to better education with the exchange

ISBN: 978-93-90631-71-1

prescription of 'knowing' 'doing' 'being' provides something instructive. 'Doing' skills have been neglected for years. Correct it and we will have more job ready graduates.

Indian management institutes need to struggle hard to introduce several adaptations. Test is menace, and India has an examination system instead of education system which limits the overall development of students. MBA curriculum must be infused with multidisciplinary, practical and ethical equations like Rural Immersion programs and Research project for organizations reflecting the complex challenge that the business leaders face and personality development, communication and soft skills training in the affiliated colleges. Accreditation agencies and corporate veterans also play a vital role in enhancing the quality of the education. College Managements should also focus on classroom diversity and selection process of the students.

References

[1] https://www.jklu.edu.in/blog/management-education-in-india-the-changing-scenario-the-way-forward/

[2] Shubhendu S. Shukla, " Management Education in India Issues and Concerns" "International Journal of Education and Learning "Vol.2, No.2 (2013), pp.15-26. http://dx.doi.org/10.14257/ijel.2013.2.2.02

[3] Yasir Arafat ELAHI, Anisur REHMAN "A Detailed Study on Issues and Challenges of Management Education in Digital Age with Special Reference to Lucknow District" "Romanian Journal for Multidimensional Education" Volume 5, Issue 1, June (2017), pp:215-233, ISSN: 2066 - 7329 (print), ISSN: 2067 - 9270 (electronic)

[4] Neetu Choudhary and Ravin Kadian, " Management Education In 2020: Issues, Challenges, And Opportunities", "Journal of Radix International Educational and Research Consortium", Volume 2, Issue 9 Sep(2013) ISSN: 2277 - 1018

[5] Ms. Sumedha Tuteja and Ms. Sonal Mehta, "Challenges in Management Education in India" https://www.researchgate.net/publication/3257112, January 2015.

[6] Dr. J Balamurugan and L Priya Dharsini, "Issues and challenges of management education in India: A global review" "International Journal of Applied Research" "Vol.3(3) (2017), pp 162-165, ISSN Print: 2394-7500, ISSN Online: 2394-5869, Impact Factor: 5.2

[7] Dr. D. Madan Mohan, " Emerging issues and challenges in management education in india" "Journal of Advance Management Research" Vol.05 Issue-04, October (2017), pp 342-346, ISSN: 2393-9664, Impact Factor: 4.598

[8] Ayesha Khatun and- Sajad Nabi Dar, "Management education in India: the challenges of changing scenario" "Springer Nature Singapore Pte Ltd", Received: 29 March 2019 / Revised: 20 May 2019 / Accepted: 13 June 2019, doi.org/10.1007/s41959-019-00010-7.

ISBN: 978-93-90631-71-1

Chapter- 29
Management Education in India: Issues & Challenges

R. Uma Devi[1], Dr. A. Amruth Prasad Reddy[2], G. Surekha[3]

[1]Research Scholar, Yogi Vemana University, Kadapa.
Research Supervisor, Yogi Vemana University, Kadapa.
[3]Assistant Professor, CBIT College, Proddatur.

Abstract

Management education in the current scenario seems to be diversified across the spheroid which plays a decisive role when talking about qualified education. The major issues lying around us in terms of education like the personality development sessions, faculty development programmes , employment opportunities and compensation for the MBA graduates are not up to the mark .Now a day's B-schools are facing a lot issues because of lack of quality education , developing worthy curriculum , poor technology for the class room lectures and governance and accountability . Here we can find indigent regulatory frame work or malfunctioning of regulatory bodies . It seems there is a shortage of context and concept in the education and gives more priority for the communication dealing with lot of seminars and group discussions. Here in this paper we are analyzing the current scenario of management education and remarkable insights that may be valuable for the benefit of stakeholders.

Keywords: Management education , lack of quality education , worthy curriculum, B-school governance, malfunctioning of regulatory bodies.

Management Education in India :- An Overview

Today's Indian Economy has been changing at a fast pace with the emerging era of Pharma, IT and Manufacturing sectors but the lack of quality production has been identified in every sector that is amply because of skilled managers to give our country a desired impetus for the development of each sector. Thus identified the importance of management education which springs up the budding managers in our nation. Now in India there are about 1000 B-Schools offering the same.

Introducing new educational policy-foreign universities Bill means that foreign business schools in the country have been listed as a leading B-Schools, however it was surprised to know that Indian B-schools are far better than any other B-schools among Asian ones, why because Indians discuss the global ideas and class room lectures even the brain storming sessions also in English unlike other Asian countries B-schools like China, Japan where they teach in their national languages only.

ISBN: 978-93-90631-71-1

Conclusion

Management education across the globe is facing a unique crisis of relevance in th contemporary scenario. All the aspects of Business Education such as quality of MBA aspirant curriculum, business research, quality of research publications, industry-institute interface management development programmes, faculty development programmes, placements compensation packages of B-school graduates, career development trajectory of alumni, diversit among faculty as well as students, governance and accountability, etc. are under critical scanner Indian B-schools are not untouched by the contextual compulsions of the Management education in the international arena.

References

[1] A. Conger and R. M. Fulmer, "Developing your leadership pipeline", Harvard Business Review, (2003) December

[2] AACSB International, "The value proposition for Business Education", CIME Task force report; Ethics Education in Business Schools, (2004).

[3] AICTE Hand Book year 2006-07, (2006).

[4] A. K. Penthoi and S. Dash, "Indian Higher Education in the Era of Globalization: Challenges & Quality management strategies", University News, (2005) December

Bibliography

- https://theknowledgereview.com/recent-trends-in-management-education-in-india/
- http://www.knowledgecommission.gov.in/downloads/documents/wg_managedu.pdf
- https://www.jkdu.edu.in/blog/management-education-in-india-the-changing-scenario-the-way-forward/
- https://idronline.org/no-detention-why-did-a-popular-policy-get-scrapped/?gclid=EAIaIQobChMIhYz-kKSP6AIVIYePCh2newAqEAMYAiAAEgIGbPD_BwE
- http://apps.aima.in/ejournal_new/articlesPDF/RitikaMahajan_Article.pdf
- https://www.aicte-india.org/downloads/nkc.pdf
- https://www.indiaeducation.net/management/indian-scenario.aspx

255

Chapter- 28

Management Education in India - An Overview

Dr. S. Subba Reddy[1], K. Maddileti[2]

[1]Assistant Professor & Co-ordinator, Dept of MBA, Yogivemana University, Kadapa
[2]Research Scholar, Dept of MBA, Yogivemana University, Kadapa

Abstract

The Indian economy is growing at a rapid pace generating significant opportunities in the fields of IT, manufacturing, pharmaceutical, etc. But we also need to understand that a rapid economic growth through these sectors can only happen with the help of highly skilled managers, which will give the country a necessary impetus for each sector's development. This is the reason why the nation is springing up more and more business management colleges. Management education in India is booming with over 1000 business schools providing the same.

In the 1990s, Indian Government liberalized business education, resulting in rapid growth of Management Institutes offering both graduate and undergraduate levels to programmers. Indian management education is almost a replica of US business education, especially in the field of pedagogy, curricula, industry interface and academic research models, but it is observed that Indian management institutes are struggling hard to implement multiple adaptations due to differences in the work culture structure. As a result of globalization, many shifts are found in the functioning of industries worldwide requiring multi-skill manpower rather than merely knowledge-oriented. Top Institutes of Management are continually changing content & distribution modes. This paper examines the insights and overview of management education in India.

Keywords: Education, management, Indian economy, business, globalization

Introduction

The Indian economy is growing at a rapid pace generating significant IT, manufacturing, pharmaceutical, etc. opportunities. But we also need to understand that rapid economic growth through these sectors can only come about with the aid of highly skilled managers, which will give the country a necessary impetus for each sector's development. This is the reason why the nation is springing up more and more business management colleges. Management education in India is at its peak with over 1000 business schools providing the same.

In addition, India's latest educational policy-Foreign Universities Bill further signifies an increase in the country's number of foreign business schools leading to better education through global exchange of ideas. However, you will be surprised to know that, for that matter, an Indian

ISBN: 978-93-90631-71-1

number of B-schools but it hardly appears to be in line with the challenges posed by the Indian industry's globalization.

This only focuses on equipping students with hard skills and unfortunately ignores the as much as if not more vital part of management education, i.e. soft skills imparting. It makes the managers inefficient in times of crisis due to their limited research vision. The corporate dog-eat-dog world needs outstanding results from day one itself. It puts enormous pressure on MBA students to show their ability right from the start of their careers.

There are still milestones and business challenges ahead. In order to meet the upcoming requirements of developing and raising human capital as a competitive advantage for an enterprise, our new corporate generation WELL-EQUIPPED needs to move forward and create effective synergy between corporate necessities and educational standards. It goes without saying that this is a disturbing warning for our education system to concentrate on key areas rather than distracted students with irrelevant things.

India's government recently accorded the IIMs autonomous status. They are now permitted to create centers outside the country. This is in complete reversal to the Government's earlier approach. So, e.g. IIM Bangalore was not allowed to open its Singapore center (the government rejected its request on the ground that its Association Memorandum did not approve the Institute to open campuses abroad).

More such radical transitions are required. Those in charge of management education affairs need to think out of the box and apply innovative and distinctive ideas. Fostering creativity is the need of the hour. We need imagination and practicality that is being combined into one. Total Quality Management should be the priority. What matters is not the degree, the point is what one has learnt. The day we start focusing on imparting knowledge instead of awarding a degree, the entire management education sphere will be revolutionized. Training for company in India awaits that day.

ISBN: 978-93-90631-71-1

Chapter- 26
Management Education in India: Issues & Challenges

Dr S Subba Reddy[1] A Raghavendra Prasad[2]

[1] Asst Professor, [2] Research Scholar
Yogivemana University, Department of Management Studies, Yogivemana University, Kadapa

Abstract

Education is a potential driver of growth and is the best tool for minimizing economic condition, getting better health, reducing gender inequality, increasing harmony, and maintaining firmness. The main objective of the present paper is to know the evolution of management education in India & to identify its important issues and challenges. In India higher education especially Management education is witnessing a exponential growth in terms of number of institutes imparting management education which are usually termed as Business School. The paper describes the rise of management education in India, relevance and significance, different issues and challenges faced by B-schools in India and strategies to improve with emphasis on faculty retention, faculty development, functional literacy and academic excellence. Further it tries to study emerging issues of Management education, and to find implementation of possible direction and policy towards improvement of management education in India.

Keywords: Management Education, Management, Business School

1. Introduction:

Education is defined as the learning of knowledge, Skill & practices of one group, who transfer the information from generation to generation through Mentoring, Coaching and Guidance with means of extensive research. In other words Education is the systematic process of instruction in School, Colleges and Universities that enables to practice the theory into practice. Management education is one among those which got a new dimension with this changing time. Initially Marketing, Finance and Human Resource .Management were considered as functional area of management, but now management education covers much more functional area like Operations, Information Technology, International Business, Supply Chain Management, retail and much more to add to the list.

2. Brief Evolution of Management Education:

The Evolution of management education in India dates back to the late 1940s. The first department of management studies was set up at Indian Institute of Science, Bangalore in 1948

ISBN: 978-93-90631-71-1

References

[1] Angehrn,A.&Nabeth,T.,(1997)"Leveraging Emerging Technologies in Management Education: Research and Experiences", European Management Journal, Vol.15, No.3, pp.275-285.

[2] Bandyopadhyay,R.,(1991))"Indian Management Education: Need for a Constructive Debate",Economic and Political Weekly,Vol.26,No.48,pp.M118-M122.

[3] Baumgartel,H.J., Pathan,R., Roy,B., Khandelwal,G &Rahman,A.,(1984)"Changes in Organisational Climate and Management Education, 1968 to 1981: Some Warning Signals",Economic and Political Weekly,Vol.19,No.8,pp.M15-M21.

[4] Bowonder,B. and Rao,S.L.,(2004)"Management Education in India its evolution and some contemporary issues ",available at :http://www.aima-ind.org /pdf/ Director_ Conclave_ 9_ Paper.pdf (accessed 25 October 2010).

[5] Cornuel,E.,(2005)"The role of business schools in society", Journal of Management Development,Vol.24,No.9,pp.819-829.

[6] Crowther,D.and Carter,C.,(2002)"Legitimating Irrelevance: management education in higher education in institutions", The International Journal of Educational Management, Vol.16,No.6,pp.268-278.

[7] D'Mello,B.,(1999)"Management Education: A Critical Appraisal", Economic and Political Science.

Chapter- 25

Management Education: Current Challenges and Future Perspectives

C. Sowbhagya Lakshmi[1], R. Uma Devi[2], A. Amruth Prasad Reddy[3]

[1]Research Scholar, [2]Research Supervisor

[3]Department of Business Management, Yogi Vemana University, Kadapa-516005, A.P. India

Abstract

The world and working life changing gradually and dramatically so it requires a demand of management education. An efficient management education is needed for every country as the efficient managers are required to run the corporate world. This active managers with skills ,abilities are available when they got education from good institutions. There are so many challenges faced to transformation of management education. The study going to reveal the current challenges in implementation of management education and development of management education in future and how it is important to us. The main purpose of the study is transformation of current management education into future and it identifies the present position of management education in India. The study is purely based on collection of secondary data and it uses descriptive research design .

Keywords: B-Schools, pedagogy, quality education, challenges .

History

Management is part of a civilization. Management skills are found in ancient civil Mohanzadaro and Harrapan civilization. Srimath Bagavadgeeta written many years back there found out managerial wisdom and how to avoid conflict. Great epics of Ramayana, Mahabarata, Vedas, srutis, puranas, teach us management. The Vedas like Brahmanas, Darmasutras also have details of management, wisdom, skills. Koutilya, popularly known as Chanakya, prime minister of Chandra gupta mourya famous for administration skills.

Education in India known from British rule. It is oriented towards generating of skills that can do more than think. Globalization has created many challenges in the education and created more challenges, opportunities of the world that enter into India also. It suggested think out of the box in education rather than just learning.

New era of Management education started in INDIA and formal management education was initiated 50 years back. From 1990'S onwards the management education was started and still it is going to many paradigm shifts to get right shape.

ISBN: 978-93-90631-71-1

...ferences :

Academy of Management Learning & Education (AMLE), special issue 3/2013. Theme: cross-cultural management education and learning. Chaudhary , Sarita et al., (2011) Emerging Issues in Management Education in India, VSRD International Journal of Business & Management Research, 1(3).

Balakrishnan Muniappan. Issues, and Challenges of Management Education in Malaysia, Working Paper, Curtin University of Technology, 2007, 1-12.

Jokull Johannesson. Asian Mega Trends and Management Education of Overseas Chinese, International Education Studies, 2010; 3(1):58-65.

Kumar k. Ashok, Rao Bala Nageswara and Mohan j. Madan., (2013) Management Education in Indi , Role of the Institutes of Management, Past, Present and Future Trends. Journal of Educational Research(Jer) 1(1), 1-16.

Kumar Sanjeev, M. K. Dash., (2011) Management Education in India: Trends, Issues and Implications. Research Journal of International Studies;(18).

MacNamara,M., Meyler,M.& Arnold,A.,(1990) Management Education and the Challenge of ActionLearning. Higher Education, 19(4), 419-433.

Mehta Adarsh Preet., (2014) New Paradigms in Contemporary Management Education in India. Indian Journal of Research, 3(5).

Sahu G Gautam.,(2012) Management Education in India: Issues and Concerns. Journal of Information Knowledge and Research in Business Management and Administration, 2(1), 35-40.

Chapter- 24

Issues, Challenges & Opportunities in Management Education in India

M Hanta[1], Dr A Amruth Prasad Reddy[2]

[1]Research Scholar, Yogi Vemana University, Kadapa-516005, AP
[2]Research Supervisor, YVU, Kadapa
E-Mail: hantareddy.munagala@gmail.com[1]

Abstract

Management education has taken different shapes in India. During 1985-90, due to privatization, management education was offered by several institutions and it was like a mushroom growth. The regulatory bodies were allotted to grow it like an unorganized sector. But after 2010, slowly the regulatory bodies started controlling the management institutions, mainly by using Information Technology. In India, management education has made significant growth since its inception in 1950s, and by the mid1960s India became one of the leaders in the field of management education. At present, India has the second largest number of business schools in the world. However, the expanding of B-Schools in India led by globalization has resulted in an intense competition among the B-Schools themselves giving rise to many contemporary issues and challenges in the changing time affecting the quality of management education in the country.

Keywords: Management Education, Information Technology, B-School, Globalization

Introduction

Present corporate world is full of competition. New technologies are emerging every day, and everything is turning towards globalization. In such challenging situation, young managers possessing management degree turn out to be survivors. The biggest challenge of the corporate world is to produce efficient managers. A management degree from a reputed institution certifies that the person holding the degree has enough managerial skills required to face the competition. Management courses develops skillful workforce which constitutes of leaders of future as well as competitive managers. Today managers are in great demand in every sector of economy. India needs a huge reservoir each year of people who are trained for business and for management and demands is to last for coming years. But it is matter of concern whether the demand is for what they have been taught. In management education, quality has become a necessity. To make India an intellectual capital of the world, we have to create a dynamic environment, which can encourage superior quality management education colleges and effort should be made to breathe life into management education.

ISBN: 978-93-90631-71-1

that their courses had enough local content so that students could relate to them easily. Change in study material and teaching methodology with time as it is said "Any corporate which does not change with time is bound to die". Experts opine that old curriculum and teaching methodologies in B-schools has not able to keep pace with fluid and dynamic environment.

References

[1] A.K. Pandey and S. Dash, "Indian Higher Education in the Era of Globalization: Challenges & Quality management strategies", University News, (2005) December.

[2] GFM, The Global Management Education Landscape, Shaping the future of Business Schools, (2007).

[3] http://articles.timesofindia.indiatimes.com/keyword/management-education.

[4] Bowonder and S. L. Rao, "Management education in India its evolution & some contemporary issues", AIMA/CME 2005, (2005).

ISBN: 978-93-90631-71-1

Chapter- 17

Emerging Trends, Issues and Challenges Faced by Management Education in India

Shaik Abdul Mazeed[1], Dr. P Saritha[2]

[1]Research Scholar (Part Time), Yogi Vemana University, YSR Kadapa-516005
Assistant Professor, Dr. B R Ambedkar Institute of Management and Technology
Baghlingampally, Hyderabad-500044, Telangana
[2]Assistant Professor, Department of Business Management, Yogi Vemana University
YSR Kadapa-516005, Andhra Pradesh
E-Mail: mazeed22@gmail.com[1], sarithamsg@yahoo.co.in[2]

Abstract

The purpose of this paper is two-fold. It is to assist local authorities in the evaluation of their own systems of quality assurance and educational development, or quality development as it is increasingly known, and to set out the quality indicators which will provide the basis for external inspection and Best Value scrutiny of the education functions of local authorities. Through self-evaluation, authorities will be supported in providing continuously-improving services in their area and meeting the requirements of the Best Value initiative. The fact that the quality indicators will be used for inspection and other forms of external scrutiny removes any mystique from the inspection process. Although purposes and audiences may be different, the language and basis for self and external evaluation should be the same so that there can be an open and honest dialogue and consistency across different areas and different evaluators.

Keywords: Management Education, Quality, Improvement, Emerging Trends.

I. Introduction

Management Education is all about learning different skills and to apply them for mutual and multi faceted growth and value creation. Its aim is to create the desired competence for the optimum and most productive utilization of man and materials. In this volatile and fast changing scenario when every other day new technology is emerging and rendering the older one obsolete and outdated, it is imperative that management education should be dynamic and responsive towards the new challenges that are knocking at its doorstep. As an emerging and promising

experiential product. Today's knowledge society prefers learning instead of education. Learning no more happens in classrooms but through personal networks, practicing communities, and through work-related activities.

A Management student today competence in business discipline, overall understanding of business areas, technical literacy, and skills in prioritizing and resolving conflicts. For this a student today needs ability, talent, self-understanding, direction that can help tackle global problems, perform creatively in ambiguous environments, and get things done in complex conditions. Hence management education must emphasize a mechanism of building knowledge, capabilities and techniques, and making a student aware about values, attitudes and beliefs. Without capabilities and techniques just the knowledge building will have no value and capabilities and techniques will be unproductive without the self-expression on values and beliefs.

V. Conclusion

The conventional approach that is adopted in management education is restricting innovation not just in application but more importantly in thought. The pedagogy should address realities making students understand that organisations are not merely machines to which formulas and frameworks can be attached. They should also be told that strategy does not mean only Porter's framework or the core competence approach though brilliant has limitations, or the Blue Ocean strategy can get bloodied by sharks in the market. That will make them think on the next goals on which their organisations will have to work. Till we find our own voice we will have to remain satisfied and adapt to innovations made by others.

References

[1] Bitner & Pandit, "Services Marketing", Tata Mc Graw Hill, 2009

[2] Dialogue January - March, 2008 , Volume 9 No. 3, British Raj in India:Myths and the Realities

[3] http://www.asthabharati.org/Dia_Jan08/B.B.htm

[4] G M. Young (ed.) 1935. Speeches by Lord Macaulay with his Minute on Indian Education. Oxford University Press, London

[5] The Hindu - Sunday July 10, 2005 - Front page - http://www.thehindu.com/2005/07/10/stories/2005071002301000.htm

[6] Indian Education - Past, Present and suggestions for future - http://theanalyst007.blogspot.com/2013/01/indian-education-past-present-and.html#sthash.RKvA1JW4.dpuf

[7] Indian Education - Past, Present and suggestions for future - http://theanalyst007.blogspot.com/2013/01/indian-education-past-present-and.html#sthash.9fyV5Wt1.dpuf

[8] Kantanen, H.(2007)Branding in Higher Education, Exploring an emerging phenomenon, EAIR Series Research, Policy and Practice in Higher Education, pp. 56-69.

[9] Language in India Website.

[10] Minute by the Hon'ble T. B. Macaulay, available on Columbia University Website.

[11] Rama Mohana Rao, "Services Marketing", Pearson Education, 2009

[12] The Background of Macaulay's Minute by Elmer H. Cutts. The American Historical Review, Vol. 58, No. 4 (Jul., 1953), pp. 824-853

Chapter- 14

Recent Trends, Emerging Issues and Implications Involved in Management Education: India

Dr S Subba Reddy

Assistant Professor, Department of Business Management, Yogi Vemana University, Kadapa-516005

Abstract

Usually, students are fascinated towards management education, as it is driven by positive results. Higher Education in India is experiencing an exponential growth in terms of the number of institutions providing management education, management education which is commonly called business school. The present paper tries to find out the current state of management education in India, this paper also studies the trends prevalent in management education in India, and tries to explore the implications involved in management education in India on industry and individuals. In addition, it tries to study the emerging issues of management education and find the implementation of the policy and the potential towards improving management education in India. This paper will fill the gap between existing literatures, as not much work has been done in this area.

Keywords: Management Education, Management, Business School, India

Introduction

The development of management education can be traced back to the 18th century. From 18th century to 21st century, management education has seen lot of changes and development. Management education in India is predominately a derivative of western management thought and practice. Occasionally, management schools draw some inferences from Indian epics, shastras and practices. It may be worthwhile to notice that management itself as a discipline, evolved from fundamental disciplines of philosophy, psychology, economics, accounting, computer science, mathematics, statistics and industrial engineering. In India, management education is seen as exclusive. Often, young men and women are attracted to management education not because they need some education, exposure and experience to create something wonderful, and hence to useful society but are usually motivated by the positive consequences associated with management education. In 21st century, India witnessed a transformation in its educational system. Process of liberalization, privatization, globalization has not only replaced traditional approach with a more efficient professional approach; but also introduced new age courses in accordance

ISBN: 978-93-90631-71-1

References

[1] Angehrn. A, & Naboth (1997) "Leveraging Emerging Technologies in Management Education: Research and Experiences", European Management Journal, Vol.15, No.3, pp.275-285.

[2] Baumgartel. H. J, Pathan. R, Roy. B, Khandelwal. G & Rahman. A (1984) "Changes in Organisational Climate and Management Education, 1968 to 1981: Some Warning Signals" Economic and Political Weekly, Vol.19, No.8. pp. 15-21.

[3] Bowonder. B and Rao. S. L (2004) "Management Education in India its evolution and some contemporary issues ", available at http://www.aima-ind.org/pdf/Director_ Conclave_ 9_ Paper.pdf (accessed 25 October 2010).

[4] Crowther. D and Carter.C (2002) "Legitimating Irrelevance: management education in higher education in institutions", The International Journal of Educational Management, Vol.16, No.6, pp. 268-278.

[5] D'Mello. B (1999) "Management Education: A Critical Appraisal" Economic and Political Weekly, Vol. 15, No. 22 (May 31, 1980), d.c. Published, Vol. 34, No.48, pp.169-176.

[6] Engwall. L (2007) "The anatomy of management education", Scandinavian Journal of Management, Vol. 23, pp. 4-35.

[7] Ganesh. S. R (1980) "Performance of Management Education Institutions: An Indian Sampler" Higher Education, Vol. 9, No. 3, pp. 239-253.

[8] MacNamara. M, Meyler, M & Arnold. A (1990) "Management Education and the Challenge of Action Learning", Higher Education, Vol. 19, No. 4, pp. 419-433.

[9] McNulty. N. G, Katkov. A & McNulty. N. C (1992) "Management Education in Eastern Europe: 'Fore and After'", The Executive, Vol. 6, No. 4, pp. 78-87.

ISBN: 978-93-90631-71-1

Chapter- 7

Challenges, Issues and Opportunities in Management Education

Y. Mallikarjuna Achari[1], Dr. P. V. Varaprabhakar[2]
[1]Research Scholar, Dept of Business Management, Yogi Vemana University, Kadapa
[2]Assistant Professor, Department of Business Management, Yogi Vemana University, Kadapa

Abstract

In this paper, we have examined the present status of management education in India. The key issues have been identified for bringing efficiency, sufficiency and equity in the overall system of higher education including management education. Abilities of head and heart, skills and knowledge (ASK) are the engines of economic growth and human development of any economy like India. In reality we are responding more effectively and promptly to challenges and opportunities of globalization which means internationalization of Indianization for all of us. It has created avenues for jobs for skilled professional in management. According to Economic Survey 2011-12, India is going to be the youngest nation with largest work force in the world which possesses the potential to become an economic superpower. Future technologies call for cusp of a revolutionary change in management education for meeting the growing requirements of the industry.

