SUSTAINABLE SOLUTIONS FOR A CHANGING WORLD

(Volume I)

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PREFACE

In the age of unprecedented global challenges, "Sustainable Solutions for a Changing World" emerges as a testament to the power of multidisciplinary collaboration and collective wisdom. Our planet is at a crossroads, with environmental, social, and economic changes converging in ways that demand innovative, holistic responses. As we face climate disruptions, resource depletion, social inequalities, and technological revolutions, the need for sustainable solutions has never been more pressing.

This edited volume is a symphony of voices from diverse disciplines harmonizing to address the multifaceted challenges of our time. We believe that true progress emerges when we embrace the richness of diverse perspectives, ideas, and approaches. The chapters within this book reflect this belief, weaving together threads from the natural and social sciences, humanities, engineering, and beyond to create a tapestry of insights and solutions.

Our contributors, experts in their respective fields, have devoted their knowledge, passion, and energy to share their visions of a more sustainable world. They explore the intricate interplay between humans and the environment, the ethical considerations that underpin sustainable practices, and the innovations that hold the promise of transformative change. Each chapter is a window into a different facet of sustainability, offering both depth and breadth in our collective understanding of the challenges and opportunities before us.

As editors, we are profoundly grateful to the authors who have contributed their expertise and creativity to this endeavor. We believe that the ideas and solutions presented within these pages will inspire readers to think critically, act intentionally, and collaborate across boundaries. Sustainability is not a solitary endeavor; it requires a shared commitment to change, and this book serves as a rallying point for all who are ready to engage.

We invite you, dear reader, to embark on a journey through the pages of "Sustainable Solutions for a Changing World." Whether you are an academic, a practitioner, a policymaker, or simply a concerned global citizen, there is something within these chapters for you. Our hope is that you will find the insights and perspectives contained herein both enlightening and motivating.

Together, let us rise to the challenge of our changing world. Let us embrace the transformative potential of sustainable solutions. Let us work collectively to safeguard our planet for current and future generations.

Editors'
Ms. Nidhi Nirwan
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CONTENT

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1. Public Health Approach and Sustainable Solutions

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Abstract:

Public Health and sustainability has a very close relation and are interconnected. In this chapter we will focus on how public health is changing the world? Their different aspects that embrace certain changes in the community in a positive manner and improving the graph of health gradually. Both are parallel because ones a change or intervention is implemented and have a positive impact on the community, people demands for its sustainability. Therefore we have to understand what is sustainable development and Public Health. The term "Sustainable Development" first came to prominence in the World Conservation Strategy (WCS) in 1980. Sustainable development is the development that meets the need of the present without compromising the ability of future generations to meet their own needs. There are four major components the climatic change, nutrient cycle, hydrological cycle and biodiversity. The pillars of sustainable development are social development, economic development, environmental protection and cultural diversity (United Nations 2005, World Summit Outcome Document).

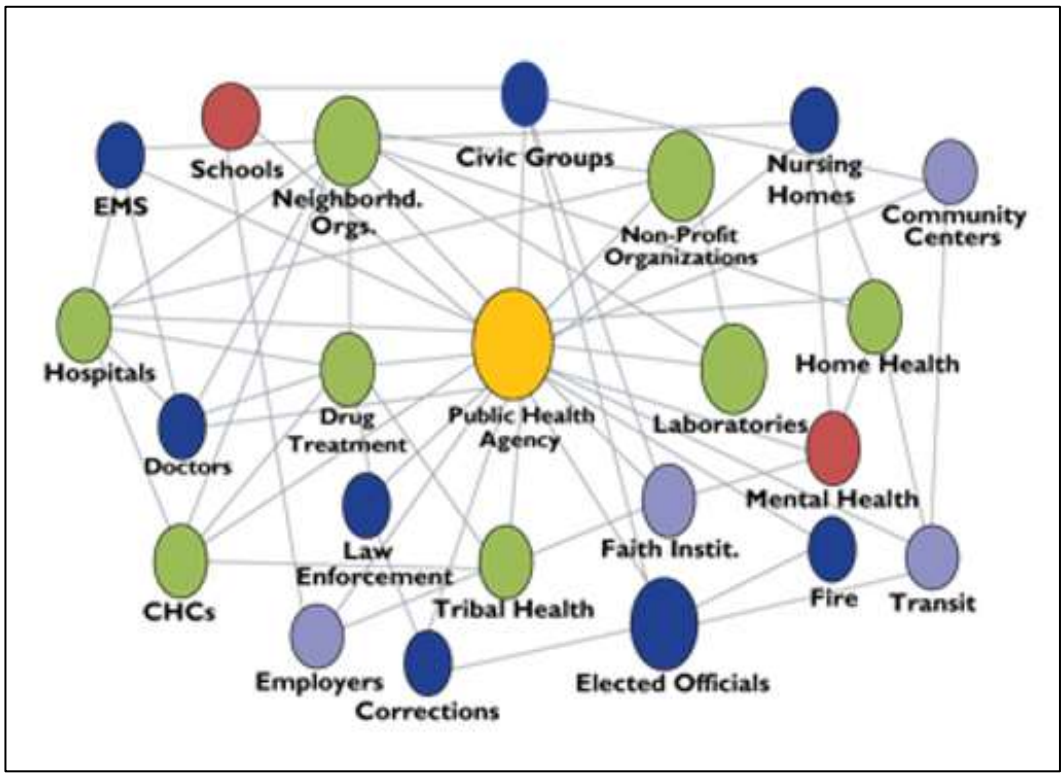
Keywords:

Public Health Strategies, Preparedness, Advanced Trainned Health Care Workers, Implementation.

1.1 Introduction:

Understanding the concept of Public health might be difficult as its being implemented in various fields, therefore the definition may change accordingly. But the main aim of Public Health is to have a positive impact on the society by improving the overall health along with health workers and experts. There are few definitions: According to the **American Public Health Association**, "Public Health is the practice of preventing disease and promoting good health within groups of people, from small communities to entire countries." According to the **World Health Organization** (WHO), "Public health refers to all organized measures (whether public or private) to prevent disease, promote health and prolong life among the population as a whole. Its activities aim to provide conditions in which people can be healthy and focus on entire populations, not on individual patients or diseases." **The Public Health System** - According to the **Centers for Disease Control and Prevention** (CDC), "Public health systems are commonly defined as 'all public, private and voluntary entities that contribute to the delivery of essential public health services within a jurisdiction. "Public Health has different dimensions like health promotion, disease

prevention, early diagnosis and prompt treatment, disability limitations and rehabilitation. Multiple public health programs have been initiated in India that has impacted the rural and urban community. Those intervention and initiative has helped the government and health infrastructure in reframing many changes in policies by the active participation of public health experts.

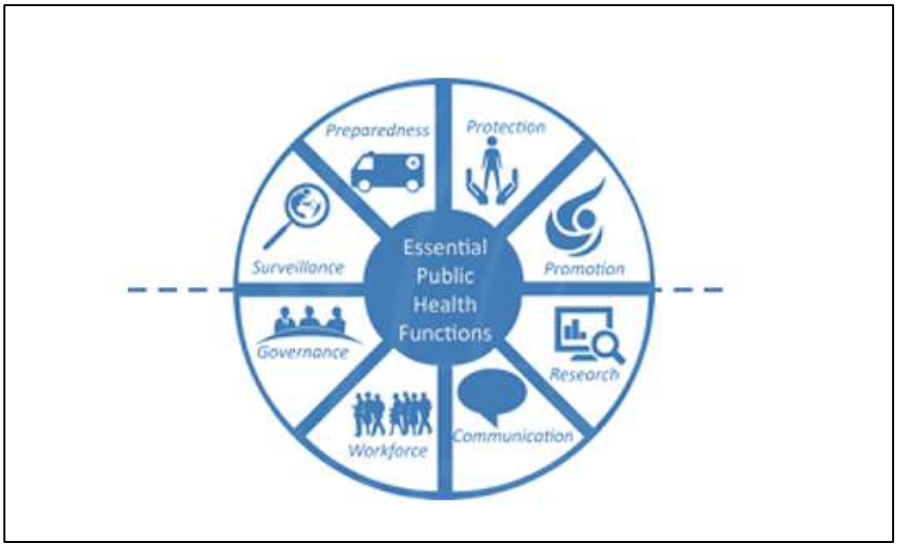


The Public Health Systems Includes: Public health agencies at state and local level, healthcare providers, public safety agencies, human service and charity organizations, education and youth development organizations, re-creation and arts related organizations, economic and philanthropic organizations, environmental agencies and organizations etc. For understanding how the system works and gradually contribute a change in the health infrastructure for a positive well-being of the community. The first and most important task is to ensure sustainability; According to Global Public Health 2022's Sustainable Development Goals Report, It was reported that in 2015, the General Assembly of the United Nations adopted the 2030 Agenda for Sustainable Development.

The list of 17 Sustainable Development Goals (SDGs), covering everything from gender equality to climate action, was developed to transform the world by creating equity and inclusion around the globe. **Goal 3: "Good Health and Well-being"** — addresses global public health directly, but many of the other goals are health-adjacent, impacting global health in a variety of ways. To analyze and find solutions for public health goals, health care professionals, armed with the knowledge, must be ready to face setbacks with skill and determination.

1.2 What Is Global Public Health?

An internationally represented board meeting of Global Health Research and Policy determined that in fact for an issue to be recognized as global health, three separate aspects must be present: Global health is concerned with health and medical issues that have a global influence. The solutions to these worldwide health problems must have the ability to have a global impact. When working on global health challenges, academic and scientific research is employed to enhance health worldwide and to reduce treatment inequalities. Although diseases, ailments and maladies that affect millions of people are almost certainly mentioned while discussing global health, the underlying concept extends much beyond identifying problems and measuring numbers. It focuses on understanding not only the ailments but also the people who suffer from them.



Source: WHO-Essential Public Health Functions

1.3 Increasing Demand of Public Health and Analysis:

In recent years, Public Health has emerged as a trending stream, with a large growth and demand worldwide. The purpose is to present an analytical assessment of the factors contributing to this increased demand and to investigate the consequences for the field of public health. We can better comprehend the evolving landscape of public health and its role in tackling current and future global health concerns by exploring the key reasons behind this trend and future health challenges.

Societal changes and Health Awareness: Several changes in society and improved health awareness among communities can be attributed to the growing need for public health services. Individuals and communities have prioritized preventative measures and health promotion as an outcome of factors such as ageing populations, changing lifestyles, and rising chronic diseases. Public health interventions, such as education campaigns and policy measures, have been critical in raising awareness and empowering people to take control of their health.

Global Health Threats and Emergencies: The rising occurrence of global health threats and emergencies has brought attention to the significance of strong public health infrastructure and preparedness. Outbreaks such as the Ebola virus, Zika virus and most recently, the COVID-19 pandemic have highlighted the important role of public health professionals in infectious disease early detection, prevention and response. The demand for skilled public health professionals has increased, stimulating interest and investment in the subject.

Intersectionality of Health and Environment: Due to the rising recognition of the association between health and environmental factors, public health has gained its importance. Climate change, pollution, and other environmental factors have significant effects on population health, given rise to new public health concerns. This recognition has culminated in an evolution towards a more holistic approach to health, with environmental sustainability and resilience being integrated into public health practices.

Advancement in technology and data-driven solutions: Technological advancements and the availability of immense amounts of health data have revolutionized the area of public health. Data analytics, artificial intelligence, and digital healthcare systems provide more precise monitoring, early illness outbreak detection and specific treatments. The demand for data professionals and health informatics researchers has increased, indicating the growing importance of these fields in public health practice.

Policy and Advocacy: Increased advocacy and policy efforts have played a vital part in amplifying the demand for public health. Governments, international organizations and non-governmental organizations (NGOs) have recognized the value of investing in public health infrastructure, research and programs to achieve better health outcomes, which has resulted in increased funding opportunities, career prospects, and expanded roles for public health professionals across sectors.

1.4 Implementing Public Health Strategy as A Major Tool:

In the face of a rapidly changing world and its impact on the environment, public health strategies play a crucial role in addressing the resulting challenges. By utilizing public health approaches, we can implement sustainable solutions that not only mitigate the negative consequences of environmental change but also promote overall well-being and resilience. This chapter explores the significance of public health strategy implementation as a major tool for sustainable solutions in a changing world.

Health Impact Assessment: (HIA) is a systematic procedure that assesses the possible health effects of policies, projects and programs on populations. We can analyze the effects of environmental changes on public health by including environmental factors into HIAs. This enables policymakers to make educated decisions and create long-term solutions that prioritize health and well-being.

Effective Risk Communication and Education: Effective risk communication and education are critical in encouraging long-term solutions. Individuals and communities can be educated about the environmental dangers they face, allowing them to make informed decisions and adopt sustainable behaviors. Public health tactics can urge people to take

action and support sustainable projects by sharing information about climate change, pollution and other environmental issues. Educating communities on the environmental hazards they face and empowering them.