Keywords: Management Education, Policy Formulation, Knowledge-Oriented Paradigm of Development

Introduction

Indian economy is going to emerge as a knowledge economy with third largest technical manpower in the world after US and China. However, compared to our population (1210.19 million-2011 census) it is not significant and there is a tremendous potential and scope of ensuring efficiency, sufficiency and equity. In India, the emphasis has been on general education, with vocational education at the receiving end. This has resulted in large number of educated people remaining unemployed which justifies the rationale for vocationalisation of education. In the new knowledge economy, to achieve professional, managerial, operational, and behavioral, inter personal and inter functional skills, India needs flexible education and training system that will provide the foundation for learning to develop required competencies with morality, credibility and accountability (MCA) through spirituality- the science of soul which can make us superior to anyone in the World. By changing the tracks of our thoughts we can turn the tides in our favor. We need to open the windows of the mind and spirit by spiritual revolution above religious differences. We need to transmit the Indian wisdom flowing from our epics with mental superiority

ISBN: 978-93-90631-71-1

addressed through appropriate policy formulation and its effective implementation. To develop India as an education hub for becoming a prosperous partner in global economy, we have to strengthen higher education in general and management education in particular with research and development in terms of balancing quality and quantity. There is a logic and rationale for broadening our vision, developing skill and integrating all those aspects which have their direct or indirect bearing or human resource development to meet the challenges of higher and management education. In order to respond to the global challenges more strongly than ever before, India today needs a knowledge-oriented paradigm of development to give the country a competitive advantage in all field of knowledge. National Knowledge Commission's (NKC) overarching aim is to transform India into a vibrant knowledge economy. The present system of higher and management education produced some degree holders with mere knowledge and information in a particular area, but it has failed to develop general employability skills needed for entry level employee. Hence, it is high time for us to ponder over it and make necessary reforms in the course and strategies so that employability skills can be developed among the students. We need job led growth and for this, the thrust should be on quality and vocational/management education. India has demographic advantage in the form of huge number of young people. To make the best, these young minds need to be provided opportunities for accessing quality higher management education, only quality human resource will ensure emergence of a true knowledge society which will ultimately enhance the country's competitiveness in the global economy. The cause of concern for the gaps in the demand and supply of management manpower in India is the imbalance between quality and quantity without manpower planning. To utilize the human capital of India in an effective manner calls for manpower planning for matching demand and supply of skilled personnel, Training of manpower for reducing mismatch between the abilities and the jobs on offer and above all mechanism by pairing people with jobs through information network (WWW). To research the ways and means of solving unemployment problem, there is an intellectual debt on the economists and policy makers of India.

For providing ROTI (Bread) and employment to the management manpower, we need to increase returns on training investment (ROTI). To attain efficiency, sufficiency and equity in overall system of education, we need to understand and adopt SMART & SIMPLE models of human resource development developed by the author elsewhere.

References

[1] Goel, M. M., (2011), Economics of Human Resource Development in India, VK Global Publications Pvt. Ltd., New Delhi, ISBN No 978- 93- 5058-014-1.

[2] Goel, M. M., and Walia, S., (2011), "Education and Economic Growth in Haryana (India): Using Granger Causality Approach," Asian Studies, (17.1).

[3] Goel, M. M., and Walia, S., (2011), "Higher Education: an Engine of Economic Growth in Post Reform India," Research Journal Social Sciences, Punjab University, Chandigarh, 19.3, ISSN-0251- 348.

[4] Goel, M. M., (2011), Education and Skill Development in India: A Review, Economic Journal, Special Issue on Enhancing Human Resources for Inclusive Growth, Employment and Welfare, December 2011.

Chapter- 5

Trends, Issues and Challenges in Management Education

Vunnam Hari Babu[1], Dr. S. Venkata Subba Reddy[2]

[1]Research Scholar (Part-Time), Yogi Vemana University, YSR Kadapa-516005
Assistant Professor, Mahineni Lakshmaiah MBA College,
Kanumalla, Singarayakonda, Prakasham-523101, Andhra Pradesh.
[2]Assistant Professor, Department of Business Management, Yogi Vemana University, YSR Kadapa-516005
E-Mail: vunnam74@gmail.com[1], svsreddyseelam@gmail.com[2]

Abstract

The business and management education could play a pivotal role in social uplift and triggering the entrepreneurial spirit in a society. The business schools face several challenges in terms of imparting quality education. External environmental forces and stakeholders continuously put pressure on the business schools to adapt the changes happening in the business world. The rapid trend of globalization and technological changes have made difficult for organizations to survive in the competitive world. As a result the importance of management education has increased many folds. Business executives need to update their skills due to sudden changes in the external environment. In order to meet the challenges of the future, the reform of the higher education could be unavoidable. The Education Institutions need to strive to achieve balance between the education cost and the quality. One of the major criticisms of MBA schools is the gap between theory and practice.

Keywords: Business, Management Education, Skills, Theory and Practice.

I. Introduction

Management education is considered as elistist as it attracts young men and women who are usually motivated by the positive consequences associated with management education. In India higher education especially management education is witnessing a exponential growth in terms of number of institutes imparting management education which are usually termed as business school. The management education plays an essential role in today's dynamic business environment. The rapid trend of globalization and technological changes have made difficult for organizations to survive in the competitive world. As a result the importance of management education has been increased many folds. Business executives need to update their skills due to sudden changes in the external environment. Due to the increasingly complex nature of organization and businesses, there is a need that the business schools impart relevant, current, and cutting edge knowledge to the students. This research also identifies some of the emerging areas in the

ISBN: 978-93-90631-71-1

X. Conclusion

"There is no need to reach high for the stars. They are already within you - just reach deep into yourself!"-Anonymous. There is failure in management education which is evident with the current economic downturn. The educational system failed to forecast the recession and failed to check the overheated economy. The four pillars for effective management education are industry experience, consultancy experience, research experience and teaching experience. When faculties possess these four areas of experience and expertise, then it ensures qualitative management education.

The present business education is broken and need to be reinvented with changing times. It is unfortunate that India with a billion plus population could not produce global leaders like Jack Welch, Peter F Drucker, Bill Gates, Michel Dell; It is time India took a relook at the methodology of management education. It is also the time Indian B-schools took stock of the situation and set their houses in order. The silver lining in the dark cloud of management education in India is the Indian School of Business (ISB) which is ranked as the 15th best Business School in the world surpassing other premier management institutions like IIMs. There is a strong need to focus management education glocally (i.e. think globally but act locally). When the course content is customized based on the market needs then students will not face unemployability problem. Let us make Indian MBA on par with global standards. We need to get out of the mindset of being copycats. We need to reinvent ourselves as leaders from being followers. To sum up, it is vital to have holistic and integrated. The problem with us is to imitate the western management education blindly. By the time we take best out of them, the content and curriculum gets outdated thus resulting into obsolescence. Let us be creative and innovative in preparation of curriculum and methodology of teaching. Management colleges may improve their services through various quality programs.

References

[1] http:/www.blogspot.in/.../how-to-improve-management

[2] http:/www.sooperarticles.com/.../business-process-

[3] http:/www.oppapers.com/essays/.../205245

[4] http://en.wikipedia.org/wiki/Management

[5] http:/iamee.edu.in/.../management-education...

[6] http:/oppapers.com/essays/.../904061

[7] http:/oppapers.com/essays/.../394570

[8] http:/sooperarticles.com/.../management-edu...

[9]. research journals of international studies-issue

[10] http:/indianmba.com/.../fc652.html

[11] http:/dreducation.com/.../2010-trends-indian-

[12] http:/www.academicjournals.org/ERR

ISBN: 978-

Chapter- 4

Challenges and Recommendations Associated with Management Education in India

Dr. S. Subba Reddy[1], Dr S. Ghousinnisa[2]

[1]Assistant Professor, Department of Business Administration, Y.V. University, Kadapa
[2]Research Scholar, Department of Business Administration, Y.V. University, Kadapa

Abstract

In terms of management graduates passing every year, India is one of the largest nations in the world. There is a lot of unemployment, even after pursuing a higher education, they are not getting desired careers. The growing rate of joblessness has become one of the main difficulties in India. The lack of essential employability skills has been detected as a reason for failure in attaining the job. Management graduates are facing the enormous challenges in attaining employment and shine in their profession. In this point, the management institutions play an important role in imparting current knowledge and improving the skills of management graduates. The recommendations in the management education system are extremely essential to bridge the gap amid industry expectancy from management graduates and the skills owned by them. This paper aims at exploring the challenges handled by participants in the education industry and the efforts have been made to give the innovative visions into the problems and ascertain the solutions to overcome these challenges. The present paper used the secondary data (previous research studies) to conclude the research work. The policies and statements made by AICTE (All India Council for Technical Education) have been considered as an essential part of this research article.

Keywords: Unemployment, Employability skills, Management Education, AICTE.

Introduction

In a scenario of stiff competition today, it has become imperative for educational institutions to look at factors affecting the quality of management education. The education system needs to be improved to bridge the gap between corporate requisite skills and genuine skills close to students. Candidates seeking career prospects in the management field are found calm due to abundant questions in their minds about success in the concerned field. Master of Business Administration, a professional course has emerged as a choice of a lot of students. This professional course not only develops managerial skills but also makes students more confident to make important decisions in their fields. This dazzling professional programme develops an entrepreneurial attitude. Management Education provides students with the skills to meet harsh challenges in

978-93-90631-71-1

case studies, market surveys, group discussions and simulation exercises to make them more capable in the international scenario.

References

[1] R. Patil, "Pedagogy of Business Education for Employability Interdependency of the factors determining Employability of the Management Students", AIMA Journal of Management & Research, Vol. 6, No. 4/4, (2011).

[2] B. Bowonder and S.L. Rao, "Management Education in India its evolution and some contemporary issues", AIMA/CME, (2004).

[3] G Buenviaje, H. A. Encio, R. F. Refozar, A. Anuran, N. C. Camello, J. M. Laguador, "Employability and Skills of MBA Graduates from Literature Review as Input to Student Development Program", Journal of Research in Business and Management, Vol. 4, No.5, (2001), pp.16-21.

[4] G Menon, "Maintaining quality of education in Management Institutes - Reforms required", Procedia - Social and Behavioral Sciences, Vol. 133, (2018), pp.122 - 129.

[5] I. A. Rizvi & A. Aggarwal, "Enhancing student employability: Higher education and workforce development", Proceedings of the 9th Quality in Higher Education Seminar, Birmingham, UK, (2005).

[6] J. Patel, "The Changing Face of Management Education: Challenges for Tomorrow", Indian Streams Research Journal, Vol. 1, No. 6, (2015), pp.01-012.

[7] J. Ranjan, "Changing Context of Indian Management Education: An Academic Framework", International journal of management in Education, Vol. 2, No. 4, (2008), pp. 432-444.

[8] K. N. Marimuthu, "Quality of Management Education in India and Reengineering Process from Traditional to Modern", International Journal of Creative Research Thoughts, Vol. 6, No. 2, (2018), pp.78-88.

[9] M. A. Mamun, "Management Education for Contemporary Challenges: The Role of Business School", European Journal of Scientific Research, Vol. 30, No. 4, (2014), pp.649-661.

[10] M. R. Chadha, "Industry's Requirement for Employability of Management Student in Present Scenario", International Journal of Business. Quantitative Economic and Applied Management Research, Vol. 1, No. 3, (2005), pp.162-165.

[11] P. Nair, "Employability Gap: A bottle neck in the progress of organizations, A study to find out the opinion of employers regarding employability skills for management students in the state of Gujarat", GJRA - Global Journal For Research Analysis, Vol. 4, No. 10, (2018), pp.51-54.

[12] R. Gopal, "Towards an educated India: Academia- Industry Partnership", Free Press Journal, Vol. May (2010).

[13] R. Hofstrand, "Getting all the skills employers want. Techniques: Making Education & Career Connections", Vol. 71, No. 8, (2012) ,pp.51.

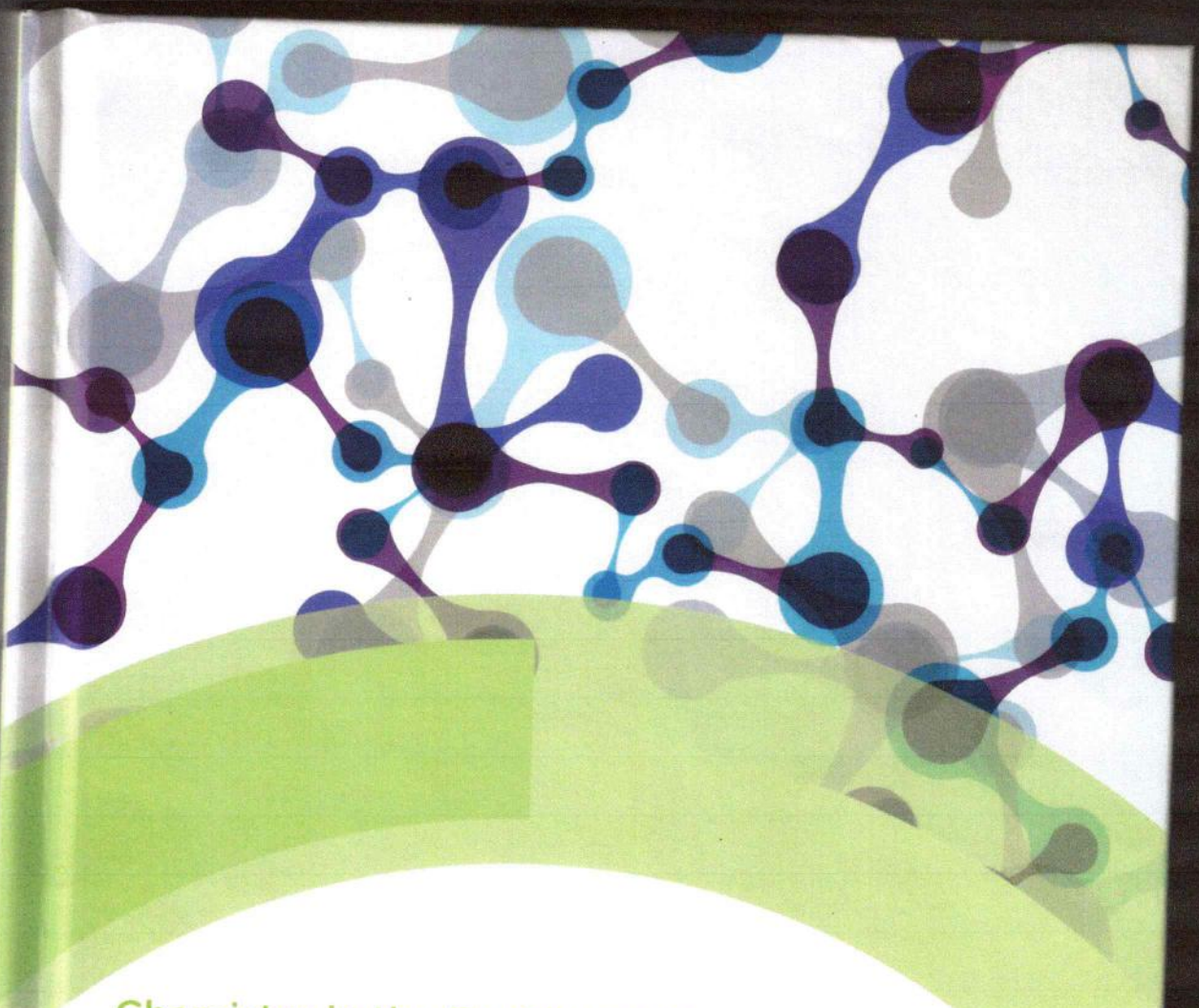
[14] R. Mahajan, R. Agrawal, V. Sharma, V.Nangia, "Factors affecting quality of Management Education in India", International Journal of Educational Management, Vol 28, No. 4, (2016), pp.379-399.

[15] Datar, M. Srikant, Garvin, A. David & Cullen, G. Patrick, "Rethinking the MBA: Business Education a Crossroads", Journal of Management Development, Vol. 30, No. 5 (2011), pp. 451-462.

[16] S. Weligamage, & S. Siengthai, "Employer needs and graduate skills, the gap between employer expectations and job expectations of Sri Lankan University Graduates", 9th International conference on Sri Lanka Studies, Matara, Sri Lanka, (2003).

[17] V. Ravan, "Employability Skills: Need of an hour for MBA Students", International Journal of Economic and Business Review, Vol. 4, No. 10, (2016), pp. 40-43.

ISBN: 978-93-90631-71-1



Chemistry in the Environment

Functional Hybrid Nanomaterials for Environmental Remediation

Edited by Ahmad Fauzi Ismail and Pei Sean Goh

ROYAL SOCIETY OF CHEMISTRY

Chemistry in the Environment Series No. 3

Print ISBN: 978-1-83916-221-3
PDF ISBN: 978-1-83916-528-3
EPUB ISBN: 978-1-83916-529-0
Print ISSN: 2516-2624
Electronic ISSN: 2516-2632

A catalogue record for this book is available from the British Library

The Royal Society of Chemistry is a charity, registered in England and Wales, Number 207890, and a company incorporated in England by Royal Charter (Registered No. RC000524), registered office: Burlington House, Piccadilly, London W1J 0BA, UK, Telephone: +44 (0) 20 7437 8656.

For further information see our website at www.rsc.org

Printed in the United Kingdom by CPI Group (UK) Ltd, Croydon, CR0 4YY, UK

Preface

Research and develop
with organic or inorg
the field of environme
by nanomaterials at th
potential and advanta
decades, tremendous e
tries to harness the po
address the limitation
materials, including pc
ites, play equally impo
environmental remedi

The main purpose
state-of-the-art as well
synthesis and applicat
sists of 11 chapters wh
nanocomposites for e
various approaches tha
sis as well as their app
chapters have been s
work in the multidisci
applications. Various f
antimicrobial, magnet
approach to their synth
intended uses. Their a
the removal of heavy m
also discussed.

Chemistry in the Environmer
Functional Hybrid Nanomate
Edited by Ahmad Fauzi Ismai
© The Royal Society of Chem
Published by the Royal Societ

. Othman, H. Hasbullah,
h and B. C. Ng, *Mater. Sci.*

. Lee and Y.-W. Heo, *Scr.*

'. Abidin, S. Mansur, B. C.
36, 101372.
ssarakich, *Eur. Polym. J.*,

hit, *Appl. Surf. Sci.*, 2020,

h and M. J. Bushiri, *Dia-*

4. H. D. Othman, H. Has-
and F. Kamal, *Carbohydr.*

CHAPTER 4

Nanomaterials and Their Modification for Environmental Remediation

N. LAKSHMANA REDDY*[a,b,c], KIYOUNG LEE[a,b], YEON-TAE YU[c], J. THEERTHAGIRI[d] AND M. V. SHANKAR[e]

[a]School of Nano & Materials Science and Engineering, Kyungpook National University, 2559 Gyeongsang-daero, Sangju, Gyeongbuk, South Korea; [b]Research Institute of Environmental Science & Technology, Kyungpook National University, 80 Daehak-ro, Buk-gu, Daegu, South Korea; [c]Division of Advanced Materials Engineering, Jeonbuk National University, Jeonju 54896, South Korea; [d]Department of Chemistry and Research Institute of Natural Sciences, Gyeongsang National University, Jinju 52828, South Korea; [e]Nanocatalysis and Solar Fuels Research Laboratory, Department of Materials Science & Nanotechnology, Yogi Vemana University, Kadapa-516005, Andhra Pradesh, India
*E-mail: n.lakshmannano@gmail.com

4.1 Introduction

Environmental pollution, global warming, and extreme contamination of water bodies around the globe lead to severe problems and challenges for mankind. Tackling these problems requires the development of nanotechnology and nanomaterials, which are emerging and active fields of research.[1–3] Nanotechnology is defined as the fundamental understanding of physiochemical properties of nanostructured materials and the fabrication and

Chemistry in the Environment Series No. 3
Functional Hybrid Nanomaterials for Environmental Remediation
Edited by Ahmad Fauzi Ismail and Pei Sean Goh

Published by the Royal Society of Chemistry, www.rsc.org

Shabir Hussain Wani
Manu Pratap Gangola
Bharathi Raja Ramadoss *Editors*

Compatible Solutes Engineering for Crop Plants Facing Climate Change

Springer

Shabir Hussain Wani
Manu Pratap Gangola • Bharathi Raja Ramadoss
Editors

Compatible Solutes Engineering for Crop Plants Facing Climate Change

Springer

Editors
Shabir Hussain Wani
Mountain Research Centre for Field Crops
Sher-e-Kashmir University of Agricultural Sciences and Technology
Srinagar, Jammu and Kashmir, India

Bharathi Raja Ramadoss
Bioriginal Food and Science Corporation
Saskatoon, SK, Canada

Manu Pratap Gangola
Department of Plant Sciences
University of Saskatchewan
Saskatoon, SK, Canada

ISBN 978-3-030-80673-6 ISBN 978-3-030-80674-3 (eBook)
https://doi.org/10.1007/978-3-030-80674-3

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Contents

Chapter 8
Sugar Alcohols and Osmotic Stress Adaptation in Plants

Ramachandra Reddy Pamuru, Chandra Obul Reddy Puli, Deepu Pandita, and Shabir Hussain Wani

Abstract Sugar alcohols or polyols are derivatives of sugars produced in high amounts during salt or drought (abiotic) stress in plants. A number of sugar alcohols identified in plants include manitol, sorbitol, D-ononitol, pinitol, adonitol, ribitol, glucitol etc., which are classified as cyclic and non-cyclic polyols. Osmoregulation is a phenomenon of regulating constant fluid osmotic pressure in cells through salt and water concentrations during abiotic stress conditions. In plants, abiotic stress induces water loss, and at the same time, they release osmolytes including sugar alcohols which maintains osmoregulation. Sugar alcohols play a crucial role in osmotic adaptations and exert tolerance to salt and drought stress in plants. Due to the importance of sugar alcohols in crop improvement its metaolism, osmotic adaptations and role of transformational studies are discussed in the present chapter.

Keywords Sugar alcohols or polyols · Drought · Salt stress · Osmoregulation · Transformation

R. R. Pamuru (✉)
Department of Biochemistry, Yogi Vemana University, Kadapa, A. P, India
e-mail: prcrbio@yogivemanauniversity.ac.in

C. O. R. Puli
Department of Botany, Yogi Vemana University, Kadapa, A. P, India

D. Pandita
Government Department of School Education, Jammu and Kashmir, India

S. H. Wani
Mountain Research Centre for Field Crops Khudwani-192 102, Sher-e- Kashmir University of Agricultural Sciences and Technology, Srinagar, Jammu and Kashmir, India

S. H. Wani et al. (eds.), *Compatible Solutes Engineering for Crop Plants Facing Climate Change*, https://doi.org/10.1007/978-3-030-80674-3_8

Williamson JD, Jennings DB, Guo WW, Pharr DM, Ehrenshaft M (2002) Sugar alcohols, salt stress, and fungal resistance: polyols–multifunctionalplantprotection? J Am Soc Hortc Sci 127:467–473

Wu BH, Li SH, Nosarzewski M, Archbold DD (2010) Sorbitol dehydrogenase gene expression and enzyme activity in apple: tissue specificity during bud development and response to rootstock vigor and growth manipulation. J Am Soc Hortic Sci 135:379–387

Wu GQ, Feng RJ, Liang N, Yuan HJ, Sun WB (2015) Sodium chloride stimulates growth and alleviates sorbitol-induced osmotic stress in sugar beet seedlings. Plant Growth Regul 75(1):307–316

Yu SM, Lee YC, Fang SC, Chan MT, Hwa SF, Liu LF (1996) Sugars act as signal molecules and osmotica to regulate the expression of alpha-amylase genes and metabolic activities in germinating cereal grains. Plant Mol Biol 30:1277–1289

243

Cont. from previous flap

20. A Study on Knowledge, Attitude, and Practice of Reproductive Health among Adolescent Girls in Vijayapura
21. Unforeseen Emergencies and Community Resilience: A Social Identity Perspective
22. A Systematic Review of Yoga for Mental Health and Physical Health
23. Problems and Perspectives of Ageing
24. Poverty and Social Exclusion: An Analytical Perspective of Social Work Students

Dr. Gangadhar B. Sonar is MSW., M.Phil and Ph.D in Social Work from Gulbarga University, Kalaburagi. Presently working as Associate Professor and Chairman in the Department of Social Work, Karnataka State Akkamahadevi Women's University Vijayapura, Karnataka State (India). 8 books and 52 research articles are to his credit.