Collaboration and Partnerships: Addressing complex environmental concerns necessitates collaboration among a variety of sectors and stakeholders. Partnerships between health experts, policymakers, environmental agencies and community organizations are facilitated through public health strategies. These collaborations enable the development and implementation of comprehensive, long-term solutions that balance environmental and public health concerns.

Policy Development and Advocacy: By pushing for evidence-based policies that prioritize environmental health and sustainability, public health professionals can contribute to long-term solutions. Supporting policies that reduce greenhouse gas emissions, encourage renewable energy, limit pollution, and conserve natural resources is part of this. Public health specialists can influence decision-making processes and generate good change by participating in policy formulation and advocacy.

Health Promotion and Behavior Change: To achieve long-term results, public health initiatives emphasize health promotion and behavior change. Public health efforts can drastically lower ecological footprints by encouraging individuals and communities to embrace environmentally friendly practices such as recycling, energy conservation and sustainable transportation options. These behavioral changes help to reduce environmental degradation and improve public health.

Monitoring and Evaluation: The adoption of long-term solutions necessitates continuous monitoring and evaluation. Environmental health experts can use surveillance systems to track environmental health indicators and evaluate the efficacy of interventions. Monitoring the impact of sustainable practices enables continual improvement and informed decision-making, ensuring that actions are in line with the changing needs of the environment. In order to solve the environmental difficulties we face, it is critical to implement public health initiatives as a primary tool for long-term solutions in a changing world. Public health practitioners can influence positive change by utilizing techniques such as health impact evaluations, risk communication, teamwork, policy advocacy, behavior modification and monitoring. We can achieve a healthier and more sustainable future by mitigating the effects of environmental change and increasing well-being and resilience in individuals and communities alike. While one of the UN's SDGs clearly focuses on essential global health challenges, numerous others address areas that could also help to meeting public health objectives. The vision of Goal 3 of SDG is to “ensure healthy lives and promote well-being for all at all ages.” The specific targets for this goal include:

1.5 Health Care Professionals Can Improve Their Outlook:

Although there are signs of some progress in terms of increased professional childbirth assistance, lower mortality rates in young children and lower numbers of adolescent birth rates worldwide, the effects of the COVID-19 pandemic, as well as ongoing and additional national and international conflicts, have undermined almost all of the target improvements

outlined in 2015.The report, on the other hand, provides insight into the areas on which the health care business should focus in order to have the greatest impact on global health and the well-being of every individual. Professionals who are well-prepared have numerous chances to contribute to the continuous endeavor to achieve the UN's goals.

It would be justified if an adequate educational foundation in global health emphasizes how socioeconomic status, environment, education and other factors influence access to and the quality of health care and medical services. Organizations like the American Red Cross and the United Nations keep an eye on how well ethical ideals are reflected in the equitable and timely provision of services and resources. Data is used by NGOs and emergency assistance programs to identify correlations between health care and human rights. They then apply their knowledge to develop interventions and treatments that are capable of reaching even the most remote places with limited access to food and clean water. Issues that are often unique to local surroundings need innovative strategies in the domain of geohealth to predict and prevent risk factors to the health of their communities. In order to solve global health care obstacles, agencies and organizations such as the Urban and Regional Information Systems Association, the Centers for Disease Control and Prevention and the World Health Organization rely on geohealth specialists for data and analysis. Experts in community health create programs that can be utilized all around the world to address illness prevention, health concerns and substance usage.

Personal Sustainability Measures:

We may take actions on a personal level to ensure that our living place is as energy-efficient as feasible. Conducting fuel consumption. If you're looking for more methods to live sustainably and reduce greenhouse gas emissions, the Environmental Protection Agency has a more complete guide. We can also urge our friends, family and neighbors to walk or cycle to work, school, errands or social activities as much as possible – not only for the benefit of the environment, but also for our own health and well-being. All little steps that can help reduce excessive fossil for young people to acquire healthy habits early on, therefore the more we can turn everyday exercise into a social activity the better and improved health we may have. Exercise that becomes an everyday habit, rather than a brief fitness regimen to lose weight, has a better possibility of changing people's lifestyles for the better.

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2. Ozonating: An Eco-Friendly Technique for Cleaning and Disinfection Activities in Dairy Industry

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Abstract:

Cleaning and disinfection operations are of great importance within the dairy and food industries for safety reasons. Most care areas in dairy industry rely on a range of chemicals such as chlorine, quaternary ammonium compounds, bromine or iodine based products to maintain an acceptable hygiene regime. Some of the most important cleaning tasks are those related to the washing of vessels, storage tanks and pipes where cleaning in place systems (CIPs) are of common use. CIPs are characterized by automatic cleaning programs based on a succession of several solutions of water, cleaning chemicals and disinfection agents that are discharged into sewer systems together with large amounts of water necessary to rinse out residual chemicals. When chlorine based compounds combine with organic residues, the results could potentially be extremely harmful to people. Thus, health and environmental concerns with chemical use on dairy & food products or food contact facilities are supporting the need for alternative sanitation technologies.

In this sense, the potential utility of ozone lies in the fact that ozone is a stronger oxidant than chlorine and it has been shown to be effective over a wider spectrum of microorganisms. But, unlike other disinfectants, it leaves no chemical residuals and degrades to molecular oxygen upon reaction or natural degradation. In comparison to conventional, ozone based CIP operations requires less water and energy consumption, offers effective cleaning and lesser amount of pollutant in waste water. The different applications of ozone have been reported at experimental and industrial scale with the objective of improving at least one of the following factors: food safety, prevention of cross contamination, extension of shelf life of produce and produce surface sanitation. In dairy industry, it has successfully been used for the removal of milk residues and biofilm-forming bacteria from stainless steel surfaces; for inactivate airborne moulds in cheese ripening and storage facilities; for production of extended shelf life fluid milk, for reducing the concentrations of pollutants in dairy wastewaters etc. This article highlights the application of ozone and its important implications in dairy industry.

Keywords:

Ozone, CIP, Milk, Hygiene, Dairy Industry.

2.1 Introduction:

Cleaning and disinfection are essential to maintain hygienic conditions in dairy processing plants. Cleaning and sanitization of the all equipment's is the last and first step of the production processes. Cleaning is one of the obligatory steps in dairy and food processing, which can be performed manually by the least experienced employees in the plants. Before the development of recirculation cleaning, manual cleaning was the state of the art for all food contact and non-food contact surfaces. In the circulating cleaning method or Cleaning-in-Place (CIP) method, cleaning solutions which include various types of detergents, sanitizers or disinfectants are circulated within the system (Tamime, 2008).

The commonly used alkali detergents are sodium hydroxide (caustic soda), potassium hydroxide, sodium carbonate etc. and the acid detergents include hydrochloric acid, nitric acid, phosphoric acid, citric acid etc. Typically, 0.5 – 2 % caustic soda has been commonly used in dairy industry at temperatures of up to 85^0C to saponify fat and convert the fat to soap, which can be removed with water (Walton, 2009).

The hard deposits, which difficult to remove by alkali detergents are generally cleaned by using acid detergents. The most common acid detergent is nitric acid, which is generally used at a concentration of 0.5–1.0 per cent under either ambient or heated conditions (55–80^0C) for 5 to 20 minutes (Bremer and Seale, 2010). In order to ensure hygienic conditions required to provide food safety, sanitization is a compulsory step for the entire cleaning process (Amitha and Sathian, 2014).

Sanitization step usually follows alkali and acid cleaning in food processing facilities. The commonly used dairy sanitizers are: steam, hot water, hot air, and chemicals (chlorine compounds, iodophor, and quaternary ammonium compounds).

2.2 OZONE as Alternative sanitizer:

One of the biggest issues currently facing the dairy industry is that most high care areas continue to rely on a range of chemicals to maintain an acceptable hygiene regime. Thus, health and environmental concerns with chemical use on food products or food contact facilities are supporting the need for alternative sanitation technologies. The interest in ozone as an alternative to chlorine and other chemical disinfectants in cleaning and disinfection operations is based on its high biocidal efficacy, wide antimicrobial spectrum and absence of by-products that are detrimental to health (Graham, 1997).

Ozone is a triatomic oxygen molecule found in liquid form above 80 K and gaseous form above 161 K. Since ozone has 2.7 V of reduction potential, it is a powerful oxidizing agent. Although ozone has 12 hours half-life in the gaseous phase. It is reported that the half-life of the aqueous ozone is 20-30 minutes only, depending on water purity, temperature, and other factors (Rice *et al.*, 2002).

2.3 Ozone and CIP Application:

Ozone-CIP system has been developed by integrating an ozone generator into a conventional CIP system. Ozone-CIP was developed in the European research project in 2005 by considering its environmental and antimicrobial properties over other conventional chemical cleaning compounds (Arranz and Schories 2007).

Canut and Pascual (2007) have introduced an ozone-based CIP system, at the International Ozone Association Conference in 2007, as the best available technology (BAT) considering the antimicrobial efficiency and environmental advantages.

Ozone has been tested as a sanitizer in a laboratory-scale CIP system. Lagrange et al. (2004) has proved that aqueous ozone had an excellent antimicrobial effect when it is applied in the CIP system provided that the organic matter placed on the surface of the equipment was removed by previous cleaning.

As per one report the use of ozone in CIP systems allowed a reduction of the water consumption needed to perform cleaning and disinfection operations and reducing at least by 50% the organic load in the cleaning waste waters produced compared to conventional CIP protocols keeping, at least, the same disinfection and cleanliness efficiency.

2.4 Ozone Production:

Ozone requires on-site generation because of it high reactivity and rapid decomposition (Kim *et al.*, 2003). There are different methods to generate ozone. Corona discharge is the most commonly used method that generates relatively high concentration of ozone.

Two electrodes separated by a discharge opening are used to create a high-energy discharge, which can separate the oxygen molecules into its atomic form. Oxygen atoms come together naturally to form its triatomic form. Dry oxygen or air is used as inlet gas in corona discharge method. Other methods to produce ozone include UV light and electrolysis of water, which produce relatively low ozone concentrations. Ozone can be generated in two phases: (i) gaseous ozone, (ii) aqueous ozone which is formed by infusion of gaseous ozone in water.

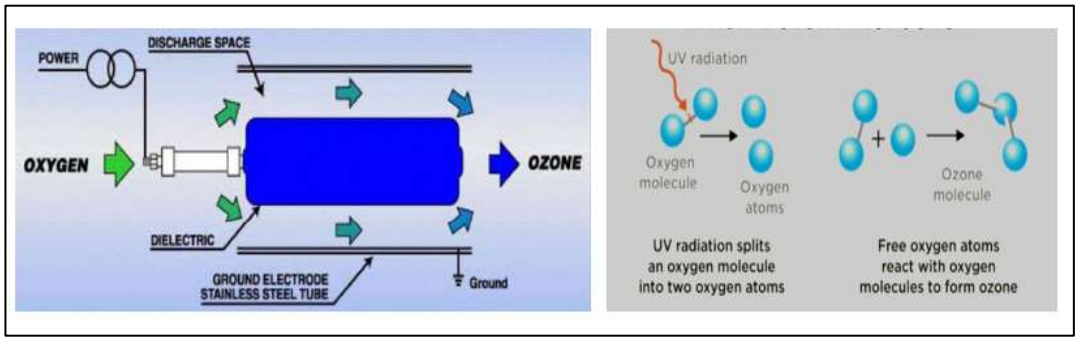

Figure 3.1: (a) Corona discharge ozone generator (b) Natural ozone production

2.5 Ozone Decomposition:

When ozone decomposes, it forms many oxidative radicals such as superoxide anion radical and hydroperoxide radicals. Those are the main source of the hydroxyl radicals, which are considered main radicals for the microbial inactivation by ozone. Hydroxyl radicals interact with cell components and inactivate the cells (Ligimol *et al.,* 2002).

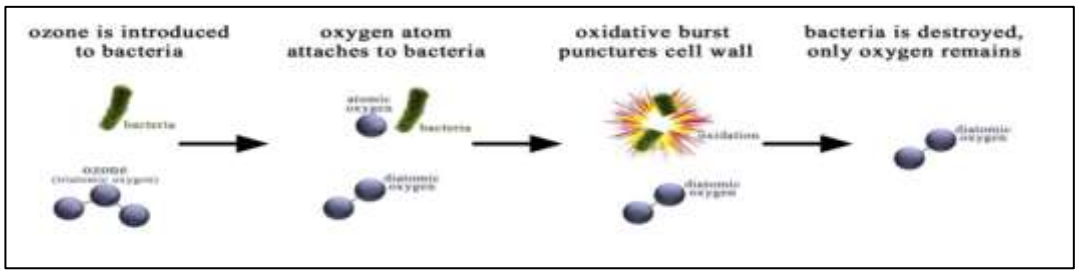

Figure 2.2: Ozone Decomposition

2.6 Application of Ozone in Dairy Industry:

Ozone was firstly used as an antimicrobial to treat drinking water. Ozone had gained the generally recognized as safe (GRAS) status in 1982 to be used in the bottled water treatments.