Of Similar Interest

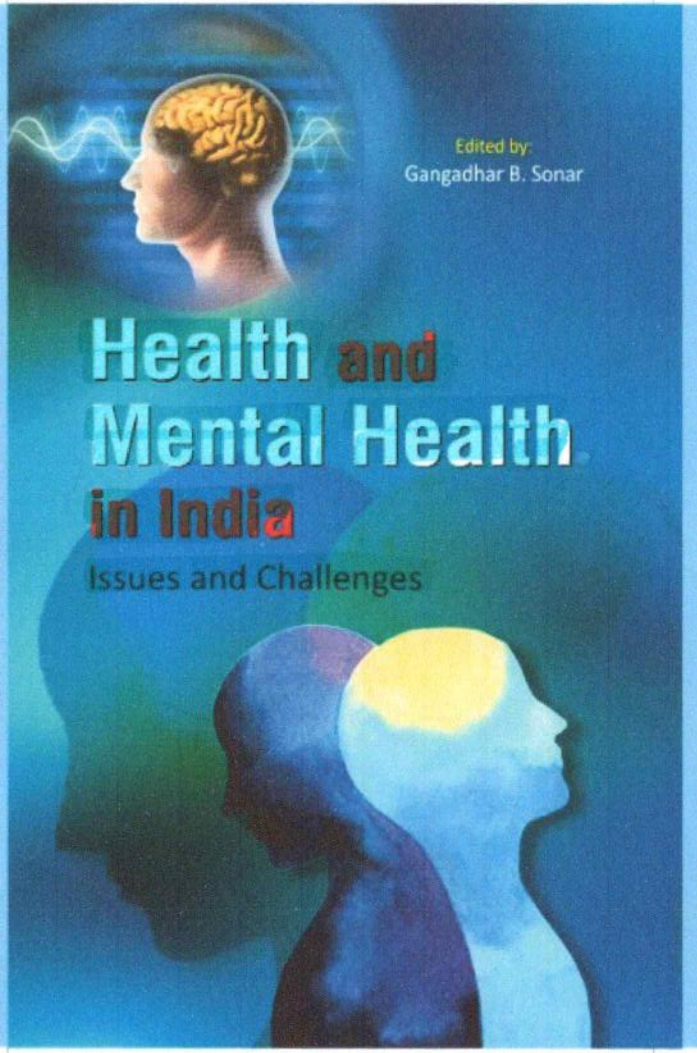
Manas Publishers & Distributors
B-8,Unit-I, Kiran Vihar,
Behind Sanskrit College,Triveni Nagar,
Gopalpura Bypass, Jaipur-302 018 (Raj.)
Tel. 09785169074, 09414035174
email : manasbooks@rediffmail.com

ISBN : 978-93-83251-66-9

₹ 1500.00 $ 75.00

Health and Mental Health in India

Edited by: Gangadhar B. Sonar



Contents

Cont. to next flap

An Analysis of Socio-economic Status of Elderly in India

■ Dr. K. Lalitha*

Abstract

Elderly or old age consists of ages nearing or surpassing the average life span of human beings. The policy defines 'senior citizen' as a person who is 60 years old and above. It strives to ensure that the well-being of senior citizens and improve quality of lives through providing specific facilities, concessions, relief, services etc. and helping them cope with problems associated with the old age. The 60 odd million elderly in India are suffering from the consequences of a dwindling joint family system, an increasing outmigration of caring children and increasing dual careers in nuclear families. Many of the elderly are close to poverty line and live in rural areas. State care of the elderly is cost prohibitive. In view of the increasing need for intervention in area of old age welfare, Ministry of Social Justice and Empowerment, Government of India adopted 'National Policy on Older Persons' in January, 1999. The policy provides broad guidelines to State Governments for taking action for welfare of older persons in a proactive manner by devising their own policies and plans of action. Empirical studies of the elderly in the contemporary Indian society showed that most of the elderly felt alienated, marginalized with depletion of status and power. This paper outlines the status of elderly, socio-economic factors and discuss about productive issues of ageing and how to empower them by using tailored to the situation prevailing in India.

Key Words: *Elderly, graying population, Socio-Economic status, Empowering elderly, NPOP.*

* Asst. Professor, Dept. of Psychology, Y.V. University, Kadapa 05, A.P.

Introduction

Elderly or old age consists of ages nearing or surpassing the average life span of human beings. The boundary of old age cannot be defined exactly because it does not have the same meaning in all societies. Government of India adopted 'National Policy on Older Persons' in January, 1999. The policy defines 'senior citizen' or 'elderly' as a person who is of age 60 years or above. The United Nations World Assembly on Ageing, held at Vienna in 1982, formulated a package of recommendations which gives high priority to research related to developmental and humanitarian aspects of ageing (United Nations, 1987). The plan of action specifically recommended that "International exchange and research cooperation as well as data collection should be promoted in all the fields having a bearing on ageing, in order to provide a rational basis for future social policies and action. Special emphasis should be placed on comparative and cross- cultural studies in ageing". The phenomenon of population ageing is becoming a major concern for the policy makers all over the world, for both developed and developing countries, during last two decades.

Elderly in ancient times: The elderly is considered as head of the family from the generations. The elderly in the ancient times considered as resource. In the Vedic-Puranic Period (B.C), they are revered and respected and considered as store house of wisdom. And society used to consider them as resource and perceives them as "One who has usable skills or assets" for benefit of others. In the post-manu period (150-300 A.D) the old age got prominence by giving priority in the four stages-prescribed roles, duties and obligations The four Asrama Dharmas- Balya, Brahmacharya (education), Grihastha (Raise Familes) and Vanaprastha (Advisor / Counselor Detachment) and Sanyasa (Renunciation). It is a fact that majority of the older people are still living in rural areas and Family system is the backbone for Indian society. Traditionally, Patriarchal Family in India is existing and the family roles and gender relationships are within this system. This is true in all family system except the matrilineal system of the nayar castes in Kerala. In a Indian traditional family system a woman must obey her father, then her husband, and then her son which is normal pattern as she goes through her. She don't have any independent role to play (Jamuna, 2003; Ramamurti & Jamuna, 1983b).

Concepts and Strategies in Plant Sciences
Series Editor: Chittaranjan Kole

Guiliang Tang
Sachin Teotia
Xiaoqing Tang
Deepali Singh *Editors*

RNA-Based Technologies for Functional Genomics in Plants

Springer

Editors
Guiliang Tang
Department of Biological Sciences
Michigan Technological University
Houghton, MI, USA

Xiaoqing Tang
Department of Biological Sciences
Michigan Technological University
Houghton, MI, USA

Sachin Teotia
Department of Biotechnology
Sharda University
Greater Noida, Uttar Pradesh, India

Deepali Singh
School of Biotechnology
Gautam Buddha University
Greater Noida, Uttar Pradesh, India

ISSN 2662-3188 ISSN 2662-3196 (electronic)
Concepts and Strategies in Plant Sciences
ISBN 978-3-030-64993-7 ISBN 978-3-030-64994-4 (eBook)
https://doi.org/10.1007/978-3-030-64994-4

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Chapter 14
CRISPR/Cas13: A Novel and Emerging Tool for RNA Editing in Plants

Deepu Pandita, Chandra Obul Reddy Puli, and Sudhakar Reddy Palakolanu

Abstract Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) and CRISPR-associated protein (Cas) act as an adaptive immune system against invading nucleic acids and bacteriophages in bacteria and archaea. Based on the constitution of effector protein, CRISPR/Cas is broadly divided into multiple types and subtypes. Among these, type VI CRISPR/Cas system is of special attention with four subtypes, namely, VI-A, VI-B, VI-C, and VI-D, and are believed to have evolutionary origin from transposons. These subtypes exhibit variations in structural architecture and mechanism and have diverse Cas13a (C2c2), Cas13b1 (C2c6), *Cas13b2 (C2c6), Cas13c (C2c7)* and *Cas13d* effector proteins. *CRISPR/Cas13* ribonuclease processes pre-crRNA to mature crRNA which targets and knockdown single-stranded RNA of phage genome during viral interference. The high specificity RNA guiding and RNA-targeting capacity of this protein enables to fuse with several effector molecules, opening new avenues in the field of Cas13-mediated RNA targeting, tracking, and editing. CRISPR/Cas13 has a unique feature of targeting RNAs including plants, so it can be used as a new tool for engineering interference against plant pathogens including RNA viruses, with better specificity and for other RNA modifications in plants. Fluorescent probe-tagged deactivated programmable Cas13 proteins could be used as an alternative tool for in *vitro RNA* studies. The engineered Cas13 can also be used for programmable RNA editing. The high target specificity, low cost, and user-friendly operation of CRISPR/Cas13 make this an effective tool for several RNA-based research studies and applications. Therefore, the focus of this chapter is upon classification of CRISPR/Cas system, structural and functional diversity of type VI CRISPR/Cas system including its discovery and origin, mechanism, and role of Cas13 in RNA editing of plants.

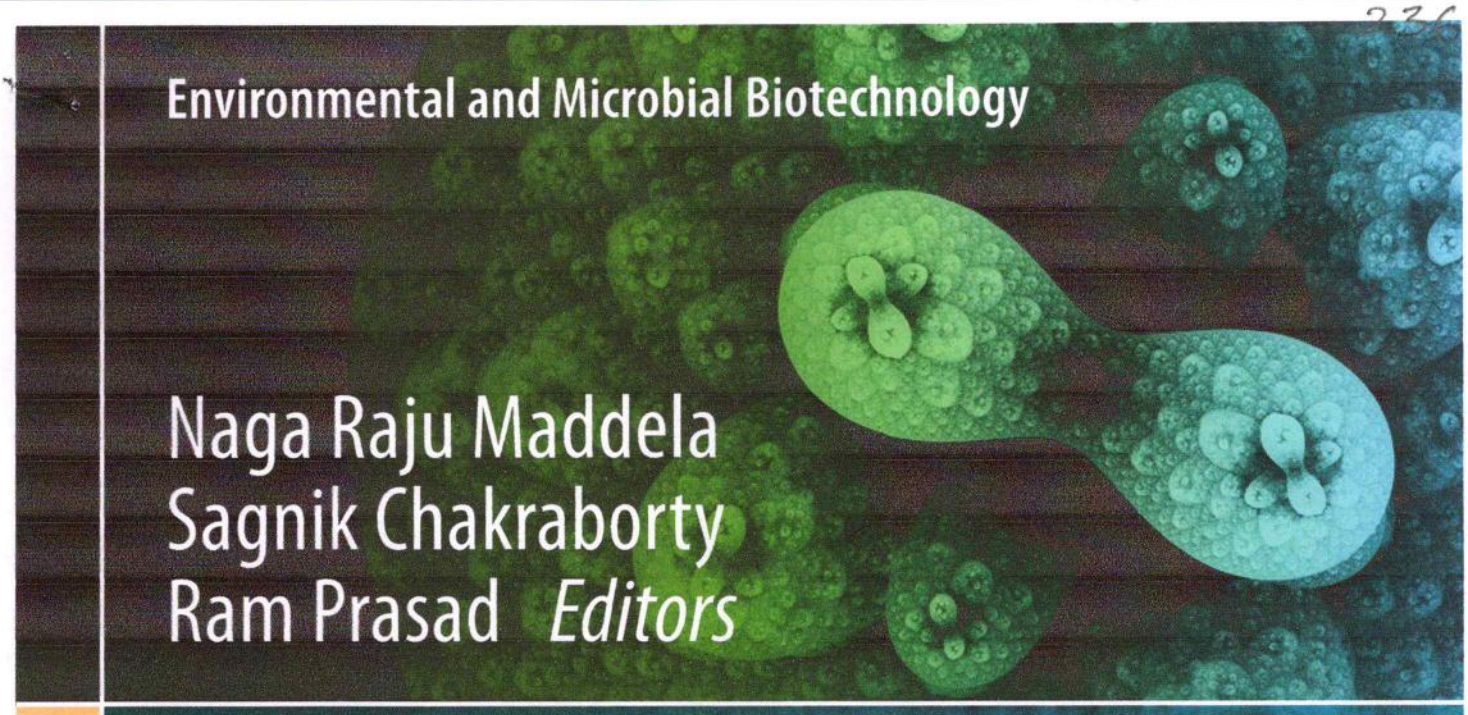
D. Pandita (✉)
Government Department of School Education, Jammu, Jammu and Kashmir, India
e-mail: deepupandita@gmail.com

C. O. R. Puli
Department of Botany, Yogi Vemana University, Vemanapuram, Kadapa 516 005, Andhra Pradesh, India

S. R. Palakolanu
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Hyderabad 502 324, Telangana, India

G. Tang et al. (eds.), *RNA-Based Technologies for Functional Genomics in Plants*, Concepts and Strategies in Plant Sciences, https://doi.org/10.1007/978-3-030-64994-4_14

Environmental and Microbial Biotechnology



Naga Raju Maddela
Sagnik Chakraborty
Ram Prasad *Editors*

Nanotechnology for Advances in Medical Microbiology

Springer

Editors
Naga Raju Maddela
Facultad de Ciencias de la Salud y Instituto de Investigación
Universidad Técnica de Manabí
Portoviejo, Ecuador

Sagnik Chakraborty
School of Environmental Science and Safety Engineering
Jiangsu University
Zhenjiang, Jiangsu, China

Ram Prasad
Department of Botany
Mahatma Gandhi Central University
Motihari, Bihar, India

ISSN 2662-1681 ISSN 2662-169X (electronic)
Environmental and Microbial Biotechnology
ISBN 978-981-15-9915-6 ISBN 978-981-15-9916-3 (eBook)
https://doi.org/10.1007/978-981-15-9916-3

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Chapter 17
Chitosan Nanoparticles: An Overview on Preparation, Characterization and Biomedical Applications

Arundathi Mesa, Grace Sugandha Sowjanya Mythatha, Rathna Silviya Lodi, Sudheer Ravuri, and Ramesh Balli

Abstract Chitosan (CS) and Chitosan nanoparticles (CNPs) have multifaceted applications in medicine, agriculture, pharmaceutics, tissue engineering, waste water treatment and food industries. CS is recognized as a less or non-toxic, biocompatible polymer by US Food and Drug Administration (FDA) for wound dressing as well as in dietary application. The properties of CS have upgraded by making their nanoparticles. Due to their exceptional properties including nanosize with large surface area to volume ratio, presence of reactive groups ($-NH_2$ and $-OH$), cationic nature (NH_3^+), bioadhesivity, biocompatibility, bioavailability and biodegradable nature; CNPs are explored in many ways in biomedical filed as an antimicrobial agent, wound healing agent, scaffolds for tissue engineering, anti-tumour agent in cancer therapy, carriers for gene and drug delivery, etc. In this chapter we highlight on CNPs preparation, characterization and certain important biomedical applications.

Keywords Chitosan (CS) · Chitosan nanoparticles (CNPs) · Scanning electron microscopy (SEM) · Transmission electron microscopy (TEM) · Tripolyphosphate (TPP)

A. Mesa · G. S. S. Mythatha · R. Balli (✉)
Department of Genetics and Genomics, Yogi Vemana University, Kadapa, Andhra Pradesh, India

R. S. Lodi
International Genome Center, Jiangsu University, Zhenjiang, Jiangsu, China

S. Ravuri
Center for Regenerative Sports Medicine (CRSM), Steadman Philippon Research Institute (SPRI), Vail, CO, USA

N. R. Maddela et al. (eds.), *Nanotechnology for Advances in Medical Microbiology, Environmental and Microbial Biotechnology*,
https://doi.org/10.1007/978-981-15-9916-3_17

Zewde B, Ambaye A, Stubbs J III, Dharmara R (2016) A review of stabilized silver nanoparticles-synthesis, biological properties, characterization, and potential areas of applications. JSM Nanotechnol Nanomed 4:1–14

Zhang Y, Zhang M (2002) Three-dimensional macroporous calcium phosphate bioceramics with nested chitosan sponges for load-bearing bone implants. J Biomed Mater Res 61:1–8. https://doi.org/10.1002/jbm.10176

Zhang D, Zhou W, Wei B et al (2015) Carboxyl-modified poly (vinyl alcohol)- crosslinked chitosan hydrogel films for potential wound dressing. Carbohydr Polym 125:189–199. https://doi.org/10.1016/j.carbpol.2015.02.034

Zhang J, Wang Y, Li J et al (2020) α-Santalol functionalized chitosan nanoparticles as efficient inhibitors of polo-like kinase in triple negative breast cancer. RSC Adv 10(9):5487–5501. https://doi.org/10.1039/C9RA09084C

Zhao X, Li H, Lee RJ (2008) Targeted drug delivery via folate receptors. Expert Opin Drug Deliv 5 (3):309–319. https://doi.org/10.1517/17425247.5.3.309

Zhao K, Li S, Li W et al (2017) Quaternized chitosan nanoparticles loaded with the combined attenuated live vaccine against newcastle disease and infectious bronchitis elicit immune response in chicken after intranasal administration. Drug Deliv 24:1574–1586. https://doi.org/10.1080/10717544.2017.1388450

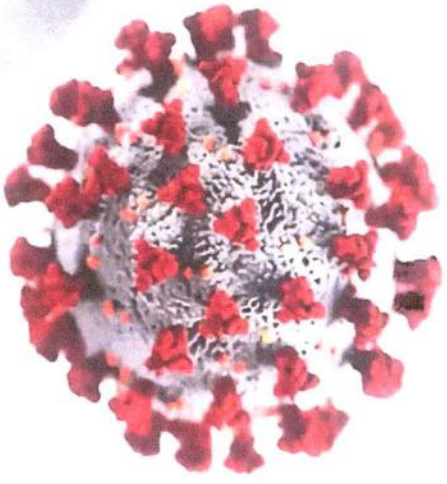
IDEAL COLLEGE OF ARTS AND SCIENCES

(Dr.P.V.N. Raju Vidya Pranganam)
Autonomous & NAAC 'B' Grade
Samalkot Road, Kakinada, E.G.Dt. (AP) - 533 001

Two Day National Seminar on

IMPACT OF COVID-19 ON THE MIGRANT LABOUR IN INDIA

26th, 27th Feb, 2021



COVID-19

Organized by

DEPARTMENTS OF SOCIAL SCIENCES

Editors
Dr. G.Steeven Raju
Dr.K.Swamiji

Likhitha Publications

Impact of COVID-19 on the Migrant Labour in India

Editors

Dr. G.Steeven Raju

Dr.K.Swamiji

First Edition, February, 2021

ISBN: 978-81-947061-4-4

Published by LIKHITHA PUBLICATIONS

Publishor's Address 4-105/1, Srinivasanagar,
Kakinada-533005,
Andhra Pradesh (India)
Email:likhithapublications18@gmail.com
Website: www.ijar.org.in/lp
Contact: 9948440288

Printed by Typeset and Design by
SS Xerox &Print
Old CBI junction
Visakhapatnam- 530 017,
Andhra Pradesh (India)

CONTENTS

Chapter-1

Impact of Covid-19 Lockdown on MSMEs in Kadapa District

Mr.K.Khasimpeera
Asst. Professor, Department of H&S, K.S.R.M College of Engineering, Kadapa-516005, Andhra Pradesh, India and Research Scholar, Department of Commerce, Yogi Vemana University, Kadapa – 516005

Prof. S. Raghunatha Reddy
Professor, Department of Commerce, Yogi Vemana University, Kadapa-516005, Andhra Pradesh, India

ABSTRACT

The outbreak of Covid-19 is the giant disasters in the history which is devastatingly impacting on the country's economy. This article means to survey the effect of COVID-19 episode on these business misfortunes and make due through the emergency. The lockdown significantly influenced the assembling exercises and the production network, due to the closure of transportation and limitations on imports, fares and assembling. In India limited scope businesses are more weak ones as it severely harmed due to Covid-19 and the resultant lockdown. The lockdown due to Coronavirus has brought Micro, Small and Medium Enterprises (MSMEs) to its knees by halting the business which evaporated the income. To see profoundly about MSMEs, it is directed a pattern investigation of miniature, little and medium business visionaries in provincial and metropolitan zones of Kadapa area of Andhra Pradesh. The information needed for the examination have been gathered both essential and optional sources. The scientists have directed the survey with the 142 example business people. The outcomes show that a large portion of the partaking ventures have been seriously influenced and they are confronting a few issues, for example, Loans and Risk receipts and Risk of installments of the client and the Micro, little and medium undertakings assortment of the Primary information.

Keywords: COVID-19, MSMEs, Lockdown, Risk of Receipts and payments.

Introduction

The Micro, Small and Medium Enterprises (MSME) sector in India has emerged as a highly vibrant and dynamic sector of the Indian economy over the last five decades. It is playing a significant role in the economic and social development of the country by fostering entrepreneurship and generating large employment opportunities at comparatively lower capital cost than large industries. It established both rural, urban and backward areas, inter alia, reducing regional imbalances, assuring more equitable distribution of national income and wealth. As MSMEs absorb the surplus agricultural labour, they help reduce the problem of disguised unemployment in rural areas. MSMEs are also complementary to large industries as ancillary units and also play an important role in the whole eco-system of the secondary and tertiary sector. The MSMEs are widening their domain across sectors of the economy, producing diverse range of products and services to meet demands of domestic as well as global markets.

The MSMEs in India are approximately 6.3 crore. The MSMEs in India contributes about 29 per cent towards the GDP through its national and international trade. According to data shared by the MSME Minister in the Rajya Sabha, the registered MSME is dominated by micro enterprises at 22.06 lakh (2.2 million) units in 2020 from 18.70 lakh (1.8 million) units in 2019, while small enterprise units went up

from 2.41 lakh (0.24 million) units to 2.95 lakh (0.29 million) units. The estimated number of MSMEs in India is 63 million and employs 110 million individuals. Indian MSMEs produce more than 6,000 products for local and global consumption. MSMEs are being encouraged to market their products on the e-commerce site especially Government e-Marketplace (GeM), owned and run by the government, where all Ministries and PSUs (public sector undertakings) source their procurement. The platform has recorded transactions worth Rs. 55,048 crore (US$ 7.5 billion) until September 2020. Domestic business requires a strong financial stimulus with concessional working capital loans to ensure adequate liquidity is maintained in business operations from the government and financial institutes.

The COVID-19 pandemic has probably given the biggest blow to the world economy no exception to the Indian economy. The announcement of country wide lockdown dragged MSME owners, employers and external stakeholders in unexpected times where no one had experience to handle this kind of situation. Extended lockdown had negative impact on supply of finished goods, procurement of raw material and availability of employees to work in production and supply processes. During the period the sector has faced challenges related to debt collections, contacts with the workers, wages/salaries, statutory dues, etc.

Need for the Study

The disruptions caused by the Covid-19 pandemic have impacted 20-50% of the earnings of Indian MSMEs. There is no exception to the MSMEs in Kadapa District. Hence, a study has been undertaken with the following objectives to find out and analyse the problems faced by the MSMEs during the covid-19 lockdown period and after lockdown period.

Objectives

- To find out the channels of communication with the workers during lockdown period
- To Evaluate the Loans taken by the firms.
- To analyse the risk in recovery of the debts by the MSMEs.

Research Methodology

The study considered the primary and secondary data to test the impact of covid-19 pandemic on MSMEs in Kadapa district. The sample size is of the study comprises of 142 industrial units. The data collected by taking the information from the District Industries Centre (DIC), Kadapa District. Purposive sampling method has been adopted for the present study. The collected data was systematically arranged, tabulated and analyzed using appropriate Percentage method.

Forms of Business Organisation

Business can be established in various forms. It can be established and managed by individuals, groups, governments and other parties. On the basis of ownership and management the business organizations can be classified as sole trading firms, partnership firms and joint stock companies.

The Table-1: exhibits the forms of organization. It can be seen from the Table-1 that out of 142 sample firms 62.68 per cent of firms belong to sole trader, 34.50 per cent of firms related to partnership firms and the meager of 2.82 per cent of firms belong to joint stock companies.

Table-1: Forms of Organisation

Firm	MSMEs	Percentage (%)
Sole trader	89	62.68
Partnership	49	34.50
Joint stock company	4	2.82
Total	142	100

Source: Primary Data

The table-2 exhibits the age of the business firms. The firms have been categorized into four. The firms which are established less than 5 years, the firms between 5 - 10 years, the firms falling the age of 10 - 15 years of age and the firms having more than 15 years of age. Among all these firms majority of the firms having more than 15 years of the age with the percentage of 44.37 per cent. The second position (20.42 per cent) occupied by 29 firms which are falling between 10 - 15 years of age. 28 firms having the age between 5 - 10 years are 19.72 per cent and 22 firms are having less than five years of the age.

Type-2: Age of the business firms

No. of Years	MSMEs	Percentage (%)
Less than 5 Years	22	15.49
5 - 10 Years	28	19.72
10 - 15 Years	29	20.42
More than 15 Years	63	44.37
Total	142	100

Source: Primary Data.

The Table-3 displays the categorization of the firms. The sample firms have been categorized in to three, those are Micro enterprises, Small enterprises and Medium enterprises. Among all the sample enterprises 95 are Small Scale Enterprises which falls 66.90 per cent, followed by 33 Medium enterprises which are 23.24 per cent to the total firms and 14 Micro enterprises which are 9.86 per cent.

Table-3: Category of Organisation

Group	MSMEs	Percentage (%)
Micro	14	9.86
Small	95	66.90
Medium	33	23.24
Total	142	100

Source: Primary Data.

Channels of Communication with workers during Covid period

During the Covid-19 lockdown almost all the firms were closed down. On this situation how the employers have communicated with their employees, to boost moral support to the employees, is most important. It's a time for sensitivity and empathy, and for helping the organizations and the people adjust to the current reality.

The Table - 4 exhibites the communication with the workers by the employers. It is found from the table that 50 per cent of the workers are having constant touch over

[illegible] 38.03 per cent [illegible]

Table 4 Channels of Communication with Workers during Lockdown

Communication Channel	MSMEs	Percentage (%)
[illegible]	13?	[illegible]
Mobile?	[illegible]	[illegible]
E-Mail	0	0
Labour has migrated back	0?	[illegible]
Other	11?	[illegible]
Total	[illegible]	100

Source: Primary Data

Loans Taken by the Firms

Business needs funds from time to time to maintain their [illegible]. They need a substantial working capital to ensure smooth operation of business activities and [illegible] profitability. There are various players in the market which can provide business loans. Banking and non-banking financial institutions and private money lenders [illegible] the sources which offer loans to the business people. Table 5 indicate the loans taken by the firms. There are 118 firms (83.09 per cent) which have taken loans from various players and 24 firms (16.91 per cent) have not taken any loan from outside. It indicates that some firms are managing with their own capital only.

Table 5 Loans Taken by the Firms

Loans taken	Firms	Percentage (%)
Yes	118	83.09
No	24	16.91
Total	142	100

Source: Primary Data

Loans from Organised and unorganized Financial Sectors

The sample enterprises have taken loans from organized financial sectors and unorganized financial sectors. The banks and other financial companies are termed as organized financial sectors and the loans procured from the money lenders and others are coined as unorganized financial sector. The table – 6 displays the Loans taken by the firms. It is evident from the table that 64.41 per cent of the firms have procured loans from the organized financial sector i.e. banks and financial institutions and 35.59 per cent of the firms have been obtaining loans from the unorganized financial sector i.e. money lenders and others. It can be concluded that still 35.59 per cent of the firms are not in a position to procure loans from the banks and financial institutions. This situation accord due to restrictions imposed by the banks.

Table 6: Loans taken from Organised and Unorganised Financial Institutions

Loan taken from	Sole Trader			Partnership			Joint Stock Company			Total	
	Micro	Small	Medium	Micro	Small	Medium	Micro	Small	Medium		
Organised	00	27	12	00	18	16	00	00	03	76	64.41
Unorganised	04	19	03	08	09	00	00	00	01	42	35.59
Total	03	46	15	06	27	16	00	00	04	118	100

Source: Primary Data

Recovery of Debts from the Customers

Debt collection is the process of pursuing payments of debts owed by individuals or businesses. This in turn leads to maintenance of good relationship with the creditors. The MSMEs were running without cash during the lockdown period. They were not able to recover the debts from the customers during the lockdown period due to this they were not able to pay the creditors.

The Table - 7 indicates the risk of collecting the debts from the customers during lockdown period. It is observed from the table that 38.03 per cent of the firms felt that the recovery of debts became very difficult and it is extremely high risky and 45.07 per cent of the firms felt it is high risk and 16.90 per cent of the firms felt it is moderately risk to collect the debts during the lockdown period.

Table - 7: Risk of Receipts from the Customers i.e. Accounts Receivables

Risk	MSMEs	Percentage (%)
Very high Risk	54	38.03
High Risk	64	45.07
Moderately Risk	24	16.90
None	0	0
Total	142	100

Source: Primary Data.

Conclusion

The lockdown during Covid-19 period has a large impact on almost all the MSMEs in Kadapa District of the Andhra Pradesh. The MSMEs have faced lot of problems during that period. They were not able to get the loans from the banks and not above to collect the debts from the customers which made them to become handicapped. Due to this many of the MSMEs were closed down and some of them are in the verge of closing. Hence, the central and state government should take further steps to help the MSMEs and see that the relief measures announced by the governments should reached to these organizations.

References:

1. www.msme.gov.in
2. www.google.com

About the Editors

Dr G.Steeven Raju, M.A.,PGDCRS.,M.Phil.,Ph.D.,(GOLD MEDALIST),UGC NET, AP SET has been working as a Lecturer and Head of the Department of Economics, ideal College of Arts and Sciences (Autonomous), Kakinada, Andhra Pradesh, India. He awarded Ph.D from Andhra University, Visakhapatnam. He has more than 20 years of teaching and more than 5 years of Research Experience. He has published more than 20 research papers in various Journals, Periodicals and Seminar Volumes. He has been attended/presented papers in several international and national Seminars and Workshops. He has administrative experience by working in the college. Dr Steeven Raju also been acting as an Editor of International Journal of Academic Research (ISSN:2348-7666).

Dr. K. Swamiji, M.A (Pol) MA. (Pub.Add), Ph.D., was joined as Lecturer in Political Sciences, Ideal College of Arts and Sciences "A", Kakinada Since 20.08.2016. He is the ALUMNI of the Department of Political Sciences AUMSN PG Center, Kakinada. He awarded Ph.D. on his research work "Democratic Decentralization for the Empowerment of weaker section in India a core study in Andhra Pradesh 21.05.2019. He published 4 Research papers in various National and International Journals. He acted as convener in Two Seminars organized by the Department. He is the member of various administrative committees of the College.

Likhitha Publications
4-105/1, Srinivasanagar, Kakinada-533 005
Andhra Pradesh (India)
e-mail:drtvramana@yahoo.co.in

ISBN:978-81-947061-4-4

ISBN:978-81-947061-4-4

Price: Rs. 1050/-

Proceedings of the TEQIP-III sponsered One-Day National E-Conference on Emerging Paradigms in Teaching Englsih Language and Literature

Editer:

Prof.V.B.Chithra

Organized by
Department of Humanities
JNTU College of Engineering, (A)
Ananthapuram, AP

Published & Printed By:
JNTUA College of Engineering ,Anantapur
Ananthapuramu-515002, Andhrapradesh, India
Edition-1
ISBN : 978-81-949924-1-7

Visual Pleasure in Shakespeare's Film Adaptations with Special Reference to Vishal Bharadwaj's Omkara.

Dr. R.V. Jayanth Kasyap
Assistant Professor
Department of English
Yogi Vemana University,
Kadapa, A.P India
Email: rvjayanth@gmail.com-Mobile: 9441206399

Abstract

Shakespeare the unparalleled monarch in the realm of dramatic world is best remembered for his stupendous contribution not merely to the literary world but for his philosophical, spiritual and psychological insights present in his plays. The bard who wrote for pleasure influenced the world touching upon different aspects of the life and its facets . His dramatic art has been optimally explored by movie makers and the cinematic treatment enhanced the worth and value of his plays. It is easy to fathom the depth of his artistic talent in his works but a few skillful artists of the glamorous world of films have been successful in unveiling Shakespeare's plays on the celluloid with utmost talent and creative ability . The present paper titled ***Visual Pleasure in Shakespeare's film adaptations with Special Reference to Vishal Bharadwaj's Omkara*** *brings into context the directorial talent and success in adapting Shakespeare's play Othello , a tragedy packed with emotional intensity. The film which was produced in 2006 received adequate critical acclaim.*

Introduction

William Shakespeare, a creative genius, who reigned the kingdom of dramatic art and who continues to inspire the connoisseurs of art and literature needs no special introduction. Introducing him is placing mirror before the Sun for his uniqueness in terms exemplary contribution to the world of letters and creative output he is best remembered . His plays touch upon every aspect of life and its different facades. They are not without spiritual and philosophical content. Every emotion of life is presented in rich and vivid terms reflecting his deep insight about human behavior. The treasured utterances from his plays are oft quoted and embellishing every discourse. Film makers have been successful to explore his plays by lending them cinematic treatment bringing enriched grace to his dramatic talent. Most of the film adaptations of Shakespeare have received tremendous success artistically as well as commercially. It is certainly a massive task to adapt a play and tune it for the celluloid.

228

అమృతవర్షిణి

శతవసంతాల తిలక్

(1921-2021)

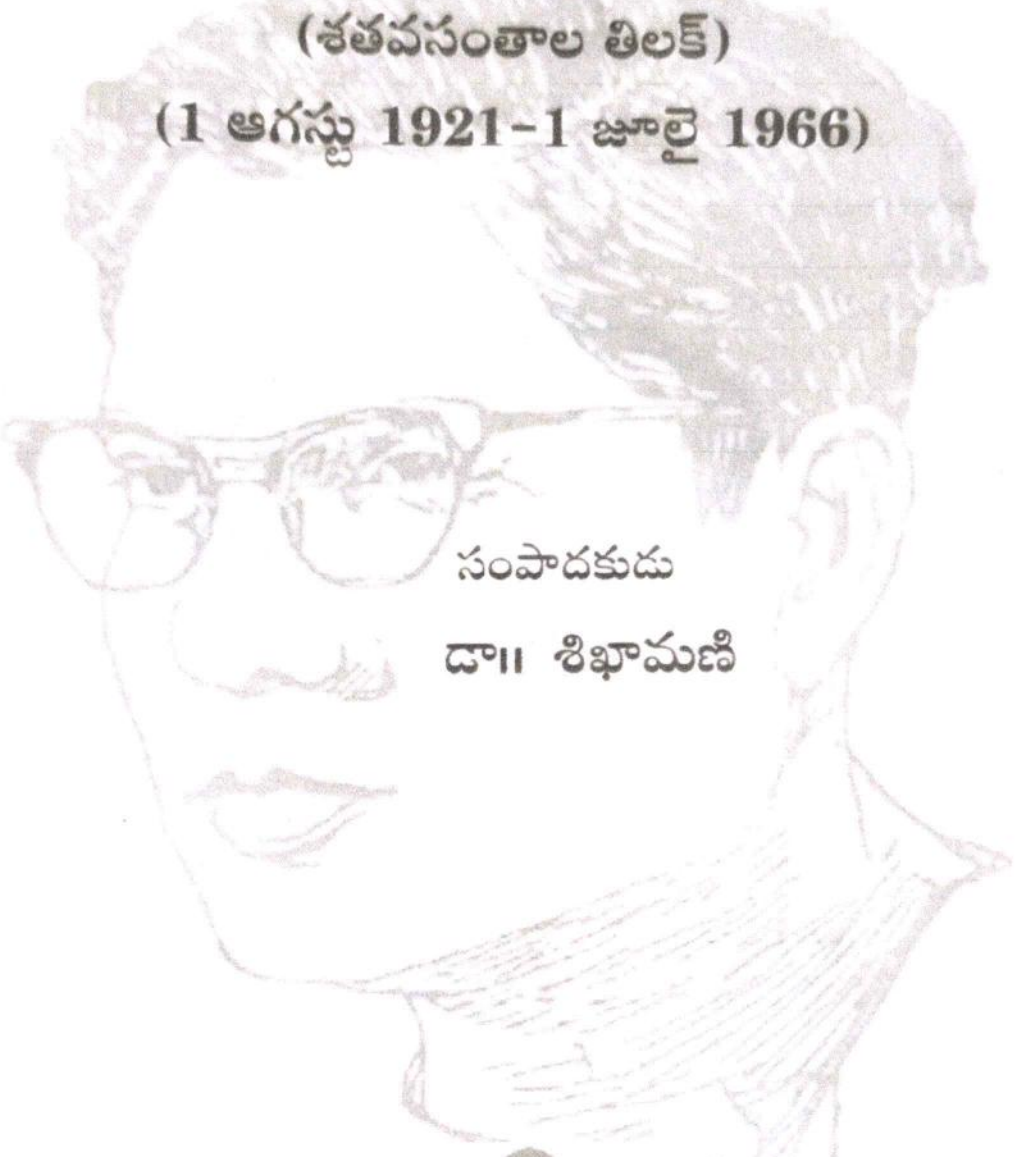
కవిసంధ్య
గ్రంథమాల ప్రచురణ

సంపాదకుడు
డా. శిఖామణి

అమృతవర్షిణి

(శతవసంతాల తిలక్)

(1 ఆగస్టు 1921-1 జూలై 1966)



సంపాదకుడు

డా॥ శిఖామణి

కవిసంధ్య

కవి సంధ్య గ్రంథమాల

యానాం - హైదరాబాద్

2021

Amruthavarshini - (Gaz...

Edited by Dr. Sikhamani

First Edition : 01-08-2021 తిలక్ శతజయంతి

No. of pages: xxiv + 430

Copies : 500

Price: Rs.350/-

Co-Editor :

Dr. N. Eswara Reddy, Associate Professor & Head
Dept. of Telugu, Yogi Vemana University, Kadapa - 516 001

Published by:

Kavisandhya Granthamala
Yanam and Hyderabad

Copies Can be had:

From all leading Book Shops (like Visalaandhra, Prajasakti, Navachetana, Nava Telangana, Navodaya & Aneka)

Sole Distribution :

Kavisandhya Granthamala
Plot No.61, Siddhartha Nagar, Vengala Rao Nagar, S.R. Nagar Post
Hyderabad - 500 038, Mobile: 9848202526
Email: kavisandhya.yanam@gmail.com
&
H.No.2-1-043, Ambedkar Nagar, Yanam Post, PIN-533464,
East Godavari Dist. Andhra Pradesh.

ISBN: **978-81-921672-4-4**

D.T.P.: **Nagasri Graphics**
Kuppam -517 425; Chittoor District, A.P.
Ph.No.08570-517 825; 8500619283

Cover Design by:

Brahmam, Bhavana Graphics, Hyderabad
Mobile: 9848254745

Inner Art by: **Bapu**

Printing at:

M/s Vijayavani Printers,
Chowdepalle - 517 257; Chittoor Dist.A.P.; Ph. No.08581-257234

Nanomaterials for Spectroscopic Applications

edited by
Kaushik Pal

JENNY STANFORD
PUBLISHING

Published by

Jenny Stanford Publishing Pte. Ltd.
Level 34, Centennial Tower
3 Temasek Avenue
Singapore 039190

Email: editorial@jennystanford.com
Web: www.jennystanford.com

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

Nanomaterials for Spectroscopic Applications

ISBN 978-981-4877-69-5 (Hardcover)
ISBN 978-1-003-16033-5 (eBook)

Chapter 11

Preparation of Metal Nanoparticles Extractions from Green Natural Products

Muthukumar Harshiny,[a] Sekar Aiswarya Devi,[b] Manickam Matheswaran,[b] and Muthukonda V. Shankar[c]

[a]*Department of Biotechnology, Indian Institute of Technology Madras, Chennai, Tamil Nadu 600036, India*
[b]*Department of Chemical Engineering, National Institute of Technology, Tiruchirappalli, Tamil Nadu 620015, India*
[c]*Nanocatalysis and Solar Fuels Research Laboratory, Department of Materials Science and Nanotechnology, Yogi Vemana University, Kadapa, Andhra Pradesh 516005, India*
matheswaran@nitt.edu

Metal nanoparticles (MNPs) are novel and inspiring material with unique traits and various applications. Multifunctional MNPs can be prepared using physicochemical and biological methods. Though, exploiting physicochemical routes requires high energy, and cost, it also leads to environmental damage via harmful chemical solvent utilization, consequently rising noxiousness and health concerns. In this regard, green extract mediated synthesis of MNPs has recently arisen as an eco-friendly method for synthesizing MNPs. Importantly covered, synthetic processes of MNPs using green natural products alike plant extracts and micro-organisms such as algae, bacteria, fungi, etc. Besides, the various parameters like

Nanomaterials for Spectroscopic Applications
Edited by Kaushik Pal

ISBN 978-981-4877-69-5 (Hardcover), 978-1-003-16033-5 (eBook)
www.jennystanford.com

Groundwater Geochemistry

Pollution and Remediation Methods

Edited by

Sughosh Madhav
Shaheed Bhagat Singh College,
Delhi, India

and

Pardeep Singh
PGDAV College, University of Delhi,
Delhi, India

WILEY Blackwell

This edition first published 2021

Registered Offices
John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA
John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

Editorial Office
9600 Garsington Road, Oxford, OX4 2DQ, UK

For details of our global editorial offices, customer services, and more information about Wiley products visit us at www.wiley.com.

Wiley also publishes its books in a variety of electronic formats and by print-on-demand. Some content that appears in standard print versions of this book may not be available in other formats.

Library of Congress Cataloging-in-Publication Data

Names: Madhav, Sughosh, editor. | Singh, Pardeep, editor.
Title: Groundwater geochemistry : pollution and remediation methods / edited by Sughosh Madhav and Pardeep Singh.
Description: Hoboken, NJ : Wiley-Blackwell, 2021. | Includes index.
Identifiers: LCCN 2021001375 (print) | LCCN 2021001376 (ebook) | ISBN 9781119709695 (hardback) | ISBN 9781119709718 (adobe pdf) | ISBN 9781119709701 (epub)
Subjects: LCSH: Groundwater–Pollution. | Groundwater–Purification. | Groundwater–Quality.
Classification: LCC TD426 .G7145 2021 (print) | LCC TD426 (ebook) | DDC 628.1/14–dc23
LC record available at https://lccn.loc.gov/2021001375
LC ebook record available at https://lccn.loc.gov/2021001376

Cover Design: Wiley
Cover Image: Courtesy of Sughosh Madhav

Set in 9.5/12.5pt STIXTwoText by Straive, Pondicherry, India

10 9 8 7 6 5 4 3 2 1

Contents

3

Salinity Problems in Groundwater and Management Strategies in Arid and Semi-arid Regions

Balaji Etikala[1], Narsimha Adimalla[2], Sughosh Madhav[3], Srinivasa Gowd Somagouni[4], and P.L. Keshava Kiran Kumar[4]

[1]*Department of Geology, Sri Venkateswara University, Tirupati, Andhra Pradesh, India*
[2]*School of Environmental Science and Engineering, Chang'an University, Xi'an, China*
[3]*School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India*
[4]*Department of Geology, Yogi Vemana University, Kadapa, Andhra Pradesh, India*

3.1 Introduction

Salinity is a major social, economic, and environmental menace in climates with low rainfall and high evapotranspiration (Jabbar and Chen 2008; Abuelgasim and Ammad 2018). In general, the surface water supply in arid and semi-arid climates is scarce, which shifts the attention of policymakers to groundwater. Groundwater in these regions is very limited and considered a major resource for sustaining terrestrial ecosystems (Balaji et al. 2019a, b; Huang et al. 2019). In addition, intense urbanisation, demand for freshwater due to an increase in population, and poor management strategies have generated additional stress to this limited resource which leads to lowering groundwater levels (Cosgrove and Loucks 2015; Nagaraju et al. 2016). Therefore, people dig bore wells to great depths for groundwater that are basically rich in soluble salts (Miglietta et al. 2017; Akinlalu and Afolabi 2018). Among complex environmental issues such as droughts, heavy blowing winds, heatwaves, and floods, salinity is also a major issue. It turns soils and irrigated land more saline, which impairs crop growth and leads to low production and land degradation (Shrivastava and Kumar 2015). Moreover, salinity is a serious public health concern and its consequences are seen mostly in coastal drylands. Consuming a higher amount of salt increases blood pressure, which increases the risk of cardiovascular disease that induces heart stroke and attack. Nowadays, it accounts for a large number of deaths worldwide. Among various direct and indirect sources, salinity is one of many serious issues that affect the hydrological cycle in terms of water quality deterioration (Pulido-Bosch et al. 2018). In urban landscapes (non-agricultural lands) it affects the structures by subsidence, corrosion, and water quality deterioration. All these practices result in the loss of arable lands that affects terrestrial habitats, particularly in

Groundwater Geochemistry: Pollution and Remediation Methods, First Edition.
Edited by Sughosh Madhav and Pardeep Singh.

drylands. It is estimated that the annual loss of arable land due to salinity is 20–50% (Pitman and Läuchli 2002). It is projected that about 50% of the world's arable land that is to be lost by 2050 will be attributed to the salinity problem (FAO 2009; Hussain et al. 2020).

Therefore, some knowledge on salinity-related health issues, management strategies, and reclamation techniques are needed to tackle this exacerbated situation. Hence, the sources, implications, and reclamation strategies are discussed in this chapter.

3.2 Problem of Salinity

Salinity refers to the amount of soluble salts in water and soils, mostly of ions such as Na^+, Cl^-, SO_4^{2-}, HCO_3^-, K^+, NO_3^{2-}, and F^- (Imadi et al. 2016; Artiola et al. 2019). It is likely to be one of the major issues that affect the world economy in the near future, especially in drylands. Figure 3.1 represents the world map showing countries with salinity issues. Salinity could be either natural or human-induced. Weathering of minerals, sea breeze (mainly in coastal areas), and capillary rise of saline water from lands of low water tables are the natural factors. This can be further accentuated by irrigated agriculture, intense fertilization, and seawater intrusion due to critical groundwater overdrafts, which are human induced. It is a serious issue affecting crop production worldwide. Abrol et al. (1988) reported that more than 932.2 million hectares of the world's fertile land are at risk due to salinization which makes the arable lands unusable for farming. According to UNEP (1992) (cf. FAO-ITPS-GSP 2015; Shahid et al. 2018) 1030.1 million hectares of the world's arable land were affected by salinity. About 20–50% of the world's arable land is salt-affected and degraded (Pitman and Läuchli 2002; Glick et al. 2007). The current scenario of land degradation could be much higher than previously thought.

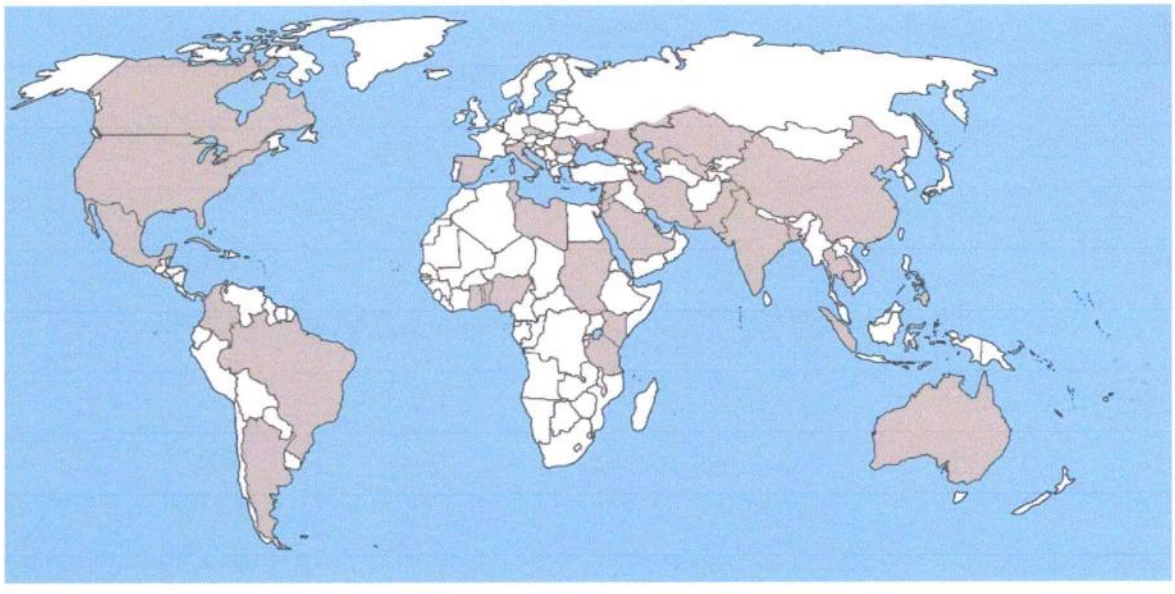


Figure 3.1 World map showing countries with salinity issues.

3.3 Sources of Aquifer Salinity

Salinity in aquifers can be either inland or coastal induced. The most common sources of salinity in aquifers is given in the following sections.

3.3.1 Inland Aquifer Salinity

Inland salinity is one of the main concerns linked to groundwater pollution and other associated issues worldwide (Greene et al. 2016). It is a daunting challenge for policymakers to handle water resources effectively. Inland salinity may result from a number of mechanisms like weathering of native rocks, erratic water supply due to low rainfall or high evaporation, leaching of poor quality irrigation water and untreated sewage effluents, recharge water quality, the inflow of paleo-saline water from adjacent formations due to critical pumping of groundwater, rise in water level due to removal of vegetation and poor drainage system, and use of excess fertilizers (Figure 3.2).

3.3.2 Coastal Aquifer Salinity

Saline water intrusion is a global threat to coastal aquifers that leads freshwater ecosystems to be contaminated due to excessive groundwater pumping (Badaruddin et al. 2015). This excess pumping of groundwater near coastal aquifers reduces the hydraulic head of inland groundwater that allows the saltwater to enter into inland aquifers, which leads to aquifer salinization. In fact, it is not only the cause, but it is also affected by global warming, which increases the opportunity for the intrusion of saltwater into coastal aquifers (Figure 3.3).

3.4 Types of Salinity

Based on the causes, salinity has been divided into four types. They are given in the following sections.

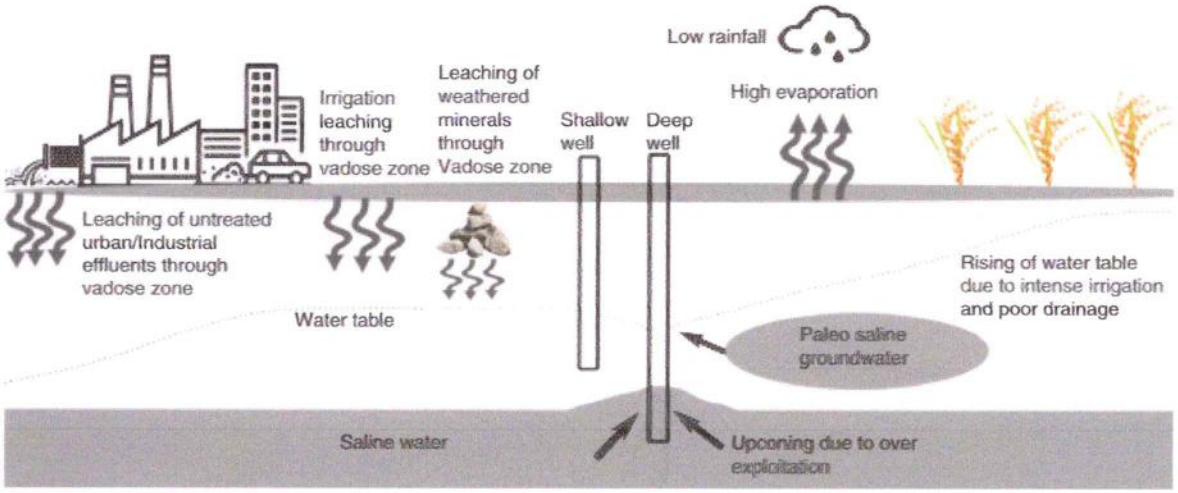


Figure 3.2 Salinization of inland aquifers. *Source:* Brindha and Schneider (2019), Elsevier.

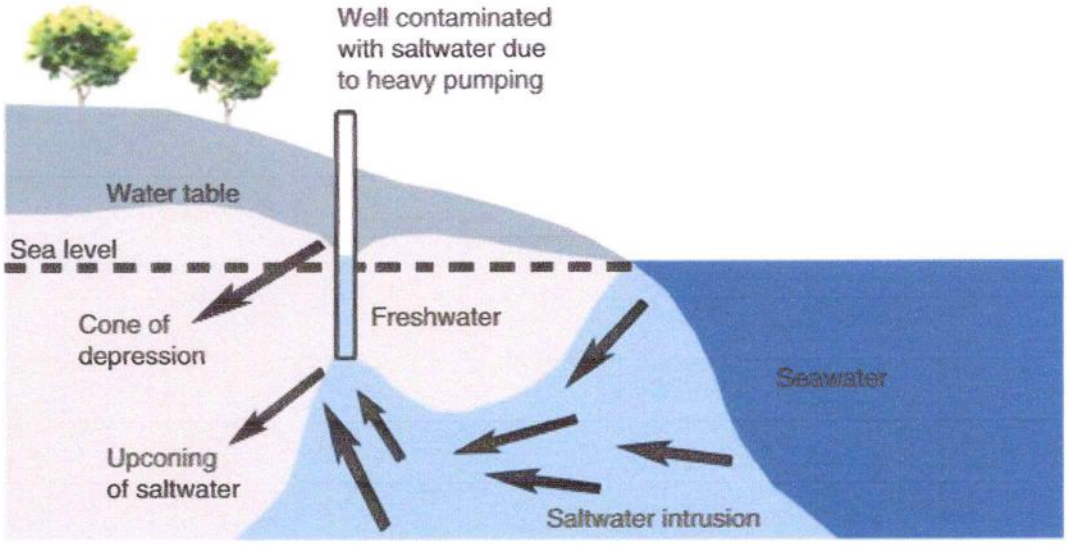


Figure 3.3 Salinization of groundwater in coastal areas.