In the dairy industry, ozone can be applied both as a gas and in ozonated water (Laszlo and Sziget, 2016). Some of its applications in dairy industry is highlighted as below:

A. Ozone as a Sanitizer in Dairy Farm:

The production of quality milk begins with good hygienic practices. Dirty cows and soiled equipment can lead to elevated bacterial levels in the bulk tank. Ozone as a sanitizing agent are used alternatively in dairy farm.

The entire udder and the rear legs of milking animals are washed off with ozonated water (0.04 to 1.5 ppm ozone per litre of water) prior to milking in order to destroy bacteria, pathogens and viruses present (Heacox, 2013). Ozonated water can also be used for rinsing the milking equipment, sanitizing it, thus reducing the chances of milk contamination. All equipment that is used to provide feed for the cows may be washed out with ozonated water on a regular basis to kill mold, mildew, and bacteria (Ozone Systems, 2014).

B. Ozone Treatment of Fluid Milk:

Raw milk is traditionally treated with thermal processes in order to be safe for human consumption. Heating, however, may negatively influence both the nutritional value and the sensory properties of milk. Various authors reported ozone as an alternative to reduce the microbial load and to increase the shelf-life of fluid milk (Table 2.1).

Table 2.1: The summary of ozonating in fluid milk

Treatment	Target	Result	Reference
'Mild' ozone treatment (parameters unknown)	Milk and fluid milk products	Minimised deterioration of product quality	Sander (1985)
Pressurised ozone (5–35 mg/L for 5–25 min)	Microbial population of skim milk	2.4 $\log_{10}$ cfu/mL reduction in psychrotrophic counts	Rojek *et al*. (1995)
Gaseous ozone (generation rate: 0.2 g/h)	*Listeria monocytogenes* in commercial raw and branded milk samples (mean viable counts: 5.5 and 5.7 $\log_{10}$ cfu/mL, respectively)	Complete elimination of *Listeria monocytogenes* after 15 min	Sheelamary and Muthukumar (2011)
Gaseous ozone (1.5 mg/L for 5–15 min)	Microbiota of raw milk (mean total plate count: 4.18 $\log_{10}$ cfu/mL)	Up to 1 $\log_{10}$ cfu/mL reductions in bacterial and fungal counts after 15 min	Cavalcante *et al*. (2013a)
Gaseous ozone pre-treatment (concentration and duration unspecified) followed by pasteurisation	Raw milk	Shelf life extension without excessive lipid or protein oxidation in final product (commercial fluid milk)	Pastair (2014)

C. Ozone in Powdered Milk Products:

The application of ozone and its effect on quality and functionality of powdered milk products have been reported by the various authors (Table 2.2).

Table 2.2: Ozonating in dried milk products

Treatment	Target	Result	Reference
Gaseous ozone (2.8 mg/L or 5.3 mg/L for 0.5–2 h)	*Cronobacter sakazakii* ATCC 51329 in skim milk powder (SMP) and whole milk powder (WMP) at 5.92 $\log_{10}$ cfu/g	Log_{10} cfu/g reductions of approximately 3 (SMP) and 1.4 (WMP) in *Cronobacter* counts after 2 h	Torlak and Sert (2013)

Treatment	Target	Result	Reference
Gaseous ozone (2 ppb or 32 ppb during manufacture of milk powders)	SMP and WMP	Decreasing sensory scores with increasing background ozone levels and fat contents	Kurtz *et al.* (1969)
Gaseous ozone (treatment parameters unknown)	WMP	Negative effect on organoleptic properties due to lipid oxidation	Ipsen (1989)
Gaseous (60 g/h) or aqueous (4.5 ppm) ozone for up to 15 min	Whey protein isolates (WPI)	Enhanced foam formation and foam stability, whereas reduced solubility and emulsion stability of WPI	Uzun *et al.* (2012)
Gaseous ozone (approximately 20 mg/L for 30–480 min)	WPI	Improved foaming capacity and foam stability, whereas reduced solubility of WPI	Segat *et al.* (2014b)

D. Cheese and indoor atmosphere in cheese ripening and storage rooms:

Ozone was used in cheese-storage facilities first in the USA as early as in the 1940s. Some years later, the application of ozone at low levels to prevent mould growth on cheese during ripening was recommended by various authors.

Table 2.3: Ozone treatment in cheese.

Treatment	Target	Result	Reference
Gaseous ozone (3–10 ppm for up to 30 d)	Heavy mould growth on Cheddar cheese	Mould growth inhibition without mould destruction (fungistatic effect); and 94% reduction in mould spore counts in the air of storage room	Gibson *et al.* (1960)
Gaseous ozone (0.2–0.3 ppm for up to 63 d)	Mould growth on Cheddar cheese	Mould growth inhibition on the sides of cheese; and 88% reduction in mould spore counts in the air of storage room	Gibson *et al.* (1960)
Gaseous ozone (2.5–3.5 ppm for 4 h at 2- to 3-day intervals)	Russian- and Swiss-type cheeses	Mould growth inhibition on cheeses and packaging materials up to 4 months of refrigerated storage	Gabrielyants *et al.* (1980)
Gaseous ozone	Italian cheeses spiked with *Listeria*	Complete elimination of *L. monocytogenes* only	Morandi *et al.* (2009)

Treatment	Target	Result	Reference
(4 ppm for 8 min)	*monocytogenes* (up to 3 $\log_{10}$ cfu/g) at different stages of ripening	from cheeses contaminated during the first week of ripening	
Ozonated water (2 mg/L for 1–2 min)	Microbiota of Minas Frescal cheese	Approximately 2 $\log_{10}$ cfu/g reduction in initial bacterial and fungal counts ($P < 0.05$)	Cavalcante *et al*. (2013b)
Pre-ozonated (2 mg/L) cooling water (15 °C)	Microbiota of high-moisture mozzarella cheese	By 3.58 and 6.09 $\log_{10}$ cfu/g lower total plate counts and *Pseudomonas*spp. counts, respectively, than in control mozzarella samples cooled with nonozonated water, following 21 d of storage	Segat *et al*. (2014a)
Gaseous ozone (up to 5 ppm)	Air of cheese ripening room	Up to 99% decrease in viable counts of airborne moulds	Shiler *et al*. (1978)
Gaseous ozone (generation rate: 4–8 g/h) for 20 week	Air of cheese ripening room	Tenfold reduction in viable airborne mould load (to < 50 MPN/m^3), with majority of isolates belonging to *Penicillium* spp.	Serra *et al*. (2003)
Gaseous ozone (0.24 ppm for 40 d)	Parmesan-type cheese surfaces, shelf surfaces and air of cheese ripening room	0.74, 0.93 and 2.07 $\log_{10}$ reductions, respectively, in fungal viable counts ($P < 0.05$)	Pinto *et al*. (2007)
Gaseous ozone (0.38 ppm for 60 d)	Air of cheese ripening room	63% decrease in viable counts of airborne yeasts and moulds	Lanita and da Silva (2008)

E. Cleaning & disinfection of dairy process equipment's:

Several studies have examined its efficacy by testing different treatments on various surfaces and micro-organisms, some of these are listed in Table 2.4.

Table 2.4: Summary of studies of surface disinfection using ozone

Treatment	Target	Result	Reference
Ozonated cold water (10 °C) for 15 min	Heated dairy soil (reconstituted non-fat dry milk, 20% total solids) on metal plates	84% of dairy soil removed from plates	Guzel-Seydim *et al.* (2000)

Treatment	Target	Result	Reference
Ozonated water (40 NL/h, 80 g/Nm^3) in a bath-substrate-flow device for up to 30 min	Heat-denatured whey protein concentrate (WPC) on stainless steel coupons	Increased WPC removal rates within 10 min compared to treatment with 0.5% (w/w) NaOH solution	Jurado-Alameda *et al.* (2014)
Gaseous ozone pre-treatment (0.1–0.5%, v/v)	Heat-treated bovine serum albumin (BSA) on stainless steel particles	Increased BSA desorption rates during subsequent caustic alkali cleaning	Fukuzaki (2006)
Ozonated deionised water (0.5 ppm for 10 min)	*Pseudomonas fluorescens* ATCC 949 and *Alcaligenes faecalis* ATCC 337 in UHT milk biofilm on stainless steel plates	5.6 and 4.4 $\log_{10}$ cfu/cm^2 reductions, respectively	Greene *et al.* (1993)
Ozonated phosphate-buffered saline (0.6 ppm for 10 min)	*Pseudomonas* spp. in UHT milk biofilm on stainless steel coupons	Approximately 3–4 $\log_{10}$ cfu/in^2reductions in *Pseudomonas* populations	Dosti *et al.* (2005)
Gaseous ozone (2 ppm for 4 h)	*Escherichia coli* ATCC 25922, *Listeria innocua*, *Serratia liquefaciens*, *Staphylococcus aureus* and *Rhodotorula rubra*in UHT milk biofilm on stainless steel squares	Up to 5.64 $\log_{10}$ cfu/cm^2 reductions in microbial viability	Moore *et al.* (2000)
Distilled, deionised water treated with pulsed ozone (0.4–0.5 ppm) applied for 20 min/d for 7 d at 21–23 °C	Metal materials (plates) used as food contact surfaces in dairy processing	Significant weight loss of carbon steel plates ($P < 0.05$)	Greene *et al.* (1999)

F. Waste Water Treatment in Dairy Processing:

In dairy industry, cleaning and disinfection generated large quantities of wastewater. These wastewaters are conventionally purified with physicochemical and biological methods. Over the recent years, however, several researchers have tested ozonation, using it either alone or in combination with other technologies, in order to reuse, at least in part, the wastewater produced by the dairy sector.

Table 2.5: Ozone for waste water treatment in dairy processing

Treatment	Target	Result	Reference
Gaseous ozone (treatment parameters unknown)	Dairy effluent with 80–230 mg/L of fat content	96–98% decrease in fat content	Loorits *et al.* (1975)
Gaseous ozone pretreatment (150 mg/L/h for 60 min)	Dairy wastewater with 6100 mg/L of chemical oxygen demand (COD)	Enhanced COD removal and increased biodegradability of retentate during subsequent nanofiltration (4.0 MPa at 20 °C)	László *et al.* (2007)
Gaseous ozone treatment (30 mg/L for 5–20 min)	Model dairy wastewater with 4000 mg/L of COD	Up to 25% decrease in COD	László *et al.* (2009)
Gaseous ozone pretreatment (30 mg/L for 5–20 min)	Model dairy wastewater with 4000 mg/L of COD	Increased flux and decreased membrane fouling during subsequent nanofiltration (3.0 MPa at 25 °C)	László *et al.* (2009)
Gaseous ozone pretreatment (2 g/h for 240 min at pH 7–12)	Dairy wastewater with 6300 mg/L of COD	High COD removal efficiency (71%) at pH 12	Sivrioğlu and Yonar (2015)
Ultrasonication (76.4 kJ/kg TS of specific energy) followed by gaseous ozone pretreatment (0.0011 mg O_3/mg SS)	Dairy waste activated sludge with soluble COD, suspended solids (SS) and total solids (TS) levels of 400, 7000 and 12 560 mg/L, respectively	Enhanced COD solubilisation, SS reduction and anaerobic biodegradability (compared to single pre-ozonation)	Packyam *et al.* (2015)
Gaseous ozone (10 g/Nm^3 for up to 7 h at pH 2–10)	Biologically pretreated cheese whey wastewater with 520 mg/L of COD	Substantial decrease in COD, especially when ozonation was combined with application of 16.5–33.0 mM of H_2O_2	Martins and Quinta-Ferreira (2010)

2.7 Advantages of Ozonating Over Conventional Cleaning and Disinfection:

Water consumption in dairies is mainly associated to cleaning operations. The wastewater is the main environmental issue in the dairy sector. The pollution load on the wastewater is high due to residual milk fat and proteins as well as cleaning chemicals. Adopting ozone in cleaning and disinfection processes can bring various advantages over commonly employed disinfectants in the dairy industry. Ozone breaks down quickly into oxygen without leaving undesirable residues. This is an advantage both from the point of view of food safety and to improve the quality of wastewaters by avoiding the presence of harmful chlorine compounds. Replacing chemical products with ozone also lowers the concentration of salts and, therefore, the electrical conductivity of discharges (Canut and Pascual, 2007). The use of ozone can save water in comparison to other biocides, as it is faster-acting. Additionally, since it does not leave residues it does not require a final rinse to remove any residual disinfectant that might remain in the treated medium (Canut and Pascual, 2008). Another advantage, provided adequate microbiological controls are implemented, is that the ozonated water that has been used for disinfection can potentially be re-used for the initial cleaning stages, either directly or after reozonation to attain the required quality. Wastewaters are oxygenated by ozone conversion, so ozone use will improve the performance of aeration tanks and biological wastewater treatment processes. This is also an advantage from the point of view of reducing odour generation. Ozone use also provides energy savings as it is normally used at low temperatures. Finally, as it is generated ‘‘on the spot’’, ozone removes the need to store hazardous substances which could give rise to accidents that endanger human and environmental health and safety Pascual et al., (2007).