3.4.1 Primary Salinity

Primary salinity is also called natural salinity. The most common sources of primary salinity are the rainfall, the characteristics of the parent rock, and seawater intrusion (Podmore 2009). In general, the rain leaves a certain amount of salt in the soils through evaporation. Over many cycles, these salts in the soil reach elevated levels. Rocks such as granites, rhyolites, and marine sediments left by the retreating of seas can contain high salts, which may release into the soil and mobilise into groundwater through weathering. Moreover, salts may be brought into the lands by strong winds and some salts may enter into the coastal aquifer by seawater intrusion.

3.4.2 Secondary Salinity

Secondary salinity is also referred to as dryland salinity and it is a major problem in the world. It is caused by the rising of the water table due to the evaporation of water from the soil. In drylands, the water loss is reduced due to the removal of vegetation and change in land use patterns that allows accumulation of more salts into the soil and groundwater, which have adverse effects on plant growth and lead to low crop yield (Zaman et al. 2018). The other causes that induce water table rise are restricted drainage systems, excessive recharge of groundwater due to heavy rains and floods, and replacement of deep-rooted perennial plants with shallow-rooted annual plants.

3.4.3 Tertiary Salinity

Tertiary salinity is also called irrigated salinity. It is characterised by the rise in the local groundwater level due to repetitive irrigation with large quantities of water over many cycles. This process can add some salts to the soil profile, which may also be mobilised into the groundwater. Each successive irrigation or reuse of saline groundwater keeps adding

more salts to the groundwater, which progressively becomes more saline, resulting in higher levels of salinity over several cycles (Zaman et al. 2018). It gets even worse when irrigating from poor quality water or saltwater.

3.4.4 Urban Salinity

Urban salinity is a combination of both dryland salinity and irrigation salinity that has the potential to affect valuable assets. It is characterized by the rise in groundwater level that is possibly due to blocking or changing natural drainage patterns due to urban developmental activities like laying roads, constructing buildings and other infrastructures, and leakage of pipes and drains. The most common sources of urban salinity are untreated urban effluents/industrial wastewater, building materials, fertilizers, and chemicals (Brindha and Schneider 2019).

3.5 Effects on Agriculture

3.5.1 Soil Structure

The bivalent cations such as Ca^{2+} and Mg^{2+} tend to flocculate, which facilitates penetration of water into roots, whereas the monovalent cations such as Na^{+} and K^{+} disperse the clay particles, which reduces the porosity of the soil. Hence the excess amount of Na^{+} and K^{+} has a profound impact on the relationship between soil and water, resulting in soil erosion and crop failure (Chibowski 2011).

3.5.2 Oxidative and Alkaline Stress

In general, the osmotic gradient helps in taking water from the soil by roots. Salinity in soil diminishes the osmotic gradient, which reduces the intake of water by roots and hinders cellular activities. This leads to the loss of vacuole fluid and the plant starts to wilt (Litalien and Zeeb 2019). The alkaline soils, usually saline/saline-sodic with pH above 8, tend to reduce the absorption of nutrients that due to the redox potential of major nutrients (Husson 2013).

3.5.3 Ion Toxicity

Long-term saline stress in terms of excess Cl^{-} and Na^{+} ions in soils induces the accumulation of ions into the plant that leads to ion toxicity. A high concentration of Cl^{-} ions in the soils affect the plant; further, it can affect photosynthesis, which leads to leaf burn and necrosis. Whereas the excess amount of Na^{+} ions in soil reduces the intake of K^{+} ions, which is highly desirable (White and Broadley 2001; Barhoumie et al. 2007; Machado and Serralheiro 2017). Boron toxicity is a common issue in the soils of the arid and semi-arid regions. It affects various aspects of the plant growth, such as metabolism alteration, lowering chlorophyll content in leaves, and decreasing root growth (Nable et al. 1990, 1997).

3.5.4 Nutrient Deficiencies

Continuous salt accumulation in soils over a period of time can cause an ionic imbalance in plant cells that inhibits the absorption of core elements like Ca^{2+}, K^{+}, and NO_3^{2-}. Accumulation of Na^{+} and Cl^{-} ions in soil induces nutritional deficiencies in plant tissues, which results in Na^{+} induced Ca^{2+} and K^{+}, Ca^{2+} induced Mg^{2+} and Cl^{-} induced NO_3^{2-} deficiencies (Grattan and Grieve 1992). Excess boron in soils results in deficiencies of Ca^{2+} in plants that cause necrosis of the leaf (Abdulnour et al. 2000).

3.6 Effects on Non-Agricultural Lands and Other Natural Resources

3.6.1 Subsidence of Land

Salinity has a profound effect on land subsidence, especially in clay-dominated coastal soils. Higher salinity in water reduces the interconnectivity of the pores by converting clay fabrics into parallel alignments that induce the fast dissipation of pore water. Hence, consolidation is more pronounced (Sarah et al. 2018).

3.6.2 Corrosive Risk

In general, the corrosive risk of freshwater is lower than that of saline water. The water containing a high percentage of dissolved oxygen and sodium and other chlorides makes metals like steel and low-alloy steels more susceptible to metal corrosion. In fact, these are not only the causes but are also affected by the other dependant factors such as pH, temperature, amount of soluble gases, and pollutants (Zakowski et al. 2014).

3.6.3 Deterioration of Water Quality

Salinity is one of the major issues that affect water resources in various forms. It is possibly due to both natural and anthropogenic activities. Seawater intrusion, rise in the water table due to poor irrigation and drainage, disturbance in existing groundwater salinity stratification by digging bore wells, and industrial effluents are the notable natural and human-induced groundwater salinity sources that can deteriorate the water quality by acidification and release of toxic ions into it. (Greene et al. 2016).

3.7 Effects of Saline Water on Human Health

Salinity is a serious environmental issue worldwide, especially in drylands and coastal regions. Dryland salinity is a major environmental degradation problem observed in Australia (Lambers 2003). Seawater intrusion is a major concern in coastal areas of Bangladesh, Brazil, California, China, India, Indonesia, Netherlands, and Vietnam (Chakraborty et al. 2019; Rahaman et al. 2020). The sea-level rise is a major issue for coastal cities such as Chennai, Cochin, Kolkata, and Mumbai. The major fertile river deltas in

India such as Cauvery, Indus, and Krishna are vulnerable to floods and seawater intrusion (Rahaman et al. 2020). The salinity issues in terms of seawater intrusion and sea-level rise may increase in the future due to climate change, and human activities like an increase in groundwater overdrafts and shrimp culture along the seacoasts, which may affect the coastal ecosystem to a greater extent (Akib Jabed et al. 2018).

Drinking saline water is a global health issue notably in coastal areas. Earlier, a number of studies reported that the people drinking large quantities of saline water may suffer from cardiovascular disease, diarrhoea, rise in blood pressure, hypertension, infant mortality, and skin and respiratory diseases (Dasgupta et al. 2016; Akib Jabed et al. 2018; Chakraborty et al. 2019). Though the salinity is a global issue, its health effects are often seen in low-income countries where water is poorly treated or totally untreated (Vineis et al. 2011). Health issues such as chronic malnutrition, low-calorie intake and hypertension were reported in coastal peoples of Bangladesh (Nahian et al. 2017; Rahaman et al. 2020). Mental and respiratory diseases were reported in Australia due to the inland salinity issue (Jardine et al. 2007). Studies in Arizona, Illinois, and Massachusetts, USA, suggested that high intake of salts would lead to raising blood pressure (Tuthill and Calabrese 1981; Welty et al. 1986; Rahaman et al. 2020). A study from Vietnam reported that high salt intake is highly associated with a rise in blood pressure that increases the risk of cardiovascular disease (Do et al. 2016). Moreover, the salinity shows some considerable impacts on soil microbial species which lowers the crop productivity (Dasgupta et al. 2017).

3.8 Management Strategies

Proper management strategies have to be followed to reduce the salinity effects, especially in arid and semi-arid areas. They are given in the following sections.

3.8.1 Lowering of the Groundwater Table

Extensive withdrawal of groundwater in the upstream side of the river may reduce the groundwater level in the coastal areas that allows the intrusion of seawater. Hence, crop cultivation is quite difficult in coastal areas due to the presence of saltwater. In order to reduce the salinity effects in coastal areas, leaching of salts has to be reduced. Hence, it is necessary to maintain a proper drainage system to lower the water table at least 1.5 m from the surface of the soil to prevent salt accumulation (Alam et al. 2017).

3.8.2 Construction of Water Harvesting Structures

In order to reduce the effect of salinity, groundwater consumption has to be substituted with freshwater (rainfall) for irrigation. Proper rainwater harvesting structures have to be constructed to cope with salinity for sustaining agricultural livelihood in drylands. Floodwater harvesting such as spat irrigation and runoff farming, macro-catchments such as highlands, and micro-catchment structures such as bunds, pits holes, and basins are the rainwater harvesting structures that can reduce the groundwater consumption for irrigation especially in drylands (Gebreyess and Abayineh 2019).

3.8.3 Reclamation of Saline Soils

Soil reclamation is one of the best ways to reduce the impact of salinity. In general, it refers to the strategies to extract soluble salts from the roots of the crops. Some of the best practices to reduce the impact of salinity are leaching, enhanced water management techniques, establishing surface (through ditches) and subsurface drainages (through open ditches, mole drains, crop rotations), use of organic or chemical fertilizers and use of salt-tolerant cultivars (Esenov and Redjepbaev 1999; Shrivastava and Kumar 2015; Kaledhonkar et al. 2019).

3.8.4 Leaching

Soil salinity is one of the important factors that influence plant physical and biological activities thereby reducing the crop yields. Hence, it is necessary to remove the excess salts from the root zone of the soil for improving crop production. Leaching is one of the important processes to remove salts from the root zone by applying a large amount of freshwater into the field and allowing the water to infiltrate. During infiltration, the excess salts from the root zone are washed away into deep soil layers. This process is effective when it is to be done in soils with low moisture and deep groundwater water tables (Zaman et al. 2018).

3.8.5 Surface and Subsurface Drainage Systems

Drainage refers to the removal of surface or subsurface water by natural or by installing artificial drainage systems. Drainage helps in lowering the water table and reducing the risk of rising groundwater table and accumulation of salts through the capillary rise. Hence, it is necessary to have a proper drainage system in order to reduce the negative impacts of rising water table and accumulation of salts. It can be accomplished by establishing surface (through ditches) and subsurface drainages (through open ditches, mole drains) (Shahid et al. 2018).

3.8.6 Possible Strategies and Practices to Reduce Salinity-Related Health Issues

Generally, the people from drylands and coastal areas are more vulnerable to salinity-related health issues to a large extent. Hence, it is necessary to create awareness among the communities to find alternative freshwater supplies to cope with salinity related health issues. Though there are several desalination processes which are of high cost, some low-cost techniques such as rainwater harvesting structures and ponds should be constructed. Optimal use and reutilisation of rainwater for various purposes is needed to reduce the risk of salinity to some extent.

3.8.7 Organic or Chemical Fertilizers

Organic fertilizers help in releasing various elements like Ca^{2+} and Mg^{2+} into the soil through decomposition and help in increasing soil water holding capacity. It also helps in reducing Na^{+} toxicity through cation exchange capacity (Machado and Serralheiro 2017).

Application of potash fertilizers can reduce the salinity effect of soils on crops. It reduces the uptake of Na^+, which helps in increasing crop production. It also helps in the uptake of elements such as Ca^{2+}, Mg^{2+}, K^+, and P. The boron toxicity can be overcome by adding nitrogen fertilizers (Koohkan and Maftoun 2016). The effects of Cl^- toxicity in soils can be ameliorated by adding nitrogen fertilizers (Bar et al. 1997; Karaivazoglou et al. 2005). The toxic effects of sodic soils on crops can be rectified by adding gypsum to the soil (Zaman et al. 2018).

3.8.8 Salt-Tolerant Cultivars

Salt accumulation in soils is one of the major issues worldwide. An uptaking of a large amount of soluble salts through roots has a significant impact on plant physiological and metabolic processes, which reduces crop yields. Usage of salt-tolerant cultivars is one of the major mitigation processes to cope with salinity problems. To overcome this issue, high tolerant crops have to be grown. Table 3.1 shows the list of salt-tolerant cultivars.

3.8.9 Water Management

Efficient water management techniques in saline soils can reduce the risk of salt accumulation in root zones and increase the crop yield. They are given in the following sections.

Table 3.1 List of salt-tolerant cultivars.

Sensitive	Moderately tolerant	Tolerant	Highly tolerant
Pea (*Pisum sativum*)	Wheat (*Triticum aestivum*)	Cabbage (*Brassica oleracea var. capitata*)	Asparagus (*Asparagus officinalis*)
Soybean (*Glycine max*)	Sunflower (*Helianthus annus*)	Olive tree (*Olea europaea*)	Beetroot (*Beta vulgaris*)
Gram (*Cicer arietium*)	Onion (*Allium cepa*)	Tomato (*Solanum lycopersicum*)	Rye (*Secale cereale*)
Groundnut (*Arachis hypogea*)	Barley (*Hordeum vulgare*)	Rice (*Oryza sativa*)	Date palm (*Phoenix dactylifera*)
Peach (*Prunus persica*)	Lucerne (*Medicago sativa*)	Spinach (*Spinacia oleracea*)	
Sesamum (*Sesamum oriental*)	Garlic (*Allium sativum*)	Sugarbeet (*Beta vulgaris*)	
Mung (*Phaseolus aureus*)	Oat (*Avena sativa*)	Dhaincha (*Sesbania aculeata*)	
Maize (*Zea mays*)	Pearl millet (*Pennisetum typhoides*)	Carrot (*Daucus carota subsp. sativus*)	
Lime (*Citrus aurantiifolia*)			

Source: Abrol et al. (1988), Singh (2009), Galvani (2006).

3.8.9.1 Irrigation Methods

To alleviate the saline stress coupled with low soil moisture, the crops grown under saline conditions should be more frequently irrigated than the non-saline conditions (Shrivastava and Kumar 2015). Sprinkler irrigation is the best method for frequently irrigated lands. It has the advantage of releasing small amounts of water for the infiltration process that reduces the leaching of salts (Minhas 1996). Drip irrigation is one of the best irrigation methods in lands irrigated with saline water. It keeps the plant root zone hydrated, which maintains low salt levels (Alhammadi and Al-Shrouf 2013).

3.8.9.2 Mulching

Mulching is the prominent process of soil moisture conservation from evaporation by placing polyethylene sheets, grass, and crop residues at the top of the soil. It helps to improve the quality of soil by reducing soil erosion and weed growth, regulating soil temperature, improving aeration, and supplying nutrients to the roots. Moreover, it also reduces the upward movement and accumulation of salts in the root zone, which helps to increase crop yields (Abd El-Mageed et al. 2016).

3.8.9.3 Crop Rotation

Crop rotation is the widely used cropping system in combating salinity which gives better results when the crop rotation is accompanied by good quality water and salt-tolerant cultivars. Growing of crops that rely on long fallowing for soil moisture conservation may favour rising of the groundwater table. It brings salts to the surface, which inhibits crop growth. In order to reduce the salinity perennial crops to be grown in rotation with annual crops. The earlier studies show that growing of Lucerne in rotation with wheat has a significant impact in combating salinity (Jobbágy and Jackson 2007).

3.9 Conclusions

Salinity is a serious threat to the environment which reduces agricultural yields, economic outcomes, and soil erosion that eventually leads to land deterioration, particularly in drylands. Moreover, it affects public health to a greater extent. Therefore, it is necessary to have basic knowledge of crop response to salt tolerance and proper management strategies such as constructions of artificial recharge structures, reclamation of soils, and water management methods to boost the global economy by increasing food production and reducing the risk of exposure to salinity-associated health issues. Earlier literature showed that some cropping patterns, management strategies, and methods of water management have been successfully adopted by the farming community and governing bodies and yielded good results in managing dryland salinity and other salinity-related problems. Considering the earlier literature as a reference, some future research is required in this field for sustainable development of agricultural livelihood and human ecology in combating salinity.

References

Abd El-Mageed, T.A., Semida, W.M., and Abd El-Wahed, M.H. (2016). Effect of mulching on plant water status, soil salinity and yield of squash under summer-fall deficit irrigation in salt affected soil. *Agricultural Water Management* 173 (1): 12. https://doi.org/10.1016/j.agwat.2016.04.025.

Abdulnour, J.E., Donnelly, D.J., and Barthakur, N.N. (2000). The effect of boron on calcium uptake and growth in micro propagated potato plantlets. *Potato Research* 43: 287–295. https://doi.org/10.1007/BF02358088.

Abrol, I.P., Yadav, J.S.P., and Massoud, F.I. (1988). *Salt-Affected Soils and Their Management*. FAO Soils Bulletin 39. Rome, Italy: Food and Agriculture Organization of the United Nations 131 pp.

Abuelgasim, A. and Ammad, R. (2018). Mapping soil salinity in arid and semi-arid regions using Landsat 8 OLI satellite data. *Remote Sensing Applications: Society and Environment*. https://doi.org/10.1016/j.rsase.2018.12.010.

Akib Jabed, M., Paul, A., and Nath, T.K. (2018). Peoples' perception of the water salinity impacts on human health: a case study in south-eastern coastal region of Bangladesh. *Exposure and Health* https://doi.org/10.1007/s12403-018-0283-0.

Akinlalu, A.A. and Afolabi, D.O. (2018). Borehole depth determination to freshwater and well design using geophysical logs in coastal regions of Lagos, southwestern Nigeria. *Applied Water Science* 8: 152. https://doi.org/10.1007/s13201-018-0798-3.

Alhammadi, M.S. and Al-Shrouf, A.M. (2013). Irrigation of Sandy soils, basics and scheduling. *Crop Production*. https://doi.org/10.5772/55117.

Alam, M.Z., Carpenter-Boggs, L., Mitra, S. et al. (2017). Effect of salinity intrusion on food crops, livestock, and fish species at Kalapara Coastal Belt in Bangladesh. *Journal of Food Quality* 2017: 1–23. https://doi.org/10.1155/2017/2045157.

Artiola, J.F., Walworth, J.L., Musil, S.A., and Crimmins, M.A. (2019). Soil and land pollution. *Environmental and Pollution Science*: 219–235. https://doi.org/10.1016/b978-0-12-814719-1.00014-8.

Balaji, E., Veeraswamy, G., Peiyue, L., and SiddiRaju, R. (2019a). Deciphering groundwater potential zones using MIF technique and GIS: a study from Tirupati area, Chittoor District, Andhra Pradesh, India. *HydroResearch* 1: 1–7. https://doi.org/10.1016/j.hydres.2019.04.001.

Balaji, E., Veeraswamy, G., Narsimha, A., and Subba Rao, M. (2019b). Factors controlling groundwater chemistry of Renigunta area, Chittoor District, Andhra Pradesh, South India. A multivariate statistical approach. *HydroResearch* 1: 57–62. https://doi.org/10.1016/j.hydres.2019.06.002.

Bar, Y., Apelbaum, A., Kafkafi, U., and Goren, R. (1997). Relationship between chloride and nitrate and its effect on growth and mineral composition of avocado and citrus plants. *Journal of Plant Nutrition* 20 (6): 715–731. https://doi.org/10.1080/01904169709365288.

Barhoumie, Z., Djebali, W., Smaoui, A. et al. (2007). Contribution of NaCl excretion to salt resistance of Aeluropus littoralis (Willd) Parl. *Plant Physiology* 164: 842–850.

Badaruddin, S., Werner, A.D., and Morgan, L.K. (2015). Water table salinization due to intrusion. *Water Resources Research* 51 (10): 8397–8408. https://doi.org/10.1002/2015wr017098.

Brindha, K. and Schneider, M. (2019). Impact of urbanization on groundwater quality. GIS and geostatistical techniques for groundwater. *Science*: 179–196. https://doi.org/10.1016/b978-0-12-815413-7.00013-4.

Chakraborty, R., Khan, K.M., Dibaba, D.T. et al. (2019). Health implications of drinking water salinity in coastal areas of Bangladesh. *International Journal of Environmental Research and Public Health* 16 (19): 3746. https://doi.org/10.3390/ijerph16193746.

Chibowski, E. (2011). Flocculation and dispersion phenomena in soils. *Encyclopedia of Earth Sciences Series*: 301–304. https://doi.org/10.1007/978-90-481-3585-1_59.

Cosgrove, W.J. and Loucks, D.P. (2015). Water management: current and future challenges and research directions. *Water Resources Research* 51 (6): 4823–4839. https://doi.org/10.1002/2014wr016869.

Dasgupta, S., Huq, M., Mustafa, M.G., et al. (2016). The impact of climate change and aquatic salinization on fish species and poor communities in the Bangladesh sundarbans. World Bank Policy Research Working Paper # 7593.

Dasgupta, S., Huq, M., Mustafa, M.G. et al. (2017). The impact of aquatic salinization on fish habitats and poor communities in a changing climate: evidence from southwest coastal Bangladesh. *Ecological Economics* 139: 128–139. https://doi.org/10.1016/j.ecolecon.2017.04.009.

Do, H.T.P., Santos, J.A., Trieu, K. et al. (2016). Effectiveness of a Communication for Behavioral Impact (COMBI) intervention to reduce salt intake in a Vietnamese Province based on estimations from spot urine samples. *The Journal of Clinical Hypertension* 18 (11): 1135–1142. https://doi.org/10.1111/jch.12884.

Esenov, P.E. and Redjepbaev, K.R. (1999). The reclamation of saline soils. In: *Desert Problems and Desertification in Central Asia* (ed. A.G. Babaev). Berlin, Heidelberg: Springer https://doi.org/10.1007/978-3-642-60128-6_15.

FAO (2009). *The State of Food Insecurity in the World*. Rome: Food and Agriculture Organization of the United Nations.

FAO-ITPS-GSP (2015) Status of the world's soil resources. FAO-ITPS-GSP Main Report, Food and Agriculture Organization of the United Nations, Rome, Italy, pp 125–127.

Gebreyess, B.F. and Abayineh, A. (2019). Water harvesting technologies in semi-arid and arid areas. *Journal of Degraded and Mining Lands Management* 7 (1): 1921–1928, ISSN 2502-2458. doi:https://doi.org/10.15243/jdmlm.2019.071.1921.

Galvani, A. (2006). The challenge of the food sufficiency through salt tolerant crops. *Reviews in Environmental Science and Bio/Technology* 6 (1–3): 3–16. https://doi.org/10.1007/s11157-006-0010-3.

Glick, B.R., Cheng, Z., Czarny, J., and Duan, J. (2007). Promotion of plant growth by ACC deaminase-producing soil bacteria. *European Journal of Plant Pathology* 119: 329–339.

Grattan, S.R. and Grieve, C.M. (1992). Mineral element acquisition and growth response of plants grown in saline environments. *Agriculture, Ecosystems and Environment* 38 (4): 275–300. https://doi.org/10.1016/0167-8809(92)90151-z.

Greene, R., Timms, W., Rengasamy, P. et al. (2016). Soil and aquifer salinization: toward an integrated approach for salinity management of groundwater. In: *Integrated Groundwater Management*, vol. 2016 (eds. A.J. Jakeman, O. Barreteau, R.J. Hunt, et al.), 377–412. Switzerland: Springer International Publishing AG https://doi.org/10.1007/978-3-319-23576-9_15.

Huang, F., Zhang, Y., Zhang, D., and Chen, X. (2019). Environmental groundwater depth for groundwater-dependent terrestrial ecosystems in arid/semi-arid regions: a review. *International Journal of Environmental Research and Public Health* 16 (5): 763. https://doi.org/10.3390/ijerph16050763.

Hussain, M.I., Farooq, M., Muscolo, A., and Rehman, A. (2020). Crop diversification and saline water irrigation as potential strategies to save freshwater resources and reclamation of marginal soils—a review. *Environmental Science and Pollution Research.* https://doi.org/10.1007/s11356-020-09111-6.

Husson, O. (2013). Redox potential (Eh) and pH as drivers of soil/plant/microorganism systems: a transdisciplinary overview pointing to integrative opportunities for agronomy. *Plant and Soil* 362 (1–2): 389–417.

Imadi, S.R., Shah, S.W., Kazi, A.G. et al. (2016). Phytoremediation of saline soils for sustainable agricultural productivity. *Plant Metal Interaction*: 455–468. https://doi.org/10.1016/b978-0-12-803158-2.00018-7.

Jabbar, M. and Chen, X. (2008). Land degradation due to salinization in arid and semi-arid regions with the aid of geo-information techniques. *Geo-Spatial Information Science* 11 (2): 112–120. https://doi.org/10.1007/s11806-008-0013-z.

Jardine, A., Speldewinde, P., Carver, S., and Weinstein, P. (2007). Dryland salinity ecosystem distress syndrome: human health implications. *EcoHealth* 4 (1): 10–17.

Jobbágy, E.G. and Jackson, R.B. (2007). Groundwater and soil chemical changes under phreatophytic tree plantations. *Journal of Geophysical Research* 112 (G2) https://doi.org/10.1029/2006jg000246.

Karaivazoglou, N.A., Papakosta, D.K., and Divanidis, S. (2005). Effect of chloride in irrigation water and form of nitrogen fertilizer on Virginia (flue-cured) tobacco. *Field Crops Research* 92 (1): 61–74. https://doi.org/10.1016/j.fcr.2004.09.006.

Kaledhonkar, M.J., Meena, B.L., and Sharma, P.C. (2019). Reclamation and nutrient management for salt-affected soils. *Indian Journal of Fertilisers* 15 (5): 566–575.

Koohkan, H. and Maftoun, M. (2016). Effect of nitrogen– boron interaction on plant growth and tissue nutrient concentration of canola (Brassica napus L.). *Journal of Plant Nutrition* 39 (7): 922–931. https://doi.org/10.1080/01904167.2016.1143492.

Lambers, H. (2003). Introduction, dryland salinity: a key environmental issue in southern Australia. *Plant and Soil* 257: 5–7. https://doi.org/10.1023/B:PLSO.0000003909.80658.d8.

Litalien, A. and Zeeb, B. (2019). Curing the earth: a review of anthropogenic soil salinization and plant-based strategies for sustainable mitigation. *Science of the Total Environment*: 134235. https://doi.org/10.1016/j.scitotenv.2019.134235.

Machado, R. and Serralheiro, R. (2017). Soil salinity: effect on vegetable crop growth. Management practices to prevent and mitigate soil salinization. *Horticulturae* 3 (2): 30. https://doi.org/10.3390/horticulturae3020030.

Minhas, P.S. (1996). Saline water management for irrigation in India. *Agricultural Water Management* 30 (1): 1–24. https://doi.org/10.1016/0378-3774(95)01211-7.

Miglietta, P., Toma, P., Fanizzi, F. et al. (2017). A Grey water footprint assessment of groundwater chemical pollution: case study in Salento (Southern Italy). *Sustainability* 9 (5): 799. https://doi.org/10.3390/su9050799.

Nable, R.O., Cartwright, B., and Lance, R.C. (1990). Genotypic differences in boron accumulation in barley: relative susceptibilities to boron deficiency and toxicity. In: *Genetic*

Aspects of Plant Mineral Nutrition (eds. N. El Bassam, M. Dambroth and B. Loughman), 243–251. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Nable, R.O., Banuelos, G.S., and Paull, J.G. (1997). Boron toxicity. *Plant and Soil* 198: 181–198.

Nagaraju, A., Balaji, E., and Dash, P. (2016). Land use/land cover analysis based on various comprehensive geospatial data sets: a case study from Tirupati Area, South India. *Advanced Remote Sensing* 5: 73–82. https://doi.org/10.4236/ars.2016.52006.

Nahian, M.A., Ahmed, A., Lazar, A.N. et al. (2017). Drinking water salinity associated health crisis in coastal Bangladesh. *Elementa: Science of the Anthropocene* 6 https://doi.org/10.1525/elementa.143.

Pitman, M.G. and Läuchli, A. (2002). Global impact of salinity and agricultural ecosystems. Salinity: environment - plants. *Molecules*: 3–20. https://doi.org/10.1007/0-306-48155-3_1.

Podmore, C. (2009). Irrigation salinity-causes and impacts. *Primefacts* 937: 1–4.

Pulido-Bosch, A., Rigol-Sanchez, J.P., Vallejos, A. et al. (2018). Impacts of agricultural irrigation on groundwater salinity. *Environmental Earth Sciences* 77 (5) https://doi.org/10.1007/s12665-018-7386-6.

Rahaman, M.A., Rahman, M.M., and Nazimuzzaman, M. (2020). Impact of salinity on infectious disease outbreaks: experiences from the global coastal region. In: *Good Health and Well-Being. Encyclopedia of the UN Sustainable Development Goals* (eds. F.W. Leal, T. Wall, A.M. Azul, et al.). Cham: Springer https://doi.org/10.1007/978-3-319-95681-7.

Sarah, D., Hutasoit, L., Delinom, R. et al. (2018). A physical study of the effect of groundwater salinity on the compressibility of the Semarang-DemakAquitard, Java Island. *Geosciences* 8 (4): 130. https://doi.org/10.3390/geosciences8040130.

Singh, G. (2009). Salinity-related desertification and management strategies: Indian experience. *Land Degradation and Development* 20 (4): 367–385. https://doi.org/10.1002/ldr.933.

Shahid, S.A., Zaman, M., and Heng, L. (2018). Soil salinity: historical perspectives and a world overview of the problem. In: *Guideline for Salinity Assessment, Mitigation and Adaptation Using Nuclear and Related Techniques*. Cham: Springer https://doi.org/10.1007/978-3-319-96190-3_2.

Shrivastava, P. and Kumar, R. (2015). Soil salinity: a serious environmental issue and plant growth promoting bacteria as one of the tools for its alleviation. *Saudi Journal of Biological Sciences* 22 (2): 123–131. https://doi.org/10.1016/j.sjbs.2014.12.001.

Tuthill, R.W. and Calabrese, E.J. (1981). Drinking water sodium and blood pressure in children: a second look. *American Journal of Public Health* 71 (7): 722–729.

UNEP (1992) Proceedings of the Ad-hoc expert group meeting to discuss global soil database and appraisals of GLASOD/SOTER, 24–28 February 1992, Nairobi, Kenya, 39 pp

Vineis, P., Chan, Q., and Khan, A. (2011). Climate change impacts on water salinity and health. *Journal of Epidemiology and Global Health* 1 (1): 5–10. https://doi.org/10.1016/j.jegh.2011.09.001.

White, P.J. and Broadley, M.R. (2001). Chloride in soils and its uptake and movement within the plant: a review. *Annals of Botany* 88: 967–988.

Welty, T.K., Freni, L.W., Zack, M.M. et al. (1986). Effects of exposure to salty drinking water in an Arizona community. Cardiovascular mortality, hypertension prevalence, and relationships between blood pressure and sodium intake. *Journal of the American Medical Association* 255: 622–626.

Zakowski, K., Narozny, M., Szocinski, M., and Darowicki, K. (2014). Influence of water salinity on corrosion risk—the case of the southern Baltic Sea coast. *Environmental Monitoring and Assessment* 186 (8): 4871–4879. https://doi.org/10.1007/s10661-014-3744-3.

Zaman, M., Shahid, S.A., and Heng, L. (2018). Guideline for salinity assessment. *Mitigation and Adaptation Using Nuclear and Related Techniques* https://doi.org/10.1007/978-3-319-96190-3.

225

MANAGEMENT EDUCATION IN INDIA: ISSUES & CHALLENGES

Editors

Dr. S. Subba Reddy

Dr. A. Amruth Prasad Reddy

Management Education in India: Issues & Challenges

First Edition - June 2021

ISBN : 978-93-90631-71-1

Price: ₹ **1250.00**

Paramount Publishing House
A-531, H.No. 4-32-521, Phase-1, Allwyn Colony, Kukatpally, Hyderabad - 500 072.
Ph. : 7799000082.

Sales Offices :
Hyderabad
A-531, H.No. 4-32-521, Phase-1, Allwyn Colony, Kukatpally, Hyderabad - 500 072.
Ph. : 7799000082.

New Delhi
C/14, SDIDC Work Centre Jhilmil Colony, New Delhi-100095. Phone: 011-2162365.
paramountpublishers@gmail.com | alluriasr2005@yahoo.com
Published by Krishna Prasad Alluri for Paramount Publishing House and printed by him at Sai Thirumala Printers.

MBA40133MIR

MASTER OF BUSINESS ADMINISTRATION
(MBA)

SECOND YEAR SEMESTER - IV

MANAGEMENT OF INDUSTRIAL RELATIONS

"We may forgo material benefits of civilization, but we cannot forgo our right and opportunity to reap the benefits of the highest education to the fullest extent..."

Dr. B.R. Ambedkar

Dr. B.R. AMBEDKAR OPEN UNIVERSITY
HYDERABAD
2021

COURSE TEAM

EDITOR

Prof. T. Sreenivas
Dean, Faculty of Comm. & Mgmt.
Department of Management
Yogi Vemana University
Kadapa.

ASSOCIATE EDITORS

Prof. I. Anand Pawar
Dean, Faculty of Commerce &
Head, Dept. of Business Management
Dr. BRAOU, Hyderabad.

Prof. Y.S. Kiranmayi (Retd.)
Senior Advisor
Dept. of Business Management
Dr. BRAOU, Hyderabad.

WRITERS

Prof. Suja S. Nair (Units: 13 to 15)
Department of Management
Vikram Simhapuri University, Nellore.

Prof. C. Viswanadha Reddy (Units: 1 to 3)
Department of Management
Rayalaseema University, Kurnool.

Prof. B. Madhu Bala (Unit: 4)
Department of Management
Aurora's P.G. College, Hyderabad.

Dr. G. Vijaya Bharathi (Units: 10 to 12)
Department of Commerce
Yogi Vemana University, Kadapa.

Dr. S.V. Subba Reddy (Units: 5 & 6)
Department of Management
Yogi Vemana University, Kadapa.

Dr. N. Udai Bhaskar (Units: 7 to 9)
Department of Management Studies
Adikavi Nannaiah University
Rajamahendravaram.

COVER DESIGN

Sri G.V. Swamy

Dr. B.R. Ambedkar Open University, Hyderabad.
First Edition: 2021

This text forms part of MBA Programme of Dr. B.R. Ambedkar Open University.

Further information on Dr. B.R. Ambedkar Open University programmes may be obtained from:

The Director (Academic), Dr. B.R. Ambedkar Open University,
Road No. 46, Prof. G. Ram Reddy Marg, Jubilee Hills, Hyderabad - 500 033. T.S. India.

Web: www.braou.ac.in
Printed on behalf of Dr. B.R. Ambedkar Open University, Hyderabad, by the Registrar.

Lr. No.

Printed at:

CONTENTS

*****

224 a,b

MBA40133MIR

MASTER OF BUSINESS ADMINISTRATION (MBA)

SECOND YEAR SEMESTER - IV

MANAGEMENT OF INDUSTRIAL RELATIONS

"We may forgo material benefits of civilization, but we cannot forgo our right and opportunity to reap the benefits of the highest education to the fullest extent…"

Dr. B.R. Ambedkar

Dr. B.R. AMBEDKAR OPEN UNIVERSITY
HYDERABAD
2021

COURSE TEAM

EDITOR

Prof. T. Sreenivas
Dean, Faculty of Comm. & Mgmt.
Department of Management
Yogi Vemana University
Kadapa.

ASSOCIATE EDITORS

Prof. I. Anand Pawar
Dean, Faculty of Commerce &
Head, Dept. of Business Management
Dr. BRAOU, Hyderabad.

Prof. Y.S. Kiranmayi (Retd.)
Senior Advisor
Dept. of Business Management
Dr. BRAOU, Hyderabad.

WRITERS

Prof. Suja S. Nair (Units: 13 to 15)
Department of Management
Vikram Simhapuri University, Nellore.

Prof. C. Viswanadha Reddy (Units: 1 to 3)
Department of Management
Rayalaseema University, Kurnool.

Prof. B. Madhu Bala (Unit: 4)
Department of Management
Aurora's P.G. College, Hyderabad.

Dr. G. Vijaya Bharathi (Units: 10 to 12)
Department of Commerce
Yogi Vemana University, Kadapa.

Dr. S.V. Subba Reddy (Units: 5 & 6)
Department of Management
Yogi Vemana University, Kadapa.

Dr. N. Udai Bhaskar (Units: 7 to 9)
Department of Management Studies
Adikavi Nannaiah University
Rajamahendravaram.

COVER DESIGN

Sri G.V. Swamy

Dr. B.R. Ambedkar Open University, Hyderabad.
First Edition: 2021

This text forms part of MBA Programme of Dr. B.R. Ambedkar Open University.

Further information on Dr. B.R. Ambedkar Open University programmes may be obtained from:

The Director (Academic), Dr. B.R. Ambedkar Open University,
Road No. 46, Prof. G. Ram Reddy Marg, Jubilee Hills, Hyderabad - 500 033. T.S. India.

Web: www.braou.ac.in
Printed on behalf of Dr. B.R. Ambedkar Open University, Hyderabad, by the Registrar.

Lr. No.

Printed at:

CONTENTS

*****

UNIT - 5 : INDUSTRIAL DISPUTES

Objectives

After studying this Unit, you should be able to:

- know the meaning, causes and consequences of industrial disputes;
- understand the machinery established for the settlement of industrial disputes, and
- explain in detail about different types of industrial disputes, viz., strikes, lock-outs, gherao, retrenchment, lay-off, etc.

Structure

5.1 INTRODUCTION

Prompt and equitable settlement of labour disputes is an important basis for sound industrial relations, and it is essential that the appropriate dispute settlement machinery exists to facilitate such settlement. The absence of effective dispute settlement systems and procedures can result in widespread industrial conflict with adverse effect on worker-employer relations and also on the collective bargaining process itself. The machinery established for the prevention and settlement of industrial disputes and also various types of industrial disputes like strikes, lock-outs, retrenchment, etc., are explained in this unit.

5.2 INDUSTRIAL DISPUTE: MEANING AND DEFINITION

Disputes mainly related to the strife between employers and their employees. An industrial dispute is defined as a conflict or a difference in opinion between management and workers

4. Mamoria M., 'Dynamics of Industrial Relations', (2010) Himalaya Publishing House, New Delhi.
5. Monappa A., 'Industrial Relations', (2012) Tata McGraw Hill Publications, New Delhi.
6. Sen R., 'Industrial Relations', (2011) Macmillion Publishers, New Delhi.
7. Kumar N.R., 'Human resource Management and Industrial Relations', (2010) Himalaya Publishing House, Mumbai.
8. P. Subbarao, Satish, Mamoria, 'Dynamics of Industrial Relations', (2007) Himalaya Publishing House, New Delhi.

5.20 CASE STUDY

Madras Printing Press is a proprietary unit in the printing business for the last over 15 years. It employs 20 employees in the different age groups. Some of them were recruited who had sufficient experience in other printing presses. It is a family business and the Owner treats the employees as part of his family. Over the years the owner noticed that one old employee is not delivering accurate work and is also slow in the work. Even after repeatedly telling him the employee did not improve. Resultantly, the work suffered and customers were lost. The Owner brought this to the notice of all employees. Employees agreed with the Owner but expressed their inability to do anything for improvement. The Owner then thought over and found out that the old employee had crossed the age of 60, which normally is the age of retirement. So the Owner called that old employee on 20th March, and told that he was superannuated and he should stop coming to work. The old employee pleaded for favour and requested that because of his financial difficulties, he be continued for a couple more years at least. The Owner did not say anything. From the next day, i.e.,. 21st onwards, the old employee continued to come to work and work as before. Neither the Owner nor any other employee talked to that old employee. Rather everyone ignored the old employee. After the month was over, the owner paid wages to 19 employees but not to the old employee. Old employee demanded wages for the entire month as he had worked for the entire month. Owner did not pay any attention to old employee nor did any other employee showed any sympathy to the old employee. No one even talked to old employee. Frustrated, the old employee approached the Government Labour Office.

Questions

1) Is the old employee justified in demanding wages for the entire month?
2) How the Owner could have avoided the problem?
3) What if the other 19 employees had supported the old employee?

UNIT - 6 : EMPLOYERS' ORGANIZATIONS

Objectives

After studying this Unit, you should be able to:

- know the concept of employers' organization;
- present the objectives and functions of employers' organizations;
- explain the organization and management of employers' organizations in India;
- know about various employers' organizations in India;
- identify the future challenges of employers' organizations, and
- discuss the role of employers' organizations from the international perspective.

Structure

6.1 INTRODUCTION

An employers' organization or employers' association is a collective organization of manufactures, retailers, or other employers of wage labour. Employers' organizations seek to coordinate the behaviour of their member companies in matters of mutual interest, such as during negotiations with trade unions or government bodies. Employers' organizations operate like trade unions and promote the economic and social interests of its member of organizations.

The effectiveness of any industrial relations system whether based on the legislation of voluntary arrangements, depends to a great extent on the attitude that unions' and employers' organizations adopt towards each other. The intention in covering employers' organizations under the Trade Unions Act, 1926 was to place both workers' and employers' organizations on a par in matters of rights and responsibilities. The principle of giving equal representation to capital and labour on all consultative bodies like the Indian Labour Conference, Standing Labour Committee and Industrial Committees recognises this basic tenet in the employer-employee relationship.

after the Enron scandal. The company could not have done a fraud without the knowledge of the auditors. PricewaterhouseCoopers is also dodging to have word on the issue.

PricewaterhouseCoopers was the auditor of Satyam while Satyam was fudging its accounts, its auditor; PricewaterhouseCoopers was certifying these accounts to be correct. Auditors minutely check and examine each and every business transaction and certify the same to be correct. These certified account statements are then sent to the shareholders. The Satyam fraud has not been committed by Ramalinga Raju alone; its auditor must also have been fully involved in it. PricewaterhouseCoopers was also the auditing firm of Global Trust Bank, which is also facing legal charges for not only certifying fudged accounts of the Bank but for also giving it a good rating. Can they involve trade unions to probe?

Even corporate frauds would be an extremely rare incidence in organizations like Satyam had the trade unions and their officers' associations performed the crucial role of whistleblower.

According to the Comptroller and Auditor General (CAG), 'The officers' associations and workers' unions ensure information dissemination and there by any wrong doing can be detected early. It cannot continue for years together as it has been done by Satyam". The CAG gets a large number of letters, often anonymous, about irregularities in various public sector undertakings. In the banking sector, another services sector like information technology, many frauds and malpractices have been exposed and nipped in the bud, since trade unions are proactive and strong in this sector.

Mr. Gurudas Dasguptha, CPI leader and general secretary of the All India Trade Union Congress (AITUC) that controls the largest banking unions in the country (AIBEA and AIBOC), believe that trade unions prevent irregularities by exposing them.

The banking unions are strong enough to the extent of compelling the management to bring to light the most confidential and unpublished lists of defaulters. However, the absence of trade unions in the IT sector gives an opportunity to the management to do the business the way they want. A comparison of banking and IT sector, both offer services, gives ample proof the trade unions have a positive role in correcting the imbalances in the system.

Questions

1) Can trade unions be involved in exposing the fraud, irregularities and malpractices in the industry?
2) "No union, more fraud". Do you agree with the statement? Why or why not?

224 c,d,e

MBA40133MIR

MASTER OF BUSINESS ADMINISTRATION (MBA)

SECOND YEAR SEMESTER - IV

MANAGEMENT OF INDUSTRIAL RELATIONS

"We may forgo material benefits of civilization, but we cannot forgo our right and opportunity to reap the benefits of the highest education to the fullest extent…"

Dr. B.R. Ambedkar

Dr. B.R. AMBEDKAR OPEN UNIVERSITY
HYDERABAD
2021

COURSE TEAM

EDITOR

Prof. T. Sreenivas
Dean, Faculty of Comm. & Mgmt.
Department of Management
Yogi Vemana University
Kadapa.

ASSOCIATE EDITORS

Prof. I. Anand Pawar
Dean, Faculty of Commerce &
Head, Dept. of Business Management
Dr. BRAOU, Hyderabad.

Prof. Y.S. Kiranmayi (Retd.)
Senior Advisor
Dept. of Business Management
Dr. BRAOU, Hyderabad.

WRITERS

Prof. Suja S. Nair (Units: 13 to 15)
Department of Management
Vikram Simhapuri University, Nellore.

Prof. C. Viswanadha Reddy (Units: 1 to 3)
Department of Management
Rayalaseema University, Kurnool.

Prof. B. Madhu Bala (Unit: 4)
Department of Management
Aurora's P.G. College, Hyderabad.

Dr. G. Vijaya Bharathi (Units: 10 to 12)
Department of Commerce
Yogi Vemana University, Kadapa.

Dr. S.V. Subba Reddy (Units: 5 & 6)
Department of Management
Yogi Vemana University, Kadapa.

Dr. N. Udai Bhaskar (Units: 7 to 9)
Department of Management Studies
Adikavi Nannaiah University
Rajamahendravaram.

COVER DESIGN

Sri G.V. Swamy

Dr. B.R. Ambedkar Open University, Hyderabad.
First Edition: 2021

This text forms part of MBA Programme of Dr. B.R. Ambedkar Open University.

Further information on Dr. B.R. Ambedkar Open University programmes may be obtained from:

The Director (Academic), Dr. B.R. Ambedkar Open University,
Road No. 46, Prof. G. Ram Reddy Marg, Jubilee Hills, Hyderabad - 500 033. T.S. India.

Web: www.braou.ac.in
Printed on behalf of Dr. B.R. Ambedkar Open University, Hyderabad, by the Registrar.

Lr. No.

Printed at:

CONTENTS

*****

UNIT - 10 : PARTICIPATIVE MANAGEMENT

Objectives

After studying this Unit, you should be able to:

- understand the meaning and objectives of participative management;
- identify the levels of participative management;
- know the forms of participative management in detail;
- aware the trends and schemes of participative management;
- explain the advantages and limitations of participative management;
- know the pre-requisites for successful participation and also know the reasons for the failure of participative management, and
- gain knowledge about the implementation of the concept of participative management in India and in abroad.

Structure

10.1 INTRODUCTION

Twentieth century has witnessed several drastic and revolutionary changes in the field of industries. The success of a business enterprise depends on cordial industrial relations. If the attitude of the workers towards their work is positive, they try to contribute their best for the achievement of organizational goals. The employer-employee relation should be strengthened to create a congenial work atmosphere so that the contribution of the employees towards the achievement of goals of management can be enhanced. This will pave way for the industrial harmony which is very essential for the uninterrupted production/service.

CASE STUDY – 10.2

Xerox has been known as one of the leading enterprises in the service business sector. It has offices in over 160 countries around the world and has been working closely with different companies since the time the company was formed. Xerox is included in Fortune 500 Companies, wherein it has a value of $11 billion. The company delves with global citizenship, investor relations, and innovation to further create a customer-focused service for its leading clients. Providing services to small and midsize businesses (SMBs), graphic communications companies, as well as governmental agencies, educational institutions as well as businesses (Xerox Corporation, 2017). The competition in the advent of technology and information archiving and distribution has increased in the Eighties and resulted in the company's shrinking market up to 35%. The company then created a quality improvement plan, wherein progress and survival of the organization were the goals.

Questions

1) What is the problem of the case?
2) What are the strategies to be followed by the company to increase the market share?
3) What are the challenges may be encountered by the company in process of implementing the total quality improvement plan?
4) Suggest quality improvement plan to be undertaken to tackle the problem.

UNIT - 11 : WORKS COMMITTEE AND JOINT MANAGEMENT COUNCIL

Objectives

After studying this Unit, you should be able to:

- understand the concepts of Works Committee and 'joint management councils';
- identify the need, importance, objectives and functions of 'joint management councils';
- get insights about various councils available to support workers participation in management like 'shop councils', 'joint consultation machinery' and 'compulsory arbitration', and
- explain the meaning and methods of 'co-determination'.

Structure

11.1 INTRODUCTION

You have already learnt that workers participation in management means giving scope for workers to influence the managerial decision-making process at different levels by various forms in the organisation. The manager, workers and industrial relations experts interpret the term "workers' participation management" in different ways. Some managers interpret it as information sharing while others consider it as joint consultation prior to decision making. However this is not all about it! The workers generally think of it as joint decision-making. That means workers treat participation as equivalent to co-decision in the spheres of management of the enterprise after all they want to really participate! They regard it as an association of labour with management without the final authority or responsibility in the general area of managerial functions. It means that the management shares in an appropriate manner the decision-making power with the lower ranks of the organization.

Thus, workers' participation in management means giving scope for workers to influence the managerial decision-making process at different levels by various forms in the organisation. There are various forms of workers' participation which are briefly explained in Unit – 10. Forms of participation vary from industry to industry, country to country and facility to facility

6. Jeff Hyman, 'Employee Voice and Participation: Contested Past, Troubled Present, Uncertain Future', (2001) Routledge Publications, New York.

7. Muhammad Abdul Mannan, 'Workers' Participation in Managerial Decision Making', (2000) Daya Publishing House.

11.14 CASE STUDY

Roy, the President and Founder of Electric Manufacturing Corporation (EMCORP) is wondering how he can follow the advice of his doctor, who had told him to take it easy after last year's coronary attack. EMCORP manufactures a full line of fractional horsepower electric motors sold to both original equipment manufacturers and distributors throughout the country. At present, the company employs approximately 1,000 people. Roy, an engineer, has maintained tight control over all major functions throughout the years, and though each of the heads of the engineering, manufacturing, sales, finance and personnel departments has the title of vice-president, they come to Roy for approval before making any change in procedure. Usually, each of these executives sees Roy several times a day. The Personnel Director once suggested a weekly meeting, but Roy voted the idea as too time consuming. Now, worried about his health as well as the problems of the company, Roy is beginning to feel the need for some relief from the constant pressure.

The manufacturing department shows a picture of rising costs, consistent failure to meet delivery schedules, and an increasing number of quality complaints. John, Vice President - Manufacturing, admits to poor performance, but says that the cost figures from accounting are pure history and of no use since they do not reach manufacturing until the fifteenth of the month following the month in which the work is completed. He states that his failure to meet delivery schedules is due almost entirely to the fact that the sales department makes unrealistic promises, and does not bother to check manufacturing schedules. John attributes most of the quality problems to the incessant flow of engineering changes that come without warning and with no time to work out the production problems present in all new products. Roy admits to himself that he had asked Smyth, Vice President Engineering, to put all the approved changes into production immediately.

The Vice President and general manager of sales, Rita, recognizes that she has no knowledge of the manufacturing schedules and realizes that she too is being criticized by Roy for many broken promises in regard to delivery dates. However, Rita's chief complaint at the present time is the result of having sold a large order of standard motors to a distributor having a supply of replacement parts in stock, and then discovering that engineering had changed specifications: a change that made all replacement parts in the field obsolete. Another irritant for Rita is the tightening of credit requirements instituted by the finance department without prior consultation with the sales department. Again, Roy admits to himself that it is the same engineering change which caused so much trouble in manufacturing that is causing trouble for the sales department and making obsolete the existing stock of replacement parts. He also realizes that at his request, due to an unusually short cash position, the finance department tightened up on credit requirement.

Questions

1) Define the major problem of EMCORP' s management.

2) Will the formation of a committee be of any value in this situation? If a committee is needed, assign a title to the committee and indicate who should be members of the committee?

3) In the event that Roy decides to retire, will the presence of a committee make it easier or more difficult for Roy's successor? Discuss.