2.8 Conclusions:

The dairy industry continues to apply more focus on the importance of reducing water cost and the recovery of valuable raw materials. Water consumption in this industry is mainly associated with cleaning operations, cooling water and process water. The concerns for health and environmental challenges have given rise to alternative solutions for disinfection. Ozone is at minimum as effective as common sanitizing agents used in wash waters in the dairy & food industry. It has been reported that the ozone CIP system allows a reduction of the water consumption needed to perform cleaning and disinfection operations of closed equipment’s in the dairy sectors. Compared to conventional CIP at least, the same disinfection and cleanliness efficiency and reducing at least by 50% the organic load in the cleaning waste waters produced. The equipment necessary is available at the market, the investment cost is somewhat higher than current CIP systems and running costs lower. Other considerations such as hazards and material compatibility are well identified and documented. Thus, ozone can be considered a complimentary sanitizing regime to help maintain the overall cleanliness and sanitation of any food processing facility.

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3. Environmental Regulation: Exploration of its Scope, Challenges and Prospects for Sustainable Development

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Abstract:

Environmental regulation plays a vital role in shaping and reshaping the interactions between anthropogenic activities for the economic development and the natural environment. It involves the formulating and enforcement of rules, laws, and policies that points to mitigate the negative impacts of human actions and safeguard the planet's natural resources and ecosystems through the sustainable development. This chapter provides overview of a comprehensive multifaceted scope, evolution, prospects and challenges for sustainable development. It also explores the key aspects of environmental regulation in India, including its legal framework, challenges, recent developments, and the path forward.

Keywords:

Climate Change, Biodiversity, Pollution, Sustainable Development, Environmental regulation.

3.1 Environment:

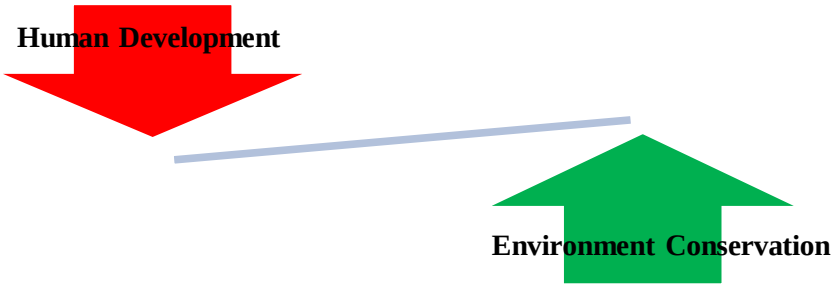
The environment is a vital reservoir that sustains all type of life on Earth. Life lines of the ecosystem such as clean air, water, fertile soil, and climate regulation are fundamental to maintaining the dynamics equilibrium of the biosphere such as climate change, scarcity of natural resource and biodiversity that contributes a lot to the resilience of ecosystems and provides benefits, to support agriculture.

However, non judicious and rapid unsustainable practices industrialization and urbanization have led to various forms of environmental degradation that pose significant threats to dynamic ecosystems by economic growth and technological advancement.

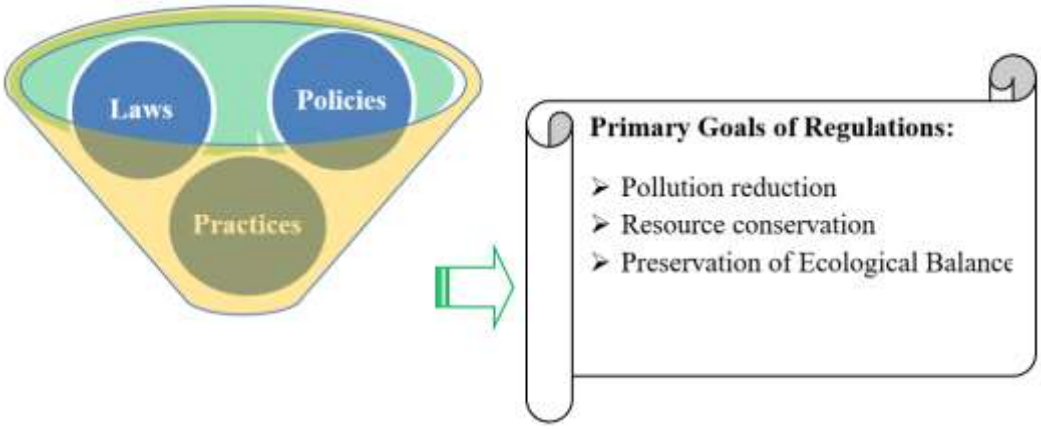
To address these alarming challenges in current scenario, environmental regulation has become a vital legal tool to restore, protect and preserve the delicate ecological balance of our planet's ecosystems. These challenges surpass borders; underscore the need for global cooperation [1-7].

3.2 Environmental Regulation:

Environmental regulation encompasses set of rules, laws, policies, and the practices that intended to regulate the anthropogenic activities to minimize negative impacts on the ecology. Its primary goals include pollution reduction, resource conservation, and the preservation of ecological balance as shown in Figure 3.1.



a) Strike balance between human development and Environment Conservation



b) Primary Goals of Environmental Regulations

Figure 3.1: a) Strike Balance for Sustainable Development b) Primary Goals of Environmental Regulation

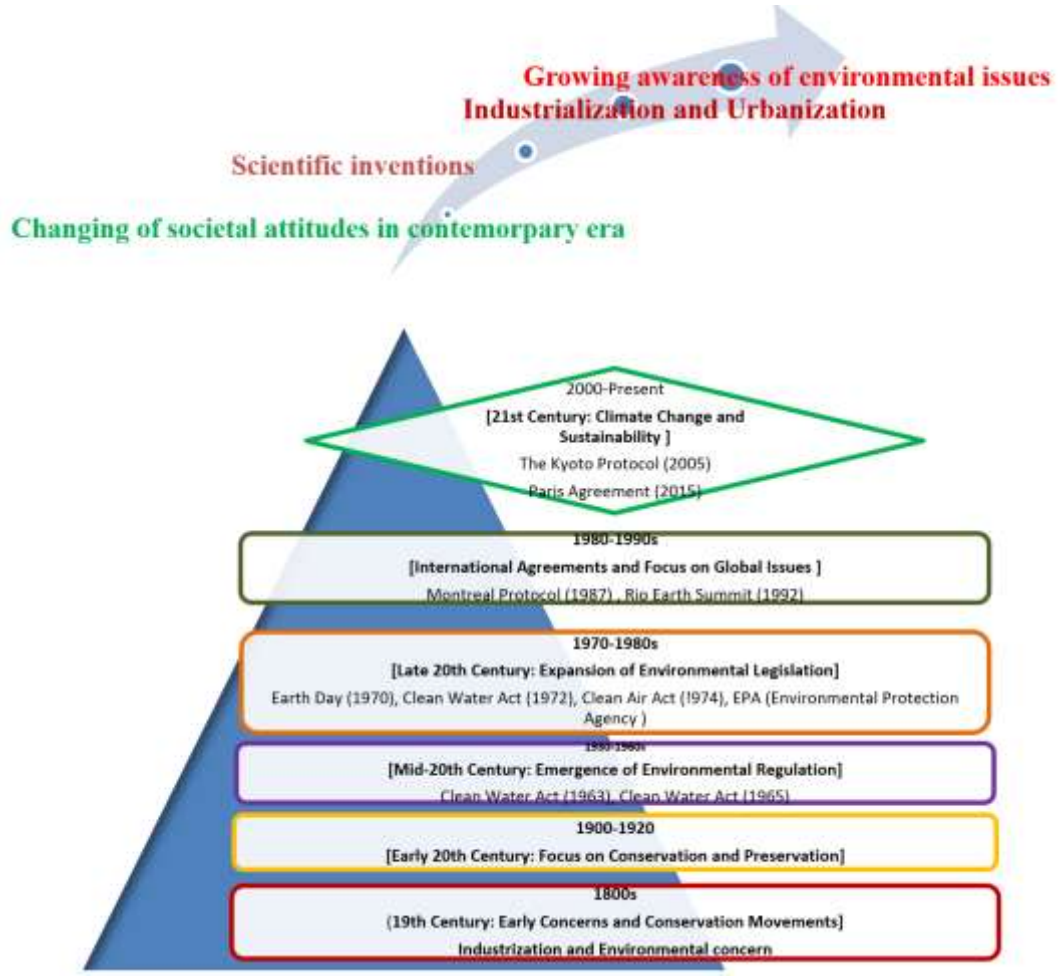
3.2.1 Evolution of Environmental Regulation, Global Status and Components:

The Major components of environmental regulation include quality standards of air and water, planning of land use, waste management and protection of endangered species.

Effective regulation requires global efforts that incorporate collaboration among governments and non-government organizations that advocate the environmental concerns to ensure sustainable and evenhanded outcomes for present and future generations.

The historical evolution and formulation of environmental regulation across the globe spans several centuries and has evolved in response to scientific inventions, industrialization, urbanization, change of societal attitudes and mounting awareness of environmental concerns in contemporary era as shown in Figure 3.2. Overview of the key milestones in the history of environmental regulation as given below:

a) Contemporary Response for the Evolution of Environmental Regulation



b) Evolution of Environmental Regulation

Figure 3.2: Evolution of Environmental Regulation in Response to Contemporary Needs

A. Global Scenario of Environmental Regulation:

a. **19th Century: Early Concerns and Conservation Movements (1800s):** As industrialization accelerated, concerns about pollution, deforestation, and resource depletion began to emerge. The conservation movement gained momentum with the establishment of the world's first national park and Yellowstone, in 1872.
b. **Early 20th Century: Focus on Conservation and Preservation (1900s-1920s):** Influential figures like Theodore Roosevelt and John Muir advocated for conservation and the protection of natural resources. The U.S. Forest Service and the National Park Service were created during this period.
c. **Mid-20th Century: Emergence of Environmental Regulation (1930s-1960s):** The post-World War II period saw increased industrialization and environmental degradation. Concerns about air and water pollution led to the Clean Air Act (1963) and the Water Quality Act (1965) in the United States.
d. **Late 20th Century: Expansion of Environmental Legislation (1970s-1980s):** The 1970s marked a significant era in environmental regulation. Earth Day was established in 1970, and landmark legislation like the Clean Water Act (1972), the Clean Air Act Amendments (1977), and the establishment of the U.S. Environmental Protection Agency (EPA) occurred.
e. **International Agreements and Focus on Global Issues (1980s-1990s):** Concerns about global environmental issues led to international agreements such as the Montreal Protocol (1987) to address ozone depletion and the Rio Earth Summit (1992) focusing on sustainable development.
f. **21st Century: Climate Change and Sustainability (2000s-Present):** The 21st century has seen a growing emphasis on climate change mitigation and adaptation. The Kyoto Protocol (2005) and the Paris Agreement (2015) are key international efforts in this regard. Sustainable development and circular economy principles have gained prominence.
g. **Technological Advancements and Digital Solutions:** Recent years have seen the integration of technology into environmental regulation, with advancements in monitoring, data analysis, and modeling contributing to more effective enforcement and decision-making.
h. **Public Awareness and Advocacy:** Throughout history, environmental activism and public awareness campaigns have played a crucial role in driving changes in regulations and policies. Grassroots movements, citizen science initiatives, and online platforms have enabled broader participation in environmental advocacy.
i. **Evolving Challenges:** The history of environmental regulation reflects the ongoing adaptation to new challenges such as emerging pollutants, invasive species, biodiversity loss, and the complexities of managing ecosystems in a rapidly changing world.

B. Evolution of Environmental Regulation in India: Balancing Development and Conservation

India, with its rich biodiversity and growing industrialization, faces the complex challenge of achieving economic development while safeguarding its environment. Environmental regulation in India has evolved over the years to address these challenges, aiming to strike a balance between growth and conservation.

a. Legal Framework: The foundation of environmental regulation in India was laid with the enactment of the Environment Protection Act (1986). This landmark legislation established the legal basis for protecting and improving the environment and preventing and abating environmental pollution.

The Act led to the formation of various regulatory bodies, including the Ministry of Environment, Forest and Climate Change (MoEFCC), State Pollution Control Boards (SPCBs), and the National Green Tribunal (NGT) (Figure 3.3).