UNIT - 12 : EMPLOYEE EMPOWERMENT AND QUALITY OF WORK LIFE

Objectives

After studying this Unit, you should be able to:

- understand the concept of employee empowerment, and its process;
- state the importance of employee empowerment in participative management;
- identify the benefits and barriers towards empowerment;
- explain various forms and pre-requisites of employee empowerment;
- know the meaning of the concept of 'quality of work life';
- discuss the issues involved in quality of work life, and
- get insights about the pre-requisites of and trends to improve 'quality of work life'.

Structure

12.1 INTRODUCTION

Employee empowerment is defined as the ways in which organizations provide their employees with a certain degree of autonomy and control in their day-to-day activities. This can include having a voice in process improvement, helping to create and manage new systems and tactics, and running smaller departments with less oversight from higher-level management. A key principle of employee empowerment is providing employees the means for making important decisions and helping ensure those decisions are correct. When deployed properly, this should result in heightened productivity and a better quality of employee work and work life.

3. Davis, Keith, 'Human Behaviour at Work, Organizational Behaviour', (1977) Tata McGraw Hill Publishing Co.
4. Subba Rao P., 'Personnel and Human Resource Management', (2006) Himalaya Publishers, New Delhi.
5. Aswathappa K., 'Human Resource and Personnel Management: Text and Cases', (2007) Tata McGraw Publishing Company, New Delhi.
6. Robert H. Quest, 'Quality of Work Life-Learning from Terrytown', (1979) Harvard Business Review.

12.19 CASE STUDY

CASE STUDY – 12.1

Naza is a private car and automotive parts manufacturing company situated in Malaysia established in the year 2002. The number of employees working in the company is 1000. Globalization has opened up various opportunities and challenges for Malaysian organizations to compete internationally. Besides technological advancement, a developed, competent and empowered workforce will give Malaysian organizations an edge over it competitors. According to news report, Naza Automotive Manufacturing (NAM) has lay-off 300 workers at its assembly plant in Gurun, Kedah. The various contemporary studies on empowerment have shown that it has strong correlation to employee performance in terms of higher productivity, job satisfaction and reduction in staff turnover in organizations.

Questions

1) What is the problem of this case?
2) Is this correlation applicable to the Malaysian context specifically in the automotive sector?
3) How would you deal with present situation?
4) What are steps to be taken by the company to avoid such problems in future?

CASE STUDY – 12.2

Employees who are keen to enact their ideas are invaluable. Yet many are frustrated that they have no outlet to do so. This was exactly what Hans Sandholt, a system engineer, experienced at Ericsson. His idea, according to Fast Company, was to 'create a series of software upgrades that could be installed in the microwave equipment in the field to essentially reprogram it rather than replace it as the broadcast technology changes.' Ericsson listened. And there's now less hardware to change, and a product that's constantly evolving. 'Idea boxes' was first introduced in 2008. It's comparable to a large scale brainstorming exercise - employees post their ideas to an online forum, where they are subject to a vote. The employee responsible for each idea becomes the 'manager', and tweaks the original concept depending on feedback. It's then made into a 'box'. And at this stage, hundreds of employees weigh in with their ideas, until a decision is made about whether it's worth being implemented.

Questions

1) What name can you suggest for the above case study?
2) Is there any other way to tackle the problem encountered in Ericsson?
3) Which kind of employee empowerment is followed by the Ericsson?
4) If you are manager of Ericsson what kind of measures would you take for employee empowerment?

CHAPTER 2

Recent advances in Effective Remediation of Groundwater Fluoride

V. Sunitha*

Department of Geology, Yogi Vemana University, Kadapa, India-516005.
**Corresponding author: vangalasunitha@gmail.com*

Abstract: Fluoride is generally referred to as a double-edged sword as dental caries are related to dental caries, but enormous intake causes dental and skeletal fluorosis. Fluoride in ground water comes due to dissolution of natural minerals in the rocks, soils into which water interacts. Toxic fluoride concentration in drinking water is noted in several areas around the world and millions of people depend on groundwater with range of concentrations exceeding the World Health Organization (WHO) guideline level of 1.5 mg/L. In India, 65 million individuals are believed to be affected by endemic fluorosis. With a proposal to resolve the problem, the Rajiv Gandhi National Drinking Water Mission has been established to monitor fluorosis. Nalgonda technique, Prasanti activated alumina technology, UNICEF in India using defluoridation based on households have been developed. A simple and economical domestic defluoridation process was developed by various researchers on the basis of findings and comprehensive investigations. This paper seeks with recent techniques on defluoridation studies using traditional and unconventional materials and to compile the various pros and cons of these defluoridation techniques, including prashanti activated alumina technology, membrane method, water treatment residues (WTR), Fe_3O_4/Al_2O_3 nanoparticles adsorption using red mud, clay, bauxite, clay, Mentha longifolia.

Key Words: Emerging trends, Defluoridation, Ground water, Fluorosis, India

Editor: Kummari SV Krishna Rao; ISBN: 978-81-949685-5-9

[58] S. Shahrokhian, M. Ghalkhani, M.K. Amini, (2009) Application of carbon-paste electrode modified with iron phthalocyanine for voltammetric determination of epinephrine in the presence of ascorbic acid and uric acid. ***Sensors and Actuators B: Chemical,*** 137(2) 669-675.

[59] D. Mohapatra, D. Mishra, S.P. Mishra, G.R. Chaudhury, R.P. Das (2004) Use of oxide minerals to abate fluoride from water. ***Journal of colloid and interface science***, 275(2) 355-359.

[60] L. Zhang, Z. Shi, Q. Lang, J. Pan, (2010) Electrochemical synthesis of belt-like polyaniline network on p-phenylenediamine functionalized glassy carbon electrode and its use for the direct electrochemistry of horse heart cytochrome C. ***Electrochimica acta***, 55(3) 641-647.

[61] I.R.W. de Oliveira, R.E.H.M. de Barros, A. Neves, I.C. Vieira, (2007) Biomimetic sensor based on a novel copper complex for the determination of hydroquinone in cosmetics ***Sensors and Actuators B: Chemical,*** 122(1) 89-94.

[62] T. Yang, N. Zhou, Y. Zhang, W. Zhang, K. Jiao, G. Li, (2009) Synergistically improved sensitivity for the detection of specific DNA sequences using polyaniline nanofibers and multi-walled carbon nanotubes composites. ***Biosensors and Bioelectronics,*** 24(7) 2165-2170.

[63] M.G. Sujana, S. Anand (2011) Fluoride removal studies from contaminated ground water by using bauxite, ***Desalination,*** 267 222–227.

[64] S.I. Alhassan, Y. He, L. Huang, B. Wu, L. Yan, H. Deng, H. Wang, (2020) A review on fluoride adsorption using modified bauxite. Surface modification and sorption mechanisms perspectives. ***Journal of Environmental Chemical Engineering*** 8. 104532.

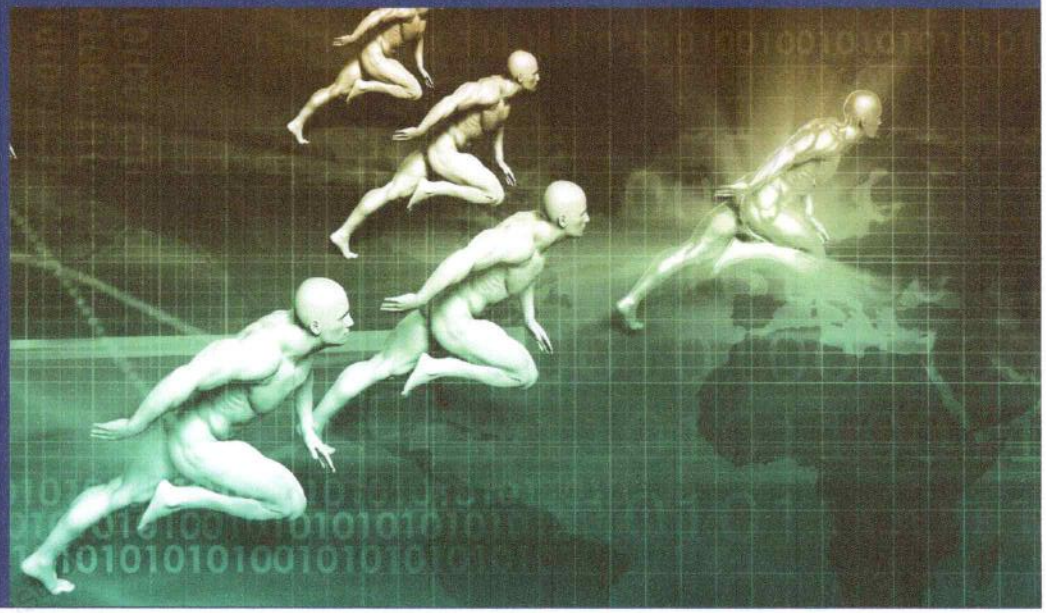
[65] R. Lavecchia, F. Medici, L. Piga, G. Rinaldi, A. Zuorro (2012) Fluoride removal from water by adsorption on a high alumina content bauxite. ***Chemical Engineering***, 26 225-230.

[66] A.V. Jamode, V.S. Sapkal, V.S. Jamode, (2004) Defluoridation of water using inexpensive adsorbents, ***Journal of the Indian Institute of Science,*** 84 163-171.

[67] Y. Wang, J. Reardon Eric (2001) Activation and regeneration of a soil sorbent for defluoridation of drinking water, ***Applied Geochemistry***, 16. 531–539.

[68] Beitollahi H, Karimi-Maleh H, Khabazzadeh H. (2008) Nanomolar and selective determination of epinephrine in the presence of norepinephrine using carbon paste electrode modified with carbon nanotubes and novel 2-(4-oxo-3-phenyl-3, 4-dihydro-quinazolinyl)-N'-phenyl-hydrazinecarbothioamide. ***Analytical Chemistry***. 80(24) 9848-9851.

The concept of leadership is a very ancient origin. In today's fast-changing world, leadership issues are getting increasingly important in organizations both at policy and implementation levels. The key to the progression of leadership is the need to coordinate the efforts of a group. The person who coordinates the group's effort is called the leader, and the behavior of the leader towards the members of the group (followers) is his leadership style. Thus, leadership is an interpersonal relationship between the leaders and followers. Leadership style is the result of philosophy as well as the personality and experience of leaders. It depends upon the nature of the tasks, type of followers, conditions prevailing in the organization, etc. Leading is a very human activity, as diverse and robust as any other activity. Each and every leader has his/her own style. Therefore, there are as many leadership styles as there are leaders.



Dr. Peram Venkata Nagarjuna Reddy, M.Com., M.B.A., Ph.D.
G. Haranath, M.Com., M.B.A., M.F.M., M.F.T., Ph.D., Assistant Professor of Commerce at Yogi Vemana University, Andhra Pradesh, India.

978-620-2-51396-8

NAGARJUNA REDDY, Haranath

PERAM VENKATA NAGARJUNA REDDY
Gundluru Haranath

Leadership Perspectives

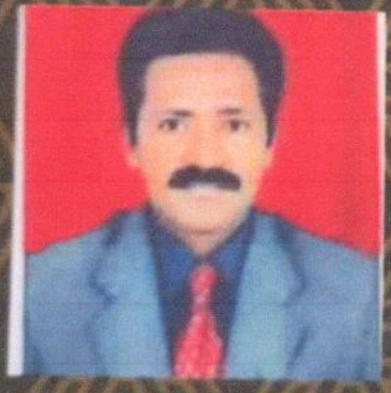
A Case Study of Zuari Cements Limited

LAP LAMBERT Academic Publishing

JOB STRESS AND ITS MANAGEMENT AMONG IT PROFESSIONALS

LAZAR VEPARALA

This book is to bring the life styles of the computer software professionals where the world is ruled by technology. where they are undergoing stress which really causes their health. Some of them are using coping mechanisms to cope with the stress, some of them are using their emotional intelligence to balance their lifestyle situation, some of them are using sense of control to overcome the given adverse situations in their currier and some of them are went to peek stage to burnout their stress

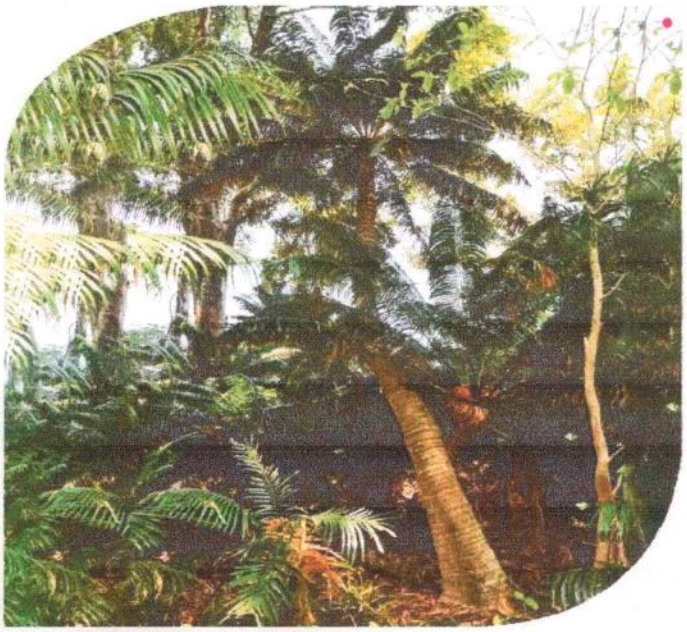


Dr.LAZAR VEPARALA working as Assistant Professor. Department of Psychology. Yogivemana University Kadapa. 516005. Andhra Pradesh INDIA. He did his research work under the guidance of Dr.S.USHASREE Professor of Psychology. Department of psychology. Sri Venkateswara University. Tirupathi, Andhra Pradesh. INDIA. she is the one who made him an instrument to sound. Area of interest is Organizational Behaviour and Health Psychology. He published 9 research articles in National and International journals. He acted as a resource person in various workshops and conferences.

ISBN 9798748443715

90000

9 798748 443715



NEW VISTAS IN

Indian Flora

Vol. I

Edited by :
Lal Ji Singh
Vinay Ranjan

8
CHAPTER

Diversity and Distribution of Lichens in Andhra Pradesh including two new records for India

[1]Satish Mohabe, [1]Gangadhar Pandava, [1]Anjali Devi B., A. Madhusudhana Reddy[✉] and [2]Sanjeeva Nayaka

[1]Lichenology Laboratory, Department of Botany, Yogi Vemana University, Vemanapuram-516 005, Kadapa, Andhra Pradesh, India

[2]Lichenology Laboratory, CSIR-National Botanical Research Institute, Rana Pratap Marg, Lucknow - 226 001, Uttar Pradesh, India

Email: grassced@yahoo.com

ABSTRACT

The present paper enumerates 103 species from Kurnool district of Andhra Pradesh belonging to 41 genera under 22 families including two new records to India viz. *Caloplaca obscurella* (J. Lahm) Th. Fr. and *Porina subargillacea* Müll Arg. and also the district includes 20 new distributional records to Andhra Pradesh while 17 species were found endemic to India. Among the 22 families the district includes 2 new distributional records of lichen families Thelenellaceae and Monoblastiaceae with the genera *Thelenella* and *Anisomeridium*. Among the different growth forms, the crustose lichens exhibited the maximum diversity represented by 67 (65%) species followed by 21 (20%) foliose, 13 (13%) squamulose and 2 (2%) species of leprose lichen. Based on their habitat the corticolous lichens exhibited the maximum diversity represented by 56 (54%) species followed by 46 (45%) species of saxicolous and single (1%) species of terricolous. The member of lichen families Caliciaceae, Lecanoraceae and Teloschistaceae shows their maximum diversity in the district represented by 16, 13 and 10 species. Among the 41 genera the *Lecanora* and *Caloplaca* exhibit maximum diversity represented by 13 and 10 species. The crustose species *Caloplaca poliotera* (Nyl.) Stein. and a squamulose species *Peltula euploca* (Ach.) Poelt found growing luxuriantly on the exposed rock represented by single species each from 7 localities. Out of 14 localities surveyed in the district, Ahobilam forest and Kolanubharathi represents the maximum diversity of lichens with 29 and 28 species. Brief descriptions of both the new records are provided with microphotographs and their world distribution.

Keywords: Diversity, Eastern Ghats, Nallamalla Forest, South India, Taxonomy.

INTRODUCTION

Kurnool district is one of the 13th districts in Andhra Pradesh (Fig.1) well known for its Nallamalla reserve forests which considered as part of the Eastern Ghats with hot

New Vistas in Indian Flora (Vol. I) : pp. 159-171 ISBN: 978-81-943323-5-0

Editors : L. J. Singh & V. Ranjan

209, 208

Brijendra Kumar Kashyap •
Manoj Kumar Solanki • Dev Vrat Kamboj •
Akhilesh Kumar Pandey
Editors

Waste to Energy: Prospects and Applications

Springer

Editors
Brijendra Kumar Kashyap
Department of Biotechnology Engineering
Institute of Engineering &
Technology, Bundelkhand University
Jhansi, Uttar Pradesh, India

Manoj Kumar Solanki
Department of Food Quality & Safety,
Institute for Post-harvest and Food Sciences
The Volcani Center, Agricultural Research
Organization
Rishon LeZion, Israel

Dev Vrat Kamboj
Division of Biotechnology
Defence Research and Development
Establishment (DRDE), Defence Research
and Development Organization (DRDO)
Gwalior, Madhya Pradesh, India

Akhilesh Kumar Pandey
Department of Biological Sciences
Rani Durgavati University
Jabalpur, India

ISBN 978-981-33-4346-7 ISBN 978-981-33-4347-4 (eBook)
https://doi.org/10.1007/978-981-33-4347-4

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Contents

Byproduct Valorization of Vegetable Oil Industry Through Biotechnological Approach

8

Kumaraswamy Hanumegowda Hosur, Usha Kiran Betha, Kamlesh K. Yadav, Madakka Mekapogu, and Brijendra Kumar Kashyap

Abstract

Vegetable oil industry produces oil cakes or meals as byproducts after the expulsion and/or extraction of oil from oleaginous materials including oilseeds. The oil cakes or meals can serve various needs of humankind once utilized properly not only in the form of food, feed, and/or concentrated manures but also as sources of various nutraceutically, pharmaceutically, and/or industrially important compounds or phytochemicals. The presence of protein, mineral, and special constituents in oil cake or meal makes it an important component of food and/or feed formulations, provided it is enabled by scientific and technological information and methodologies and supported by enabling policy ecosystem. In this context, there exists a need to review the latest literature on various technological approaches for the valorization of the byproducts of vegetable oil industry. The present chapter is an attempt to bring to the readers an up-to-date and comprehensive information on research and technology in the area of utilizing vegetable oil cakes/meals by way of harnessing the nutritional components and alleviating the problems of antinutritional and/or toxic (or poisonous) components. Though various approaches are discussed, a special emphasis is

K. H. Hosur (✉) · U. K. Betha
Crop Improvement Section, ICAR-Indian Institute of Oilseeds Research, Hyderabad, India

K. K. Yadav
GBIT Ltd., Jalna, Maharashtra, India

M. Mekapogu
Department of Biotechnology and Bioinformatics, Yogi Vemana University, Kadapa, Andhra Pradesh, India

B. K. Kashyap
Department of Biotechnology Engineering, Institute of Engineering and Technology, Bundelkhand University, Jhansi, India

B. K. Kashyap et al. (eds.), *Waste to Energy: Prospects and Applications*,
https://doi.org/10.1007/978-981-33-4347-4_8

Eco-friendly Microbial Biofuel Production from Waste

4

Mekapogu Madakka, Nambi Rajesh, Nadimikeri Jayaraju, Ballari Lakshmanna, Hosur Hanumegowda Kumaraswamy, and Brijendra Kumar Kashyap

Abstract

The rapid consumption of liquid fossil fuels not only causes depletion of energy source but also gives rise to the pollution problem of air, land and water increasing greenhouse gases which is concerned with climatic changes like global warming which in turn raises the sea level. An eco-friendly alternative of energy, i.e. biofuel, is required, which is a promising technology as it reduces the problems of production of eco-friendly energy, zero CO_2 emission and cost-effective fuels. This makes it of high demand across the world over conventional fuels. Scientists are concentrating on biomass-based biofuels, especially agricultural biomass and wastes which can transform into liquid biofuels with the versatile use of microbes. Production of renewable energy biofuels with the versatile utilization of microbes from the biological waste and biomass can reduce this threatening concern to a massive extent. Over the past few years, there has been a steady increase in the use of microbes as they have diversified metabolic activity, which enables substantial biofuels production utilizing different substrates. For the production of ethanol, bacteria utilize sugars, and cellulolytic microbes utilize substrates which are driven from plants. Atmospheric CO_2 is

M. Madakka (✉) · N. Rajesh
Department of Biotechnology and Bioinformatics, Yogi Vemana University, Kadapa, Andhra Pradesh, India

N. Jayaraju · B. Lakshmanna
Department of Geology, Yogi Vemana University, Kadapa, Andhra Pradesh, India

H. H. Kumaraswamy
Crop Improvement Section, ICAR-Indian Institute of Oilseeds Research, Hyderabad, India

B. K. Kashyap
Department of Biotechnology Engineering, Institute of Engineering & Technology, Bundelkhand University, Jhansi, India

B. K. Kashyap et al. (eds.), *Waste to Energy: Prospects and Applications*,
https://doi.org/10.1007/978-981-33-4347-4_4

Dietary methyl farnesoate, a potential growth inducer in male crab *Oziothelphusa senex senex*

P R Reddy[1] and M Arifullah[2,3,*]

[1]Department of Biochemistry, Yogi Vemana University, Kadapa – 516 003, A.P., India
[2]Institute of Food Security and Sustainable Agriculture (IFSSA), Universiti Malaysia Kelantan Campus Jeli, Locked Bag 100, Jeli 17600, Kelantan, Malaysia
[3]Faculty of Agrobased Industry (FIAT), Universiti Malaysia Kelantan Campus Jeli, Locked Bag 100, Jeli 17600, Kelantan, Malaysia

*E-mail: aurifullah@umk.edu.my

Abstract. Insect juvenile hormone-like compound methyl farnesoate (MF), identified through 'reverse endocrinology' in crustaceans is a sesqui-terpenoid and plays crucial role in growth well proved by direct administration into the animals at laboratory conditions. However, these studies are not reached to the cultural ponds. Moreover, dietary supplementation of MF and its effects on growth in crustaceans is still at infancy. The present study tested MF (concentration of 10^{-9}, 10^{-8} and 10^{-7} moles/crab added to commercial shrimp pellet diet) in the growth of male crab *Oziothelphusa senex senex* (Oss) supplemented every alternative day for about 40 days. Along with experimental group control and eyestalk removed (ESX) groups are maintained. Dietary MF induced significant enhancement in the growth of male crab. The most effective group MF 10^{-8} moles/crab supplemented. The frequency of growth induction found in this study is MF $10^{-8}>10^{-9}>10^{-7}$ moles/crab $\leq$ ESX and molted percentage is 27.5%, 17.5%, 10%, 10% in each group, respectively. The dietary supplementation of MF effective in inducing growth in cultured crustaceans thereby increases the yield of crustacean protein.

1. Introduction

Crustacean aquaculture industry plays crucial position in producing quality protein in agriculture. The flavour, deliciousness and limited availability of crustacean protein made it as one of the precious proteinaceous food on the globe. The worldwide production of crustacean protein facing many problems/difficulties. Methods are in pipeline to produce quality protein by inducing growth in culture species. One of such common technique followed to induce growth is traditional eyestalk ablation (ESX), where one-sided (unilateral) or two-sided (bilateral) eyestalk ablation tests were conducted [1]. Consequently, ablation of eyestalk triggers ecdysteroid secretion from Y-organ thereby induces precocious molting and tested in many decapods [2-4]. Although, ESX induces molting effectively in Aquaculture species, but it has its own limitations. ESX endorses with mortality owing loss of large amount of hemolymph and causes mortality. A few alternatives are in search alongside ESX and one of the best methods to improve crustacean protein identified in many studies using growth regulating hormone(s) manipulation. A process where exogenous molecules/chemicals exposed to the test animal for its growth enhancement called endocrine manipulation. Crustacean growth has been manipulated using a list of internal and external endocrine modulators [5-7].