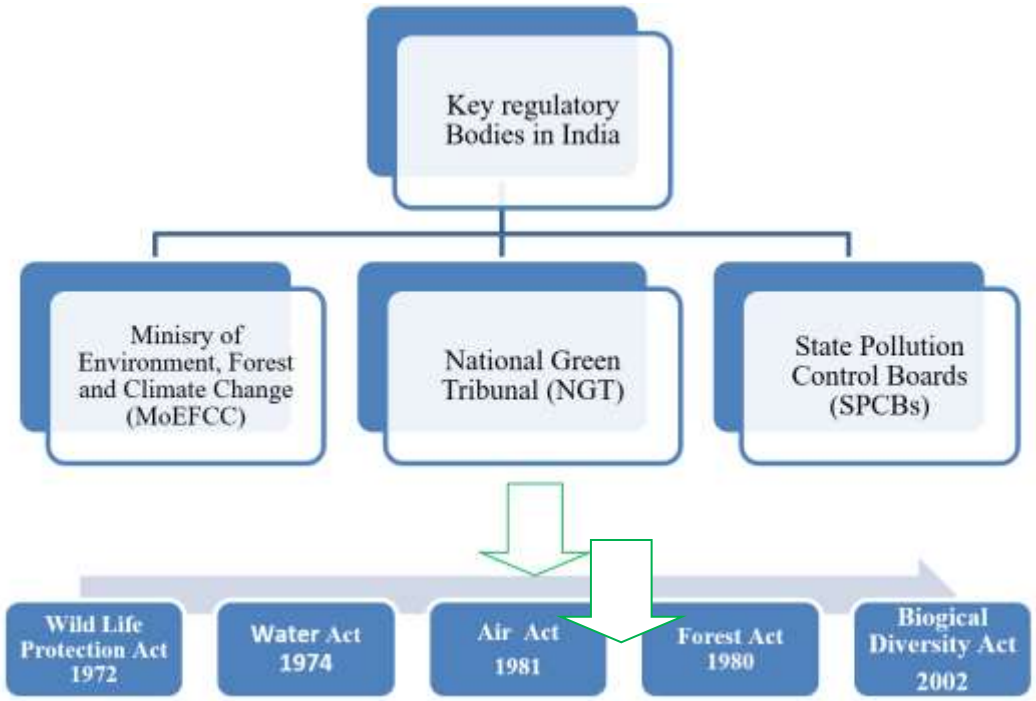


Figure 3.3: Key Environmental Regulatory Bodies and Acts in India

b. Key Regulations and Acts: Several regulations and acts supplement the Environment Protection Act to address specific environmental issues:

- **Air (Prevention and Control of Pollution) Act (1981):** Aims to control air pollution by regulating emissions from industries and vehicles.
- **Water (Prevention and Control of Pollution) Act (1974):** Focuses on preventing water pollution and regulating discharges into water bodies.
- **Wildlife Protection Act (1972):** Protects wildlife species and their habitats, regulating activities that may harm them.
- **Forest (Conservation) Act (1980):** Regulates diversion of forest land for non-forest purposes, ensuring sustainable forest management.
- **Biological Diversity Act (2002):** Seeks to conserve India's biodiversity and ensure equitable sharing of benefits arising from its use.

3.2.2 Environmental Regulation and Prospects for Sustainable Development:

Environmental regulation also offers the following prospects for achieving sustainable development:

a. **Resource Conservation:** Regulations promote the efficient use of natural resources, minimizing waste and overexploitation.
b. **Pollution Reduction:** Regulations targeting emissions and pollutants improve air and water quality, benefiting both human health and ecosystems.
c. **Renewable Energy Transition:** Regulations can encourage the shift towards renewable energy sources, reducing greenhouse gas emissions and dependence on fossil fuels.
d. **Biodiversity Preservation:** Regulations protecting habitats and ecosystems contribute to biodiversity conservation, maintaining vital ecological services.
e. Innovation and Green Technologies: Regulations can drive innovation in environmentally friendly technologies, creating new economic opportunities.

3.2.3 Scope of Environmental Regulation:

The scope of environmental regulation is broad and covers a wide range of issues related to the environment. It can include regulations on air and water quality, waste management, land use, biodiversity conservation, emissions reduction, climate change mitigation, and more. These regulations can be enacted at various levels, from local and national governments to international agreements and treaties. The scope also extends to industries, businesses, and individuals, all of which play a role in environmental impact.

a. **Air Quality Regulation:** Policies and standards that aim to control emissions of pollutants from industrial processes, vehicles, and other sources to maintain air quality and reduce the impact of air pollution on public health and ecosystems.
b. **Water Quality Regulation:** Measures to safeguard water bodies from pollution, including regulations on industrial discharges, sewage treatment, and agricultural runoff to ensure safe and sustainable water resources.
c. **Waste Management Regulation:** Regulations governing the proper handling, disposal, recycling, and treatment of various types of waste, including hazardous waste, electronic waste, and solid waste.
d. **Biodiversity and Habitat Protection:** Laws and regulations designed to conserve ecosystems, protect endangered species, and preserve natural habitats from degradation and destruction.
e. **Climate Change Regulation:** Policies focused on mitigating greenhouse gas emissions and adapting to the impacts of climate change, often involving targets for emissions reduction and the promotion of renewable energy sources.
f. **Energy Efficiency Standards:** Regulations that set efficiency standards for appliances, vehicles, and industrial processes to reduce energy consumption and associated environmental impacts.
g. **Land Use and Development:** Regulations that guide urban planning, zoning, and land development to prevent urban sprawl, protect green spaces, and promote sustainable land use practices.

h. **Chemical and Toxic Substances Regulation:** Measures to control the use, storage, and disposal of hazardous chemicals and substances to minimize risks to human health and the environment.
i. **Environmental Impact Assessment (EIA):** Procedures that require projects and activities with potential environmental impacts to undergo assessment and mitigation measures before approval.
j. **Eco-labeling and Certification:** Programs that certify products and services as environmentally friendly, sustainable, or meeting specific environmental criteria.
k. **International Environmental Agreements:** Multilateral agreements and treaties between countries to address global environmental issues, such as the Paris Agreement on climate change and the Convention on Biological Diversity.
l. **Enforcement and Compliance:** Mechanisms to ensure that individuals, companies, and organizations adhere to environmental regulations, often involving penalties for non-compliance.

The scope of environmental regulation is dynamic and evolves as new environmental challenges arise and our understanding of environmental impacts deepens. It involves a complex interplay between scientific knowledge, policy-making, technological advancements, and stakeholder engagement to achieve a balance between economic development and environmental protection.

3.2.4 Challenges in Environmental Regulations:

Implementing effective environmental regulation faces challenges like balancing economic growth with environmental protection and ensuring compliance across diverse industries[1-7]. Regulatory frameworks must also adapt to rapid technological advancements. However, these challenges present opportunities for innovation, green technologies, and sustainable business practices that benefit both the environment and the economy. While environmental regulation is essential, it also faces several challenges as given below.

a. **Complexity:** Environmental systems are intricate and interconnected. Creating regulations that effectively address these complexities while avoiding unintended consequences can be challenging.
b. **Enforcement and Compliance:** Even well-designed regulations may struggle with enforcement and compliance issues. Monitoring and ensuring that industries and individuals adhere to regulations require resources and expertise.
c. **Global Nature of Environment issues:** Many environmental challenges, such as climate change, transcend national boundaries. Cooperation and coordination among nations are necessary for effective solutions.
d. **Political and Stakeholder Interests:** Environmental regulations can be influenced by political agendas and the interests of various stakeholders, including industries, advocacy groups, and local communities.
e. **Technological Advancements:** Rapid technological advancements can outpace regulatory frameworks, leading to gaps in addressing emerging environmental risks.
f. **Public Awareness:** Many segments of society remain unaware of their environmental rights and responsibilities. Despite the regulatory framework, India also faces similar challenges in effective environmental regulation.

3.2.5 Budget Considerations in Global Environmental Regulation:

Effective implementation of these regulations hinges on financial resources**.** Global environmental regulation often faces following budget-related hurdles:

a. **Resource Constraints:** Many countries, particularly developing ones, lack the necessary financial resources to implement and enforce comprehensive environmental regulations.
b. **Competing Priorities:** Governments often allocate budgets to urgent socio-economic needs, leaving limited funds for environmental protection.
c. **Technological Costs:** Adoption of cleaner technologies and sustainable practices can require substantial upfront investments.
d. **Trans boundary Impact:** Environmental issues like air and water pollution often cross borders, necessitating collaborative financial efforts.

A. Strategies to Address Budget Constraints:

Several strategies can be employed to overcome budget challenges and ensure the successful implementation of global environmental regulations as described below [9];

a. **Capacity Building:** Investing in capacity-building programs can empower nations with the skills and knowledge needed to effectively manage and regulate their environmental resources.
b. **Public-Private Partnerships (PPPs):** Collaborations between governments, private sector entities, and non-governmental organizations (NGOs) can pool resources and expertise.
c. **Innovative Financing:** Exploring novel funding mechanisms like green bonds, environmental taxes, and payments for ecosystem services can generate revenue for environmental projects.
d. **International Aid and Funding:** Developed countries and international organizations can provide financial assistance to developing nations for environmental initiatives.
e. **Technology Transfer:** Developed nations can support technology transfer to less developed countries, helping them adopt sustainable practices without bearing exorbitant costs.

B. Innovative Financing Mechanisms:

In recent years, innovative following financing mechanisms have gained prominence in global environmental regulation [9].

a. **Green Bonds:** These financial instruments raise capital specifically for environmental and climate-related projects, offering investors an avenue to support sustainable initiatives while gaining returns.
b. **Carbon Markets:** Emission trading systems allow companies to buy and sell carbon credits, incentivizing emissions reduction and funding clean energy projects.
c. **Payments for Ecosystem Services (PES):** Communities are compensated for conserving ecosystems that provide valuable services like clean water, biodiversity preservation, and carbon sequestration.

d. **Environmental Impact Funds:** These funds pool investments from governments, philanthropists, and private investors to finance projects addressing specific environmental challenges.

3.2.6 Global Funding and Collaboration:

Global collaboration in environmental regulation is crucial for addressing the increasingly pressing challenges posed by climate change, biodiversity loss, pollution, and other environmental issues. These problems transcend national borders and require concerted efforts from countries around the world to effectively mitigate their impact and promote sustainable development. There are some key aspects and examples of global collaboration in environmental regulation:

a. **International Agreements and Treaties**: Several international agreements and treaties have been established to facilitate global cooperation in environmental regulation. Examples include the Paris Agreement (climate change), the Convention on Biological Diversity (biodiversity conservation), and the Stockholm Convention (persistent organic pollutants).
b. **Information Sharing and Data Collection**: Collaborative efforts are necessary to gather and share accurate and up-to-date environmental data. This data helps nations assess the state of the environment, track progress, and identify emerging challenges. Organizations like the United Nations Environment Programme (UNEP) play a role in facilitating data sharing.
c. **Technology Transfer**: Technological innovations can play a significant role in mitigating environmental challenges. Collaborative efforts can help transfer clean and sustainable technologies from developed to developing countries, allowing them to leapfrog more polluting technologies.
d. **Capacity Building**: Developing countries often require assistance in building their capacity to implement and enforce effective environmental regulations. Collaborative initiatives can provide training, technical support, and resources to help these nations improve their environmental management practices.
e. **Global Research and Knowledge Exchange**: Collaborative research initiatives enable scientists and experts from around the world to pool their knowledge and resources to better understand environmental issues and develop solutions.
f. **Economic Incentives**: Collaborative efforts can promote the development of global economic incentives, such as carbon pricing mechanisms, to encourage countries to reduce greenhouse gas emissions and adopt more sustainable practices.
g. **Joint Enforcement and Monitoring**: International organizations and agreements can establish mechanisms for monitoring and enforcing compliance with environmental regulations. This ensures that countries are held accountable for their commitments.
h. **Public Awareness and Education**: Collaborative campaigns can raise public awareness about environmental issues and the importance of regulatory efforts. Educating the public can create pressure on governments to take meaningful action. Environmental regulation is bolstered by public awareness and participation. Informed citizens can advocate for stronger regulations, hold industries accountable, and adopt sustainable lifestyles. Public engagement also fosters transparency and accountability in policy formulation and implementation.

i. **Adaptation and Resilience**: Collaborative efforts can help countries adapt to the impacts of climate change and enhance their resilience against environmental shocks.
j. **Conflict Prevention**: Environmental degradation can exacerbate conflicts, especially in resource-scarce regions. Collaborative environmental regulation can contribute to preventing conflicts and fostering stability.

There are several successful global collaboration [10-15] as shown below in Figure 3.4.

Figure 3.4: Global Collaboration for Environmental Regulation

a. **The Montreal Protocol:** An international treaty aimed at phasing out the production and consumption of ozone-depleting substances. It has been successful in reducing the release of such substances into the atmosphere. It has been hailed as one of the most successful environmental agreements, leading to significant reductions in ozone-depleting substances
b. **The International Maritime Organization (IMO):** Responsible for regulating shipping activities to minimize their environmental impact, including the reduction of greenhouse gas emissions.
c. **The Intergovernmental Panel on Climate Change (IPCC):** A scientific body that assesses climate change science and provides policymakers with information to guide global climate policies.
d. **The Aarhus Convention:** Focus on ensuring public participation in environmental decision-making and providing access to environmental information and justice. Overall, global collaboration in environmental regulation is essential to address the interconnected and trans boundary nature of environmental challenges and to create a sustainable future for all. Whereas the United Nations has been instrumental in

promoting and coordinating international efforts to address environmental challenges. While the term "most powerful" can be subjective and dependent on various factors, the following international agreements and frameworks initiated or supported by the United Nations are widely recognized for their impact on global environmental governance:

e. **Paris Agreement (2015):** The Paris Agreement, adopted under the United Nations Framework Convention on Climate Change (UNFCCC), is a landmark international treaty aimed at combatting climate change. It sets targets for limiting global warming and encourages countries to enhance their efforts to reduce greenhouse gas emissions..
f. **Sustainable Development Goals (SDGs):** While not a single regulation, the 17 Sustainable Development Goals adopted in 2015 are a comprehensive framework for addressing global challenges, including environmental sustainability. Goal 13 specifically focuses on climate action, while other goals address issues related to clean water, life on land and below water, responsible consumption, and more.
g. **Convention on Biological Diversity (CBD):** The CBD, adopted in 1992 at the Earth Summit in Rio de Janeiro, aims to promote the conservation and sustainable use of biodiversity. The CBD has three main objectives: conservation of biodiversity, sustainable use of its components, and fair and equitable sharing of benefits arising from genetic resources.
h. **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal:** This treaty, administered by the United Nations Environment Programme (UNEP), regulates the movement of hazardous wastes across international borders. It aims to minimize the generation of hazardous waste and control its transboundary movement.
i. **United Nations Convention to Combat Desertification (UNCCD):** The UNCCD addresses the issue of land degradation and desertification, particularly in arid and semi-arid regions. It promotes sustainable land management practices and aims to improve the livelihoods of affected communities.
j. **UNEP Regional Seas Program:** This program supports the creation of regional agreements and frameworks to protect and manage shared marine environments. Examples include the Mediterranean Action Plan and the Nairobi Convention for the Western Indian Ocean.
k. **United Nations Environment Assembly (UNEA):** Although not a regulation, the UNEA is the highest-level global environmental decision-making forum. It convenes governments, civil society, and other stakeholders to discuss and advance environmental policy and action.
l. It's important to note that the effectiveness of these regulations depends on the commitment and actions of individual countries, as well as the collaboration of the international community. Each of these agreements plays a significant role in addressing various environmental challenges on a global scale.

3.3 Recent Developments and Initiatives in India:

In recent years, India has taken significant steps to strengthen environmental regulation[1][7] [8]. as shown below:

a. **Swachh Bharat Abhiyan (Clean India Campaign):** A nationwide initiative to promote cleanliness and proper waste management.

b. **Renewable Energy Focus:** Policies promoting renewable energy sources like solar and wind power contribute to reducing carbon emissions.
c. **Plastic Waste Management Rules (2016):** Aim to reduce plastic waste through regulation of manufacturing, usage, and disposal.
d. **Green Clearance Reforms:** Streamlining the environmental clearance process to balance development and conservation.

3.4 The Path Forward:

To enhance the effectiveness of environmental regulation in India, several measures can be considered:

a. **Strengthening Enforcement:** Adequate resources, training, and transparency in regulatory bodies can bolster enforcement efforts.
b. **Public Participation:** Engaging citizens and communities in decision-making processes can improve accountability and compliance.
c. **Integrated Approach:** Coordinating various environmental laws and regulations to create a unified framework.
d. **Promoting Research:** Encouraging research and innovation to find sustainable solutions for environmental challenges.

3.5 Conclusion:

Environmental regulation is a pivotal tool for addressing the negative impacts of human activities on the environment and promoting sustainable development. While it faces challenges, its potential benefits are significant and encompass a wide range of environmental, social and economic aspects. Striking a balance between effective regulations and accommodating various interests is the key to achieve long-term environmental sustainability. Environmental regulation in India is a dynamic field, constantly adapting to the changing demands of a developing nation. While challenges persist, the nation's commitment to sustainable growth, coupled with the involvement of regulatory bodies, industries, communities, and individuals, can pave the way for a future where economic progress coexists harmoniously with environmental conservation. Balancing financial responsibility with environmental stewardship is key to securing a sustainable and prosperous future for all. Initiatives like the Green Climate Fund and the Global Environment Facility facilitate financial support for climate adaptation and mitigation efforts in developing countries. By recognizing the intrinsic value of nature and working together to develop and enforce effective policies, we can safeguard the environment's intricate web of life and ensure a harmonious coexistence between humans and the planet.

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4. A Comprehensive Study on Application of Small Business Finance: Its Importance to The Small Business Sectors

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Abstract:

This article examines the economics of financing small business in private equity and debt markets. Firms are viewed through a financial growth cycle paradigm in which different capital structures are optimal at different points in the cycle. We show the sources of small business finance, and how capital structure varies with firm size and age. The interconnectedness of small firm finance is discussed along with the impact of the macroeconomic environment. We also analyse a number of research and policy issues, review the literature, and suggest topics for future research.

Keywords:

Venture capital, Small business lending, Bank, Mergers.

4.1 Introduction:

Business finance is the cornerstone of every organization. It refers to the corpus of funds and credit employed in a business. Business finance is required for purchasing assets, goods, raw materials and for performing all other economic activities. Precisely, it is required for running all the business operations.

The role of the entrepreneurial enterprise as an engine of economic growth has garnered considerable public attention in the 1990s. Much of this focus stems from the belief that innovation – particularly in the high tech, information, and bio-technology areas – is vitally dependent on a flourishing entrepreneurial sector. The spectacular success stories of companies such as Microsoft, Genentech, and Federal Express embody the sense that new venture creation is the sine qua non of future productivity gains. Other recent phenomena have further focused public concern and awareness on small business, including the central role of entrepreneurship to the emergence of Eastern Europe, financial crises that have threatened credit availability to small business in Asia and elsewhere, and the growing use of the entrepreneurial alternative for those who have been displaced by corporate restructuring in the US.

Accompanying this heightened popular interest in the general area of small business has been an increased interest by policy makers, regulators, and academics in the nature and

behaviour of the financial markets that fund small businesses. At the core of this issue are questions about the type of financing growing companies need and receive at various stages of their growth, the nature of the private equity and debt contracts associated with this financing, and the connections and substitutability among these alternative sources of finance. Beyond this interest in the micro-foundations of small business finance is a growing interest in the macroeconomic implications of small business finance. For example, the impact of the US "credit crunch" of the early 1990s and the effect of the consolidation of the banking industry on the availability of credit to small business have also been the subject of much research over the past several years. Similarly, the "credit channels" of monetary policy – mechanisms through which monetary policy shocks may have disproportionately large effects on small business funding – has generated considerable analysis and debate. Other key issues, such as the link between the initial public offering (IPO) market and venture capital flows, prudent man rules regarding institutional investing in venture capital, and the role of small firm finance in financial system architecture are just beginning to attract research attention.

The private markets that finance small businesses are particularly interesting because they are so different from the public markets that fund large businesses. The private equity and debt markets offer highly structured, complex contracts to small businesses that are often acutely informationally opaque. This is in contrast to the public stock and bond markets that fund relatively informationally transparent large businesses under contracts that are more often relatively generic.

Financial intermediaries play a critical role in the private markets as information producers who can assess small business quality and address information problems through the activities of *screening*, *contracting*, and *monitoring*. Intermediaries screen potential customers by conducting due diligence, including the collection of information about the business, the market in which it operates, any collateral that may be pledged, and the entrepreneur or start-up team. This may involve the use of information garnered from existing relationships of the intermediary with the business, the business owner, or other involved parties. The intermediary then uses this information about the initial quality of the small business to set contract terms at origination (price, fraction of ownership, collateral, restrictive covenants, maturity, etc.). Contract design and payoff structure are chosen on the basis of the financial characteristics of the firm and the entrepreneur as well as the firm's prospects and the associated information problems. High risk-high growth enterprises whose assets are mostly intangible more often obtain external equity, whereas relatively low risk-low growth firms whose assets are mostly tangible more often receive external debt for reasons explored below. Finally, in order to keep the firm from engaging in exploitive activities or strategies, the intermediary monitors the firm over the course of the relationship to assess compliance and financial condition, and exerts control through such means as directly participating in managerial decision making by venture capitalists or renegotiating waivers on loan covenants by commercial banks.

The papers in this special issue were drawn from a conference held at New York University in May 1997 sponsored by the Berkley Center for Entrepreneurial Studies and the New York University Salomon Center. They consist of full-length research papers, discussants' comments on these papers, and shorter contributions based on panel discussions. The topics span a wide variety of key issues, including venture capital and going public (Trester,

1998, Thakor, 1998; Bergemann and Hege, 1998; Lerner, 1998b; Benveniste et al., 1998; Flannery, 1998), angel finance (Lerner, 1998a; Prowse, 1998; Acs and Tarpley, 1998), the impact of financial institution consolidation on small business lending (Peek and Rosengren, 1998; Strahan and Weston, 1998; Rosen, 1998b; Goldberg and White, 1998; DeYoung, 1998), relationship lending (Berlin and Mester, 1998; Houston and James, 1998; Pagano, 1998; Angelini et al., 1998; Kashyap, 1998; Cole, 1998; Duca, 1998), issues in credit availability (Hancock and Wilcox, 1998; Eisenbeis, 1998; Avery et al., 1998; Mann, 1998), the availability of new data sources for research on small business (Wolken, 1998; Fenn and Liang, 1998; Dunkelberg, 1998), and the future of small business finance (Gompers, 1998; Rosen, 1998a; Meyer, 1998).

This special issue and the conference on which it is based have several motivations. The first is to provide as complete a picture as possible of the nature of the private equity and debt markets in which small businesses are financed based on currently available research and data. The second is to draw connections between various strands of the theoretical and empirical literature that have in the past focused on specific aspects of small firm finance but often have not captured the complexity of small business finance and the alternative sources of funding available to these firms. The third goal is to extend research in key areas related to the markets, contracts, and institutions associated with small firm finance. Finally, we wish to highlight important issues for future research and the relatively new data sources available to address these issues.

We proceed in Section 2with a discussion of the idiosyncratic nature of small business finance, the private markets that provide this finance, and an overview of key research issues. In 3 The role of private equity markets in small business finance, 4 The role of private debt markets in small business finance, we examine more closely the extant literatures on private equity markets and private debt markets, respectively. Section 5discusses the vulnerability of small business finance to the macroeconomic environment. Section 6draws some tentative conclusions and suggests areas for future research.

4.2 Literature Review:

Perhaps the most important characteristic defining small business finance is informational opacity. Unlike large firms, small firms do not enter into contracts that are publicly visible or widely reported in the press – contracts with their labour force, their suppliers, and their customers are generally kept private. In addition, small businesses do not issue traded securities that are continuously priced in public markets and (in the US) are not registered with the Securities and Exchange Commission (SEC). Moreover, many of the smallest firms do not have audited financial statements that can be shared with any provider of outside finance. As a result, small firms often cannot credibly convey their quality. Moreover, small firms may have difficulty building reputations to signal high quality or non-exploitive behaviour to overcome informational opacity.

The private equity and debt markets we study here offer specialized mechanisms to address these difficulties. As noted above, the financial intermediaries that operate in these markets actively screen, contract with, and monitor the small businesses they invest in over the course of their relationships to help resolve these information problems. Indeed, it can be

argued that the modern theory of financial intermediation – which motivates intermediaries as delegated monitors on behalf of investors (e.g., Diamond, 1984; Ramakrishnan and Thakor, 1984; Boyd and Prescott, 1986) – is mostly a theory that applies to the provision of intermediated finance in private markets to small, informationally opaque firms.

Data on Small Business Finance:

The feature of small business finance that makes it the most interesting to study, informational opacity, also has made it one of the most difficult fields in which to conduct empirical research until recently. Small businesses are generally not publicly traded and therefore are not required to release financial information on 10K forms, and their data are not collected on CRSP tapes or other data sets typically employed in corporate finance research. Some data are collected on lending by regulated financial institutions like commercial banks and thrifts, but these data traditionally were not broken down by the size of the borrower. Although a few surveys have been conducted on small businesses, these data were not widely circulated among researchers. The lack of detailed micro data on small businesses and the funds they raise in private equity and debt markets is likely a major reason why – until very recently – small business finance has been one of the most under researched areas in finance.

However, this situation is changing rapidly, as several data sets have recently become available that make it much easier to describe the state of small business finance and to test the extant theories of financial intermediation and informational opacity. Data sets with information on US small firms include the National Survey of Small Business Finances (NSSBF) and National Federation of Independent Business survey (NFIB), both of which canvas small businesses for their balance sheet and income data and their use of financial intermediaries, trade credit, and other sources of funds. These data allow for tests of research questions regarding the cost and availability of different types of external finance and how the cost and availability vary with the characteristics of the small firms. The Survey of Consumer Finances (SCF) collects detailed financial information from households, including their ownership of small businesses, and whether they also lend to these firms or provide support through the pledging of personal collateral or through loan guarantees.