[23] Quackenbush L S and Herrnkind W F 1981 Regulation of molt and gonadal development in the spiny lobster, *Panuliru sargus* (Crustacea; Palinuridae), effect of eyestalk ablation *Comp. Biochem.Physiol.* **69** 523-27

[24] Reddy P R 2019 Methyl farnesoate through Feed: a growth manipulator in female crab *Oziothelphusa Senex Senex J. Fishscicom*. **13(1)** 1-6

[25] Homola E and Chang E S 1997 Methyl farnesoate: crustacean juvenile hormone in search of functions *Comp. Biochem. Physiol.* **117** 347-56

[26] Abdu U, Barki A, Karplus I, Barel S, Takac P, Yehezkel G, Laufer H and Amir S 2001 Physiological effect of methyl farnesoate and pyriproxyfen on wintering female crayfish (*Cherax quadricarinatus) Aquacul.* **202** 163-75

[27] Gunawardene S Y I N, Tobe S S, Bendena W G, Chow B K C, Yagi K J and Chan S M 2002 Function and cellular localization of farnesoic acid O-methyltransferase (FAO-MeT) in the shrimp, (*Metapenaeus ensis) Europ. J. Biochem.* **269** 3587-95

[28] Marilyn A, Zaleski F and Tamone S L 2014 Relationship of molting, gonadosomatic index, and methyl farnesoate in male snow crab (*Chionoecetes opilio*) from the Eastern Bering sea *J.Crust. Biol.* **34(6)** 764-72

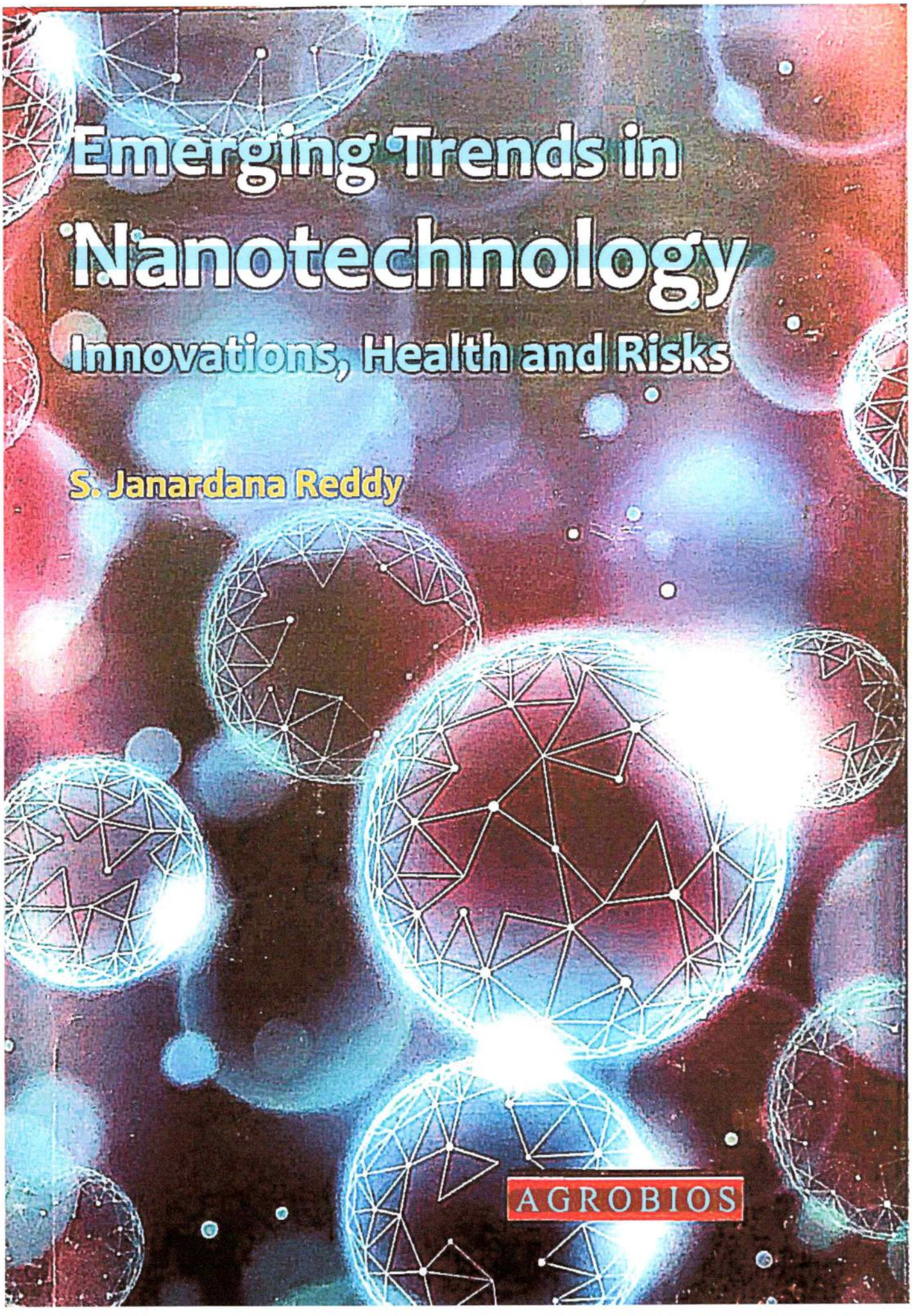
[29] Tariq A, Kim B K, Kang H E, Yoon T H and Kim H W 2014 Stimulation of molting and ovarian maturation by methyl farnesoate in the pacific white shrimp (*Litopenaeus vannamei)* (Boone, 1931) *Fish. Aquatic. Sci.* **17(1)** 115-21

[30] Xie X, Dongfa Z, Yan L, Xier Q, Xiaoyu C and Jie T 2015 Hemolymph levels of methyl farnesoate during ovarian development of the swimming crab *Portunus trituberculatus,* and its relation to transcript levels of HMG-CoA reductase and farnesoic acid O-methyltransferase *Biol. Bull.* **228(2)** 118-24

[31] Girish B P, Swetha C H and Reddy P S 2015 Expression of *RXR*, EcR, E75 and VtG mRNA levels in the hepatopancreas and ovary of the freshwater edible crab, (*Oziothelphusa senex senex)* (Fabricius, 1798) during different vitellogenic stages *The Sci.Nat.* **102(3-4)** 20

[32] Sin Y W, Kenny N J, Qu Z, Chan K W, Cheong S P, Leung R W, Ting F C, William G B, Ka H C, Stephen S T and Jerome H L H 2015 Identification of putative ecdysteroid and juvenile hormone pathway genes in the shrimp (*Neocaridina denticulata) Gen.Comp. Endocrinol.***214** 167-76

[33] Sudha D A R and Aswani A 2018 Effect of Methyl farnesoate administration on ovarian growth and maturation in the freshwater crab *Travancoriana schirnerae Egypt. J. Aquatic. Biol. Fish.* **22**(5) 257-71


Emerging Trends in
Nanotechnology
Innovations, Health and Risks
S. Janardana Reddy
AGROBIOS

3

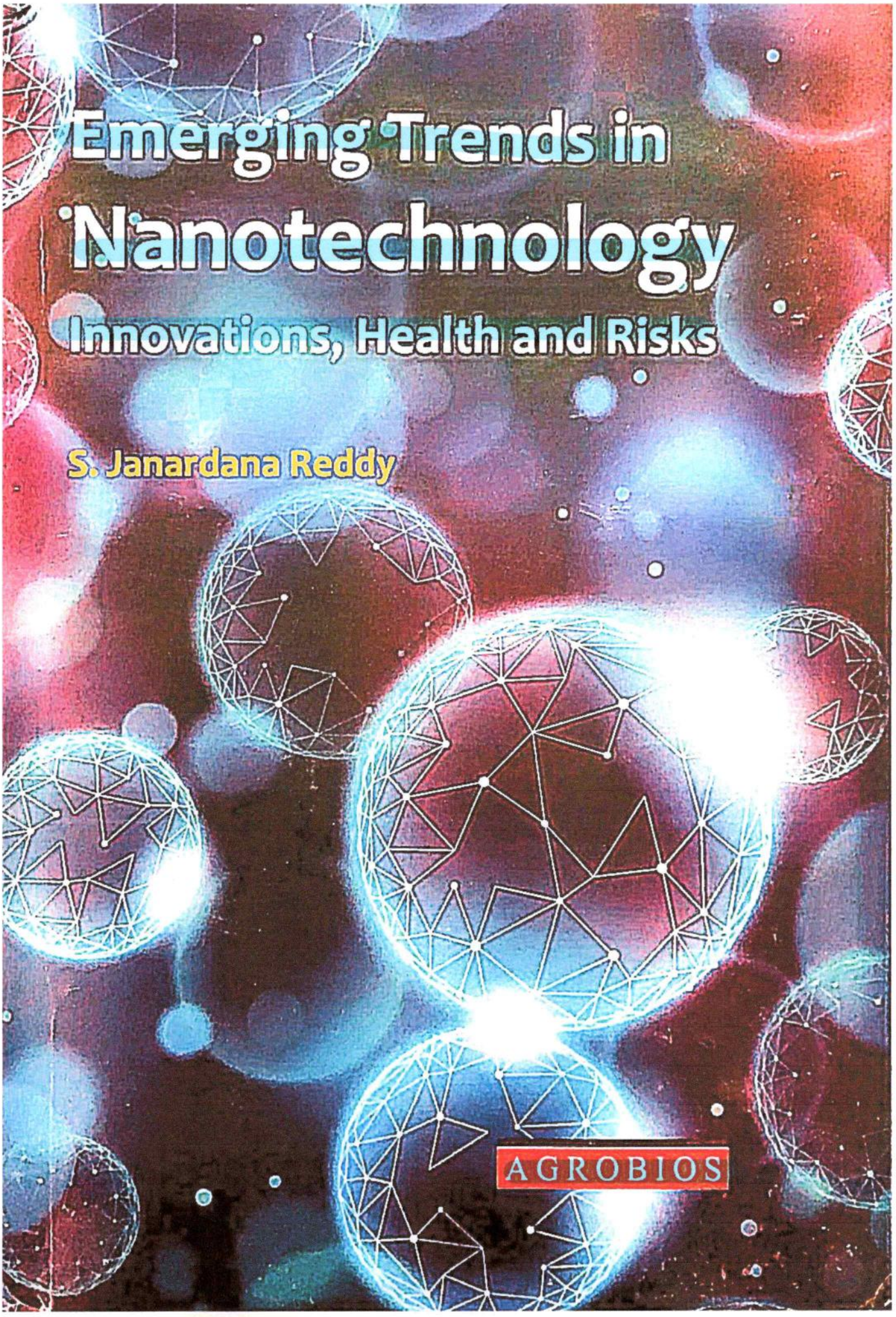
Biogenic Nanoparticles: A Comprehensive Review to Explore Multidrug Resistance Mechanisms among Microbes

K. VASAVI[1], N. RAVI KUMAR[2], A. T. VENKATRAMANA REDDY[3], G. L. N. PRASAD[4], I. S. CHAKRAPANI[5], AND M. RAJASEKHAR[2*]

[1]*Department of Microbiology, Sri Venkateswara University, Tirupati-517502*
[2]*Department of Zoology, Sri Venkateswara University, Tirupati-517502*
[3]*Department of Zoology, Yogi Vemana University, Kadapa – 560003*
[4]*Department of Zoology, Government College (A), Anantapur-515001*
[5]*Department of Zoology, PRR and VS Government College, Vidavalur-524318*
[2*]*Correspondence: zoolrajasekhar@gmail.com*

ABSTRACT

Microbial resistance has been an intense hindrance in preventing diseases for many decades. The rapid emergence of resistance towards several antibiotics could help the bacteria to become stronger to the existing antibiotics and becoming fatal to the mankind. This multidrug resistance is paving a challenging threat to human beings globally due to indiscriminate use of synthetic antibiotics and several other chemical compounds. Several factors have been influencing in developing resistance either by vertical or horizontal gene transfer among microbial species through different ecosystems. Microorganisms are altering genetic makeup to tackle the existing antibiotics very rapidly. Therefore, there is an urgent need to overcome this resistance and to develop new forms of antibiotics that are cost-effective, biocompatible, showing fewer side effects and a single-step fabricated approach that helps for large scale production. Biogenic mediated metallic nanoparticles became a


Emerging Trends in
Nanotechnology
Innovations, Health and Risks
S. Janardana Reddy
AGROBIOS

1

Nanotechnology: Biomedical Applications and Human Health

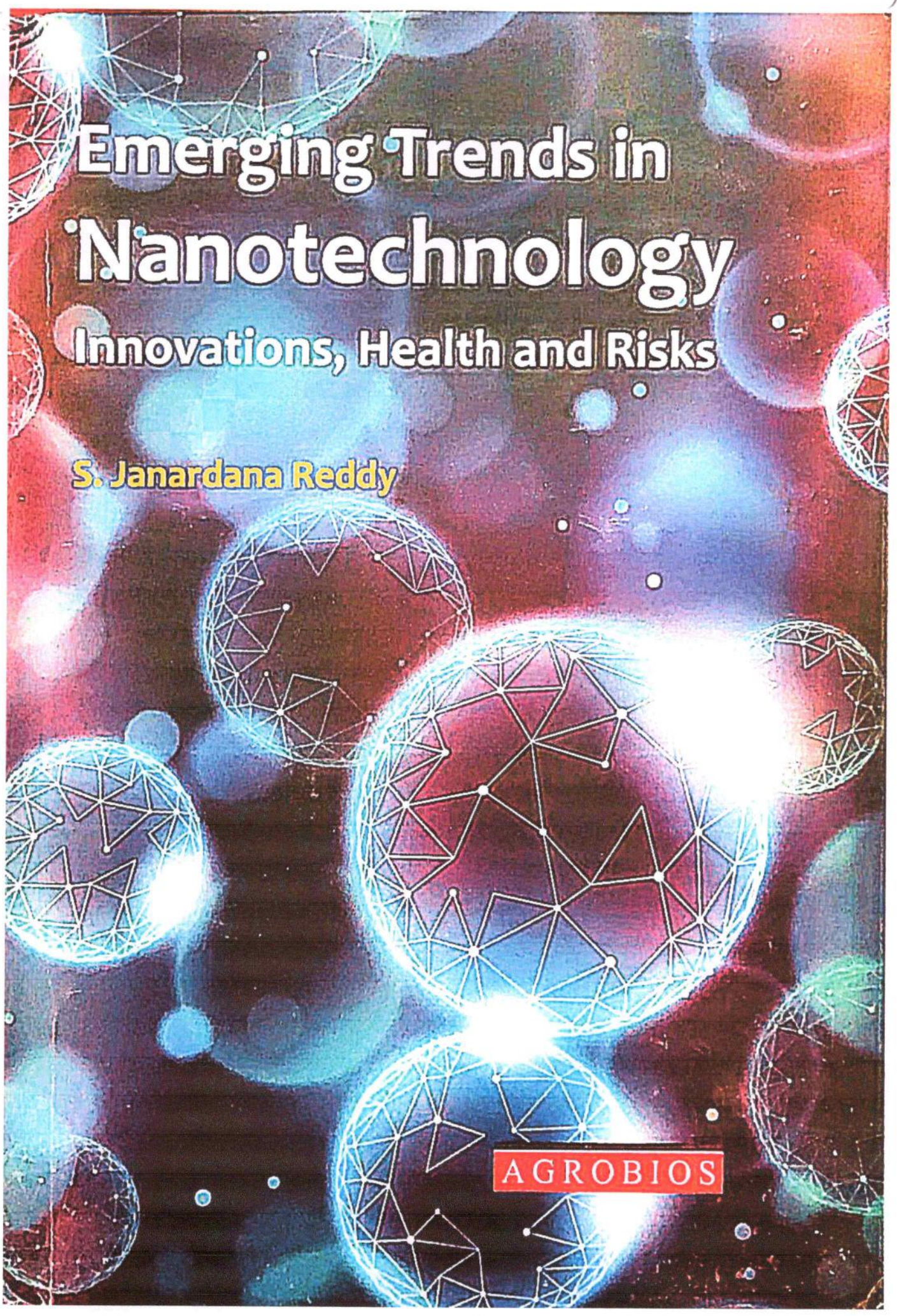
S. JANARDANA REDDY*[1], M. SRINIVASULU REDDY[2], A. T. VENKATA RAMANA REDDY[3], N. NAGA RAJU[4]

*[1]Department of Fishery Science and Aquaculture, Sri Venkateswara University, Tirupati – 517 502; 1*E-mail: sjanardanareddy@gmail.com.*
[2]Department of Zoology, SV University, Tirupati.
[3]Department of Zoology, YV University, Kadapa.
[4]Department of Botany, SV Arts College, Tirupati.

INTRODUCTION

In recent years Nanotechnology and Nanoengineering stand to produce significant scientific and technological achievements in diverse fields including medicine and physiology related to humans. It is defined generously as "The Science, Technology and Engineering are intricated in the design, synthesis, characterization, and Application of materials and the gadgets whose smallest functional organization in at least one dimension is on the nanometer scale, ranging from a few to several hundreds of nanometres". A nanometer means one billionth of a meter or triple size of a magnitude smaller than a micron (*e.g.*, a DNA molecule is 2.5nm long whereas a sodium atom is 0.2 nm) (Siddhartha and Dash, 2009).

In the 21st century, the field of nanotechnology is in rapid flux and development, and the definition of its boundaries became ambiguous. Aspects of multiple disciplines, ranging from physical science to computer science and biotechnology, plausible contribute to the endeavour. This broadness of field allows many interested alliances to contribute to nanotechnology, but the same ambiguity can productively render the field nebulous. The rigorous definition of nanotechnology remains controversial, so consideration of the present amplitude of the field might


Emerging Trends in
Nanotechnology
Innovations, Health and Risks
S. Janardana Reddy
AGROBIOS

Therapeutic Role of Nanotechnology in Neurological Diseases

VENKATRAMANA REDDY A T[1*], RAJASEKHAR M[2], JANARDANA REDDY S.[3], RAMAKRISHNA V[1], VENKATARAMI REDDY N[4], NAGARAJU N[6].

[1*]*Dept. of Zoology, Yogi Vemana University, Kadapa, India.*
[2]*Dept. of Zoology, Sri Venkateswara University, Tirupati, India.*
[3]*Dept. of Aquaculture, Sri Venkateswara University, Tirupati, India.*
[4]*Dept. of Biotechnology & Bioinformatics. Yogi Vemana University, Kadapa, India.*
[1]*Dept. of Zoology, Yogi Vemana University, Kadapa, India.*
[6]*Dept. of Botany, S.V. Arts College, Tirupati, India.*
* *Corresponding Author E-mail: atvrr@yahoo.com*

ABSTRACT

Last few decades have witnessed nanotechnology helping to improve and even revolutionize different sectors such as medicine, electronics, energy, manufacturing, food and agriculture among many others. The basic concept behind this technology is that, materials or particles at nanoscale exhibit distinct physicochemical characters that can be altered and functionalized for better results. Though nanomaterials are portrayed as a recent development, we have been exposed to naturally produced nano entities since the inception of the earth and indeed have co-evolved with humans. With the advent of the industrial revolution, incidental nanomaterials have been produced as byproducts unintentionally, whose impact on health and environment are not duly evaluated. After the realization of their potential applications, large amounts of engineered nanomaterials or particles of different types and makes are delivered to cater to their demand in varied sectors. Nanotechnology enabled approaches have gained the attention of researchers to find solutions,

202

221

P. Naga Lakshmi
S. P. Venkata Ramana

Diversity and life cycle strategies of Papilionid butterflies in A.P.

Diversity and life cycle strategies of endemic and endangered Pailionid butterflies in the plains and forest regions of Southern Andhra Pradesh - India

LAP LAMBERT Academic Publishing

Imprint

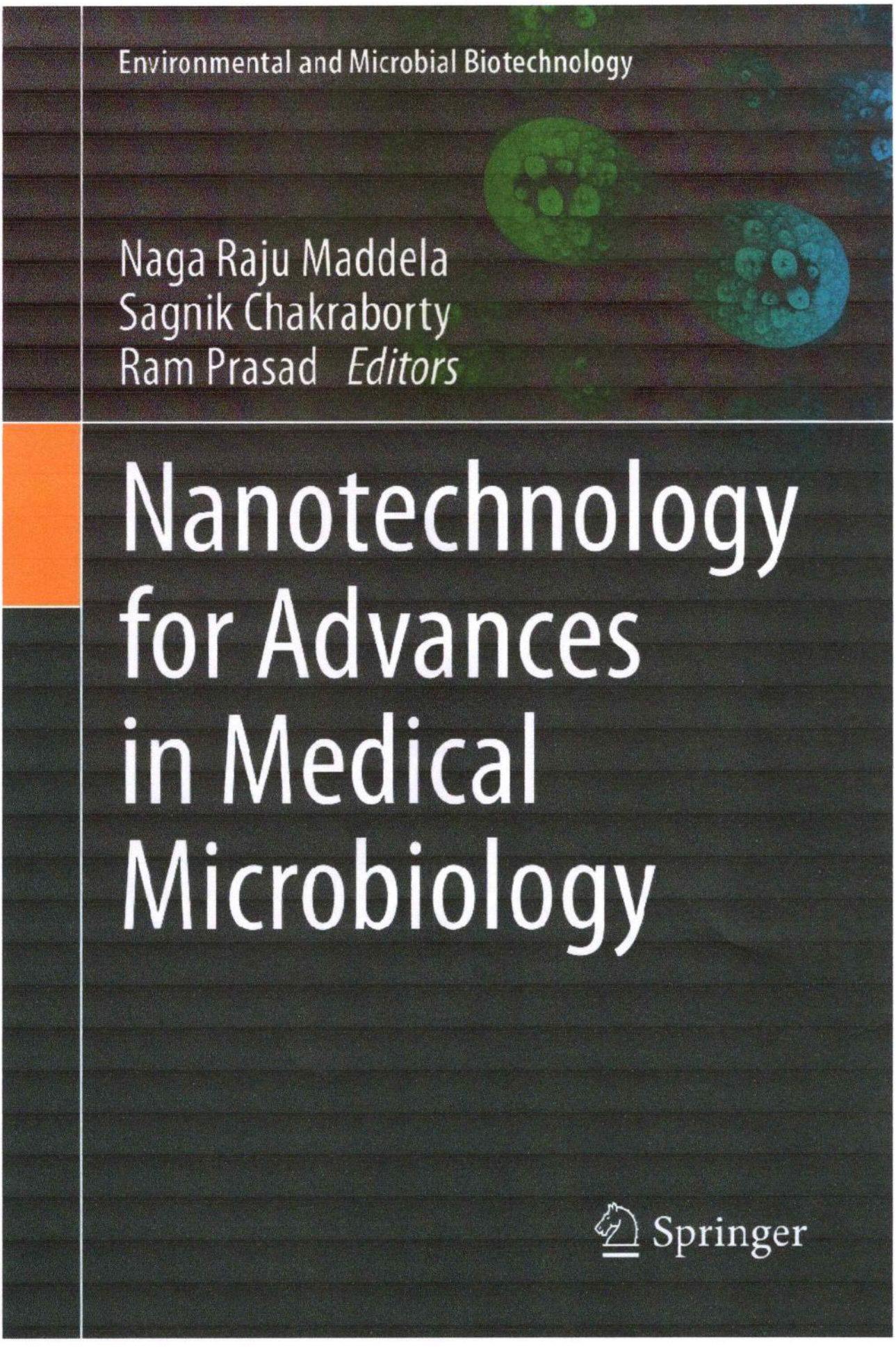
Cover image: www.ingimage.com

Publisher:
LAP LAMBERT Academic Publishing
is a trademark of
International Book Market Service Ltd., member of OmniScriptum Publishing Group
17 Meldrum Street, Beau Bassin 71504, Mauritius
Printed at: see last page
ISBN: 978-620-3-40976-5

This book is an outcome of research work carried out for three years in the Department of Zoology, School of life sciences, Yogi Vemana University, Kadapa, Andhra Pradesh, India. This book encompasses 5 chapters. Chapter I deal with the taxonomy of Papilionids and its behavior, adaptations, significance and its conservation. Chapter II covers with literature and diversity of Papilionids. Chapter III & IV deals with methodology, life cycle parameters, food energetics and detailed discussion. This book can be good foundation for future endeavors to build upon these results for development of Papilionid butterfly conservation. Butterflies are the flying jewels used as a potential requirement for analytical studies by the ecologists across the globe concerning recent scenarios of Eco-biological and Biodiversity studies.

Dr. P. Naga Lakshmi has completed doctoral degree in Yogi Vemana University, Kadapa, Andhra Pradesh, India. She has published several research papers in the field of Eco-biology of Papilionidae and other butterflies under the guidance of Dr. S. P. Venkata Ramana, Asst.Prof., YVU and she participated in several seminars.

202


Environmental and Microbial Biotechnology
Naga Raju Maddela
Sagnik Chakraborty
Ram Prasad Editors
Nanotechnology for Advances in Medical Microbiology
Springer

Chapter 16
Nanotechnology-A New Frontier in Medical Microbiology

Silpa Somavarapu, Bellamkonda Ramesh, Ch. Venkatrayulu, and M. Subhosh Chandra

Abstract Nanotechnology relates to microbiology at a number of levels as the microbial entities are nano-machines. In the second half of this decade, nanotechnology expanding its applications in the field of medical microbiology. Nanotechnology is clinically appropriate and retains the potential to be valuable in the diagnosis of general and microbial infections. The rapid detection of pathogenic microbes at the point of care is extremely critical. The application of nanoparticles permits for the detection of infectious pathogens in small sample volumes directly in a sensitive, specific, and rapid format at lower costs than current in-use technologies. A bio-conjugated nanoparticle-based bioassay for in situ pathogen quantification can detect a single microbe. The waveguide technology is an emergent area in the medical microbiology for the fast and successful diagnosis of infectious diseases. Nanotechnology is demonstrated for the detection of Avian influenza virus H5N1, Respiratory Syncytial Virus (RSV), HIV, and Severe acute respiratory syndrome (SARS) Coronavirus in clinical samples with a great degree of sensitivity. Nanoparticle-based bio-barcode amplification (BCA) assay is being applied for early detection of HIV-1 capsid antigen. The gold nanoparticle interferometer sensor has been validated for detection of Herpes simplex virus (HSV) and silver nanorod array substrates can detect spectral differences between the viral strains. A nanoparticle label technology with highly fluorescent chelated nanoparticle label has been developed for Adenovirus and Human papillomavirus (HPV). The nano-gold labelled amplification is a novel technique for the detection of Hepatitis B virus, Hepatitis C virus, and Hepatitis E virus in patient's samples. Norovirus is a leading cause of gastroenteritis and nanospray mass spectrometry is evaluated for norovirus detection. With the manifestation and intensification of microbes resistant to antibiotics, silver nanoparticle antiseptics have been evaluated for the antimicrobial

S. Somavarapu (✉) · B. Ramesh · C. Venkatrayulu
Department of Food Technology, Vikrama Simhapuri University, Nellore, Andhra Pradesh, India

M. Subhosh Chandra
Department of Microbiology, Yogi Vemana University, Kadapa, Andhra Pradesh, India

N. R. Maddela et al. (eds.), *Nanotechnology for Advances in Medical Microbiology*, Environmental and Microbial Biotechnology,
https://doi.org/10.1007/978-981-15-9916-3_16

Environmental and Microbial Biotechnology
Series Editor: Ram Prasad

Naga Raju Maddela · Sagnik Chakraborty · Ram Prasad *Editors*

Nanotechnology for Advances in Medical Microbiology

Combined fields of Microbiology and Nanotechnology have been most successful in providing novel solutions for protecting the health of humans and environment. This book covers the implications of nano-strategies to combat bacterial pathogens, applications of nontechniques in microbiology, and innovative advances in the area of medical microbiology. Contents are divided into three sections – Nanoscience in controlling bacterial pathogens, Nanoscience in Microbiology, Medical Microbiology. This volume is going to provide timely information about the technological advances of Nanoscience in the domain of Microbiology, with a special emphasis on Pathobiology. The book is a useful read for students and researchers in microbiology, nanotechnology and medical microbiology.

ISBN 978-981-15-9915-6

▶ springer.com