These data allow for tests of the roles of personal wealth and other personal characteristics in financing small businesses. The Survey of Terms of Bank Lending (STBL) provides detailed information since 1977 on the contract terms on some of the individual loans issued by a sample of banks, including the largest banks in the U.S. Beginning in 1997, the STBL includes the banks' risk ratings on their individual loans, and data on loans issued by agencies and branches of foreign banks (Brady et al., 1998). Bank call reports (CALL) since 1993 have provided data on the number and total dollar values of loans issued to businesses with small amounts of bank credit. Community Reinvestment Act (CRA) data that were first collected in 1997 help augment these data by giving more information on the size of the borrowers (annual revenues above versus below $1 million), and their location by census tract (Bostic and Canner, 1998). The STBL, CALL, and CRA data sources allow researchers to test the empirical connections between bank characteristics and the supply of small business credit. Detailed data on private equity markets are considerably sparser than data on private debt markets, but some progress is being made here as well. Venture Economics and Venture

One provide information on venture capital markets, data on both venture capital and angel finance may be gleaned from the NSSBF, some data on angel finance is obtainable from the SCF, and the Small Business Administration (SBA) provides some information on Small Business Investment Companies (SBICs). Details about these data sets, their uses in research, and how to gain access to them are provided in special issue panel discussions by Wolken (NSSBF, SCF, STBL, CALL, CRA, others), Dunkelberg (NFIB), and Fenn and Liang (Venture Economics, VentureOne, others).

Data on small firms and their suppliers of external finance have also been generated recently in other countries and have been used in recent research efforts. These include data from Eastern Europe (Karsai et al., 1997), Germany (Elsas and Krahnen, 1997; Harhoff and Korting, 1997), Italy (Angelini et al., 1998), Norway (Ongena and Smith, 1997), Russia (Cook, 1997), Trinidad/Tobago (Storey, 1997), and the UK (Cressy and Toivanen, 1997; Wright et al., 1997). The problems of small business finance likely apply with even greater force to small businesses in developing nations, but very little data are available from these nations (White, 1995).

4.3 Research Objectives:

a. To know the importance of business finance in business sector.
b. To know the uses or applications of business finance on account of business whether on the level of startup or establishment or expansion or modernization.

4.4 Scope:

a. Now finance has become a natural function and highly impossible partto get split from our day to day lives whether from our personal life or from any business.
b. So, this article or research will yield you the understanding of finance with its reasons why it is so important in today's business.
c. This study will be helpful for academic researcher or research scholar for doing research or investigation on it and off course to reach out better decision like trading policies, it may be any.

4.5 Research Methodology:

In this, there is "**Descriptive & Conceptual research"**. There is used **"Secondary data"** for conducting research. As an investigator, get this data from text books, journals, articles, published or unpublished, websites, e-journal.

4.6 Data Analysis and Interpretation:

Business Finance Meaning:

Business finance is the funds required to establish, operate business activities, and expand in the future. Funds are specifically required various purchase type of tangible assets such as furniture, machinery, buildings, offices, factories, or intangible assets like patents, technical expertise, and trademarks, etc.

Apart from the assets mentioned above, other things that require funding are the day-to-day operational activities of a business. This activity includes purchasing raw materials, paying salaries, bills, collecting money from clients, etc. It is essential to have sufficient amount of money to survive and grow the business.

Classification of Sources of Funds:

Businesses can raise capital through various sources of funds which are classified into three categories.

A. Based on Period – The period basis is further divided into three dub-division.

Long Term Source of Finance – This long term fund is utilized for more than five years. The fund is arranged through preference and *equity shares* and debentures etc. and is accumulated from the capital market.

Medium Term Source of Finance – These are short term funds that last more than one year but less than five years. The source includes borrowings from a public deposit, commercial banks, *commercial paper*, loans from a financial institute, and lease financing, etc.

Short Term Source of Finance – These are funds just required for a year. Working Capital Loans from Commercial bank and trade credit etc. are a few examples of these sources.

B. Based on Ownership – This sources of finance are divided into two categories.

Owner's Fund – This fund is financed by the company owners, also known as owner's capital. The capital is raised by issuing *preference shares*, retained earnings, equity shares, etc. These are for long term capital funds which form a base for owners to obtain their right to control the firm's management and operations.

Borrowed Funds – These are the funds accumulated with the help of borrowings or loans for a particular period of time. This source of fund is the most common and popular amongst the businesses. For example, loans from commercial banks and other financial institutions.

C. Based on Generation – This source of income is categorized into two divisions.

Internal Sources – The owners generated the funds within the organization. The example for this reference includes selling off assets and retained earnings, etc.

External Source – The fund is arranged from outside the business. For instance, issuance of equity shares to public, *debentures*, commercial banks loan, etc.

Sources of Funds Example

The sources of business finance are retained earnings, equity, term loans, debt, letter of credit, debentures, euro issue, working capital loans, and venture funding, etc.

What is meant by Finance?

The large amount of managing money or cash, basically by huge private and government entities or organization is said to be Finance. It confines with the study and creation of such as –

Money matters.

Banking system.

Credit system.

Investments system.

Assets and Liabilities.

This combination of all together that makes up Financial Systems. Finance can be superseded by the word Exchange. It is therefore said as exchange of available resources or art of managing various types of resources. Finance is so important today, it is said to be as soul of all our economic activities.

Finance is a necessity for acquiring physical resources, which are very important and needed to accomplish productive economic activities and for carrying business functionalism such as–

Sales Promotion.

Pay Compensations.

Unconfirmed Liabilities.

Reason for uncertainty and many more.

Now in today's situation, finance has become the most important natural function and inseparable part of our daily life process. Finance in more specific is solicited with the management issues such as –

Owned funds generated from promoter contribution.

Raised funds generated from equity share, preference share, etc.

Borrowed funds generated from loans, debentures, overdrafts, etc.

Finance also at the same time, confines greater approach of managing the assets generated by the business and other valuable liabilities with better organized fashion. There are 2 main types of finances such as –

Debt finance is money borrowed from external source like bank.

Equity finance were investing your own money from other stakeholders, interchange for partial ownership.

FINANCE CONSISTS OF 3 INTERCONNECTED AREAS SUCH AS –

Management of financial status which involves clarifications and decisions made within the organization.

Credit and money markets which deals with the financial institutions and with business securities.

Investments of money which focuses on made by both institutional investors and individuals decisions.

IN PERTAINING TO ANY ENTITY'S MANAGEMENT DECISIONS THERE ARE 3 TYPES SUCH AS –

Working Capital Management.

Capital Budgeting.

Capital Structure.

Finance is the functional process of business which helps to meet its goals and objectives with responsibilities for acquiring funds for the companies, managing the funds within the companies and planning for the expenditure of funds on various business aspects.

Now 5 reasons why Finance is important in today's business?

Managing finances is a very important business aspect of today, which means having a chance to work toward a stable and rewarding career in financial management field. Financial planning helps in deciding what to spend, when to spend, how to spend and how much to spend according to the funds availability. Here are the below given 5 reasons on importance of finance in today's business such as –

Without financial management business cannot exists

In today's business economy, Small businesses and Entrepreneurship are more on rise that means more positions for financial managers will continue to become much more available. Without an eligible person responsible to manage the incoming and outgoing of money a good business cannot exist.

As good business generates money, through this generated money paying bills for materials, payment of salary for the employees in an organization are done. Good business earnings

happen by selling quality services or products. Managing financial aspects plays a very vital role in progress of any good business.

Adequate funds availability

Sufficient funds are necessary to meet daily expenses to purchase long term assets for the company's requirement accordingly; also funds should be there to deal with future unforeseen over costs which may arise. The company should know from where the funds have to be raised and when it should be needed in emergency to deal the monetary crisis.

Cash flow management system

In an organization, excess cash flow can also become difficult to manage. Having excess amount of funds and not using it in a genuine much useful way is a greater waste of resources. When an organization is having adequate funds they should put it in good yielding investments by thinking very wisely. And also make sure that they have expansion future plans and think about new ventures which will gain them huge profits to earn for the long run.

Always keeping long term goals

Having long term goals in life or business is a very important aspect to keep, once it is done the responsibility has to be fulfilled as per the plan made at any cost to get fulfil the targeted goals to achieve success. In any business entity, financial planning is a process of engaging a proper financial plan to meet its financial goals in a specific time period.

To have long term financial goals in a business is a very important part, were by doing this many upcoming financial crises in future can be resolved without any hassle. It is always a good idea to have an early well planning goal, especially in finance since investing on any good options may earn high returns over the period of time to the company to gain financial stability. So investing money with good thoughtful planning from now will make easier to execute such long term goals.

Financial Planning value and importance in a business

Financial planning creates immense value to the company, without this any of the business entity cannot function properly. It is a major vital venture for all kinds of businesses worldwide. It is done for an entire year to have control over financial activities of the company. The bigger the company, the bigger will be the size of the team working on financial planning and the greater skilled professionals needed.

Financial planning needs the entire support of accurate financial analysis and reporting. It has to be done continuously, with this the outcome of the plan also need to be monitored regularly. In any case the approved plan is not working, then the plan has to be modified instantly or new plan has to be made and adopted with immediate effect to run the business successfully without any kind of hindrance occurring in between.

THERE ARE 6 PROCEDURES WHICH HELPS IN EXECUTING THE FINANCIAL PLANNING OF ANY BUSINESS SUCH AS –

Effect of plans evaluating on stock price and financial quotient.

To raise the funds identifying exact means to execute systematically.

Proper forecasting of sales.

Estimation of assets required for supporting sales.

Estimation of generated funds within the company.

Estimation required for external funds.

Financial planning always should start before the beginning of any project and should be carried throughout its functioning period of time to have strong control over the finance.

Managing business finances is imperative, and mismanagement can lead to a massive threat to the business itself. Business finances are a vital part of any company. And managers need to keep track of their finances and make sure that they are not mismanaged.

One-way business finances can be mismanaged is through a lack of financial transparency among the owners and the employees. Another way it can be mismanaged is by overspending on various campaigns and not assessing the ROI on various campaigns.

This type of overspending and negligence wastes money and can lead to poor ROI in the long term. Having a proper tracking system in place can help to avoid these types of issues.

To know more about business finance and how mismanagement can be avoided, you need to know what business finance is, the definition, the meaning, and how important it is for an organization.

Business finance is the field of finance that deals with the acquisition, use, and management of capital by business entities.

It is a broad term that can describe the financial management of any entity, including corporations, partnerships, sole proprietorships, non-profits organizations, and government agencies.

It covers all aspects of financial management, including accounting, taxation, investments, financing, and the use of debt. The finance for a business comes from various sources. Some of the sources include the company's profits, investments, and revenue.

The meaning of business finance can vary depending on the context. For instance, it might be about managing cash flow and inventory in a manufacturing company, while in an investment bank, it might be about understanding how to make money from trading.

Importance of Business Finance:

Business finance can be daunting, especially for new businesses and start-ups. But there are some ways that you can use to make the process easier and less time-consuming.

The importance of business finance is essential for every business to succeed and only by knowing its implications on the company's revenue and growth and the various elements it includes can help in understanding its importance.

A. Financial Statements:

Financial statements are a great way to monitor the performance of a company. They provide information about the company's financial standing and how they are doing financially.

They serve as a reliable source of information for investors, creditors, lenders, and other stakeholders. Financial statements also provide insight into how much debt a company has and its future financial outlook.

B. Tactical Planning:

Many businesses have a hard time managing their finances. This is because they have to spend time on things that don't contribute to the company's revenue. However, strategical planning can help businesses make more money by having a clearer vision of what they are doing and where they are going.

This is because strategic planning helps businesses make more money by having a clearer vision of what they are doing and where they are going. It also helps them get rid of bad investments, which often lead to financial losses, and focus on their strengths instead.

C. Promotion and Advertisement:

Promotion is a word that most businesses have heard before. However, not all businesses know what promotion means and why it's good for their finances.

Promotion means advertising your product or service to the public to increase awareness and demand for it. It can also mean spreading the word about your company through social media or hosting events where people can learn more about you and your company.

D. Finance:

Finance is important in strengthening business finance because it helps companies take risks and grow. Businesses could do what they wanted without any financial support in the past.

But now, with the increased use of technology and globalization, businesses are becoming more reliant on money to accomplish their goals. Finance is also important in strengthening business finance because it allows companies to take risks and grow.

With the increased use of technology, people are also becoming more reliant on money to accomplish their goals. Finance is important in strengthening because it allows companies to take risks and grow.

4.7 Conclusions/Findings:

Business finance plays a massive role and can positively impact an organization. If finances are taken care of, they can eventually help any company take a better turn towards success. Educate yourself and let this knowledge assist you in bringing more to your company's table.

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5. Legume Forages: A Multidisciplinary Approach for Ensuring Agricultural Sustainability and Global Food Security under Altered Climate Conditions

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Abstract:

In addition for providing the livestock' nutritional needs, forage legumes help to ensure the long-term viability of crop production. Increased availability of animal protein and products with better biological value than plant proteins makes forage legumes an essential component for human nutritional security. Because of their ability to increase soil productivity and serve as soil-conserving components in agricultural and agroforestry systems, forage legumes are an especially valuable addition to crop production systems. Forage crops, especially leguminous forages, require some attention due to the overall relevance of the production system and the severe lack of these resources. Hence, careful evaluation is required to ascertain the course and scale of transformation in agricultural management practice with feed legume additions. When used as a feed, forage legumes can increase production levels and improve animal health in a variety of ways. These agricultural crops possess the potential to facilitate the achievement of our objectives pertaining to food and fodder security, as well as environmental sustainability, while ensuring the preservation of long-term viability. Hence, the inclusion of forage legumes in cropping systems is crucial as it can contribute to the restoration of soil fertility, enhancement of soil biology and biodiversity, fixation of atmospheric nitrogen, reduction of fertilizer requirements, carbon sequestration, mitigation of climate change, improvement of soil carbon sequestration, and neutralization of the adverse effects of climate change. This chapter provides a comprehensive overview of the possible contributions of forage legumes in several aspects of animal nutrition, soil sustainability, food and nutritional security, soil fertility enhancement, nitrogen fixation, soil biology and biodiversity, carbon sequestration, climate change mitigation, and other ecological services.

Keywords:

Forage Legume, Carbon sequestration, Livestock and Food security.

5.1 Introduction:

Forage crops, which are typically grown for grazing purposes and known to supply quality feed for grazing animals that can play an important role in the cattle industry (Jana *et al.*, 2022). These crops can be thought of as an essential component for cultivators, one that

links the agricultural and veterinary fields. India has grown rapidly over the past few decades, passing the United States to become the world's leading milk producer (209.96 million tonnes in 2020-21, compared to 146.31 million tonnes in 2014-15; annual growth rate of 6.2%; Economy Survey 2020-21, 2021).

This can help India provide food, nutritional security, and economic returns to a growing global population. Legume forages are a ten times cheaper supply of critical feed ingredients compared to other feed sources (Kumar *et al*., 2016, Rehman& Raja., 2020), and are well recognized as a superior source of nutrition for dairy cattle.

Forage crop cultivation, however, has many other uses, including providing a living fence, bee forage, fuel wood, food, enhancing soil nutrient status, creating wildlife habitat, increasing self-sufficiency, nutrient cycling, and farm diversification.

In India, there is currently a deficit of 36% in green fodder, 11% in dry crop leftovers, and 44% in concentrate feed ingredients due to the fact that fodder crops are using almost 5.4% of the country's total arable area. It is estimated that there are 650 different genera and 18,000 different species of cultivated legumes in the world. For domestic animal consumption, only roughly 60 of these forage legume species have been farmed (Schultze *et al.*, 2018).

By changing the atmospheric concentration of greenhouse gases (GHGs) such methane, carbon dioxide, and nitrous oxide, climate change has had dramatic effects on human society and the natural environment worldwide (IPCC 2019). A reduction in the protein content of widely used forage crops has been reported, and while climate change is a continuous process on Earth, its frequency has increased rapidly in the last century or so (Xu *et al.*, 2021).

This will have a negative impact on livestock production in terms of both quantity and quality of green biomass. As a result of the negative effects of climate variability (temperature and rainfall) and climate-driven extremes (flood, drought, heat stress, cold waves, and storms) on crop and livestock production, food security has become an issue of paramount importance.

These extremes have the potential to have far-reaching social and economic consequences, including decreased incomes and livelihoods, and even negative health effects. Incorporating nitrogen-rich forage legumes into crop production systems can benefit not only the soil but also the crops that are grown alongside or after them in a rotation, making them an invaluable feed source for livestock.

This could help provide a long-term solution to the problem of global food and protein insecurity. By improving soil organic matter, soil porosity, recycling nutrients, improving soil structure, lowering soil pH, modifying the efficiency of soil biological activities, and prevents the buildup of disease occurrence and weed growth. Thus, the forage legumes have tremendous potential for increasing sustainability through soil quality remuneration (Mahanta *et al.*, 2009) act as sources of animal feed, stabilizing global food security and having positive synergistic impacts on soil biology, fertility, biodiversity.

5.2 Role of Forage Legumes in Livestock Production:

The livestock industry plays a crucial role in the global agricultural sector, with a primary focus on enhancing economic conditions, ensuring food and nutritional security, and improving the livelihoods of about 75 percent of the global farming population. Based on the 20th Livestock Census conducted in 2019, India has emerged as the country with the highest animal population, with approximately 535.82 million animals recorded and this figure reflects a 4.6% increase compared to the previous census conducted in 2012. Furthermore, India holds a prominent position in milk production, contributing 209.96 million tonnes, which accounts for 23% of global production. This makes milk the second most valuable agricultural commodity in India, after rice, and plays a significant role in contributing to the Gross National Product (GNP). The maintenance of forage quality is influenced by several essential aspects, including the concentrations of nutrients such as crude protein and fibers, the consumption of forage by animals, the digestibility of the forage, and the partitioning of metabolic products within the animals (Lee, 2018).

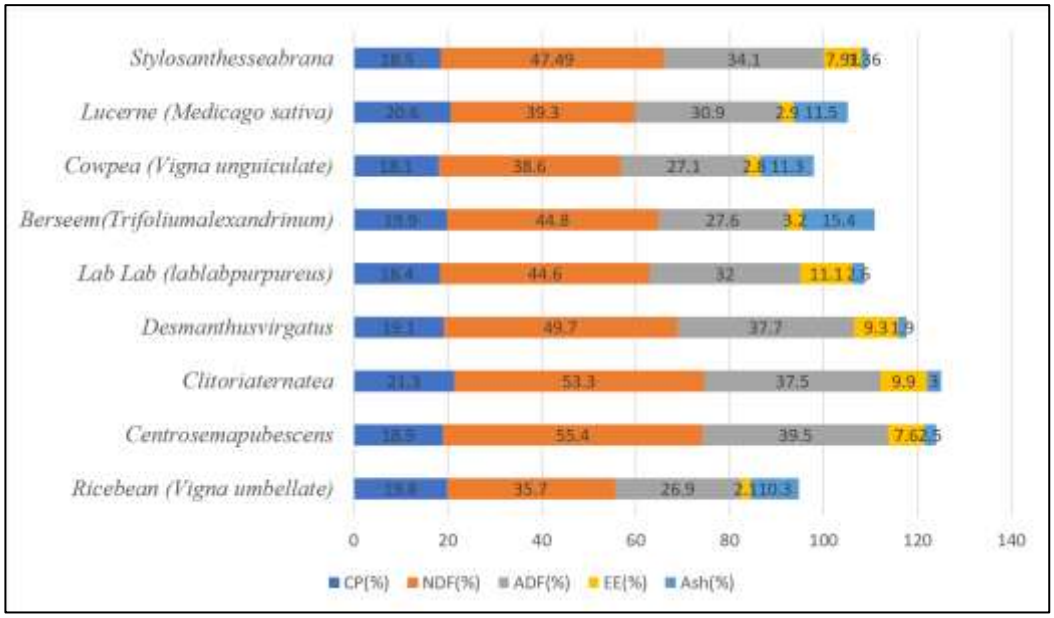
Forage legumes are known to possess superior nutritional value compared to grass species. They have the potential to enhance the nutritive value of herbage, as opposed to grass monocultures, due to their ability to maintain digestibility at a slower rate as they mature, as well as their higher quality protein content (Dewhurst *et al.,* 2009; Kumar *et al.*, 2016).The inclusion of legumes in the diet of dairy cattle contributes to a balanced nutritional profile. By incorporating legumes into the animal feed, the resulting diet becomes more digestible and has a higher nutritive value. This, in turn, promotes increased levels of production, specifically in terms of weight gain, among livestock. The consumption of fibrous fodder is primarily influenced by the degree of rumen fill, which, in turn, is directly associated with the rate of digestion and movement of fibrous particles from the rumen (Huhtanen *et al.,* 2016).

The palatability of a feed has been associated with both its physical attributes and the availability of certain components that might influence taste and hunger, such as proteins, lipids, and soluble carbohydrates. The use of legume forages in the feeding plan has the potential to address nutritional deficiencies. The significance lies in the disparities in cation exchange capacity between cereal and legume crops, with the latter exhibiting a larger capacity. Consequently, this higher capacity results in an increased accumulation of multivalent micronutrients in legume crops. Moreover, the inclusion of forage legumes in livestock feed is beneficial due to their higher crude protein (CP) content compared to cereals. This is attributed to the symbiotic relationship between legumes and Rhizobium, which enhances the nitrogen supply to legumes. The increased palatability and digestibility of forage legumes contribute to improved forage intake by livestock and subsequently enhance animal performance. The cost of milk production is mostly attributed to feed expenses, which account for roughly 50% of the total cost. Enhancing the quality of forage has been identified as a viable approach to enhance animal productivity and thus improve overall feeding efficiency. Leguminous forages possess the capacity to enhance the nutritional quality of ruminant diets due to their elevated crude protein (CP) concentration and reduced fiber content when compared to grass and cereal forages. The cell wall composition of legume plants differs from that of grass species, with legumes containing a higher proportion of uncommon hemicelluloses and pectin. This variation in cell wall composition has been found to enhance animal digestion. The study conducted by Dalgliesh et al. (2010) examines the importance of legume fodder in animal performance. The findings

indicate that animals fed with forage legumes exhibited a daily live weight gain of 230 g, whereas those fed with leucaena shown a higher rate of 290 g per day. The determination of the digestibility of forage crops is reliant upon the content of carbon-based nutrients, which are aided by minerals and vitamins, in their provision to animals (Capstaff & Miller, 2018). The study conducted by Chanthakhoun *et al*. (2010) found that the inclusion of rice bean hay in buffalo diets resulted in an increase in cellulolytic rumen bacteria. This increase in bacteria was reported to aid in the digestion and utilization of high fiber feeds.

Furthermore, it should be noted that plant secondary metabolites, including tannins and phenols, play significant roles in the defense against various stresses, both biotic and abiotic. These metabolites also have an impact on the digestibility of fodder and ultimately influence the production of cattle. Hence, there exists a pressing demand for high-quality forage crops that can enhance livestock productivity, promote human health, and yield economic advantages for growers (Singh *et al*., 2018; Varijakshapanicker *et al*., 2019).

Table 5.1: Nutritional profile of some of the important forage legumes



Trivedi (2002)

5.3 Potential Benefits of Adopting Forage Crops in Crop Production Systems:

Long-term maintenance of soil fertility and productivity can be achieved through including forage legumes in cropping practices. These systems can fix atmospheric nitrogen biologically, which has a positive effect on the yield of subsequent crops in rotation. However, the decomposition of legumes' root and shoot wastes releases both macro (N, P, and K) and micro (Zn, Fe, Mn, and Cu) nutrients from the soil, lowering the need for nitrogenous fertilizer. Increased carbon sequestration and decreased emissions of greenhouse gases are both benefits of legumes.

Soil fertility and carbon sequestration improve together, as more biomass is produced. Also, compared to other crops, legumes produce 5-7 times fewer greenhouse gas emissions per acre, facilitate the absorption of carbon in soils, and lead to a reduction in fossil energy inputs. Soil carbon sequestration occurs when legume plants in pasture boost aboveground biomass production, which in turn ensures a larger soil carbon pool and greater soil fertility (Coonan *et al.*, 2019).

Intercropping forage legumes is widely regarded as an efficient method of forage production due to its ability to decrease weed growth, increase land use efficiency, and decrease the prevalence of soil-borne diseases (Tamta *et al*., 2019).

Furthermore, it improves soil bulk density and moisture retention capacity by increasing infiltration rate and decreasing surface runoff, yielding better results in preventing soil erosion. Soil improvement occurs due to cycling of minerals from deeper soil layers and enhanced concentration of soil organic matter through litter production when deep-rooted, infertile-soil-adapted legumes like *Stylosanthes* spp., *Macrotylomaaxillare*, and *Flemingia* spp. are introduced to degraded areas (Boddey *et al*., 2015).Rotating biennial and perennial legumes with shallow-rooted crops can reduce nutrient loss from leaching below the crop root zone because the legumes' deep roots recycle agricultural nutrients in the soil profile (Mohammadi *et al.*, 2012).

Soil with a larger percentage of organic matter and a more solid structure, like that created by legumes, is less likely to be eroded by wind or water. Glomalin, a protein produced symbiotically by legume roots, acts as glue to bind soil particles together. Soil erodibility and crusting are both decreased by the aggregate stability's effect on pore space and tilth. Through increased saturated hydraulic conductivity, total porosity, and macro porosity, the roots and shoots of a plant affect the soil's physical qualities and the flow of water through it. Forage legumes are known as soil building crops because of their ability to link soil aggregates with organic matter after crop residues have decomposed (Holtham *et al.*, 2007).

Increased biological activity, seedling establishment, and root penetration can all result from better soil structure (Peypers *et al*., 2010). Because legume rhizo deposits are higher in substrate quality with a low carbon/nitrogen ratio, their adoption in cropping systems has a beneficial influence on the microbial activity in the soil (Nair and Ngouajio, 2012).

Compared to the overall microbial, bacterial, and actinomycetes activities in the soil are increased when alfalfa roots grasses release their substrate (Dhakal and Islam 2018; Kumar *et al.* 2018). Incorporating legumes in the crop rotation can be a great way to shake things up and boost the diversity of the microorganisms in your soil, which in turn improves biological pest management (Lupwayi *et al*., 2011).

Researchers have found that grass-legume combinations have higher total dry matter production compared to solitary grasses or cereals (Gulwa *et al.*, 2017) because legumes contribute nitrogen to the mixture. This means that increasing nitrogen fixation and fertilizer savings, boosting soil biology and biodiversity, and enhancing soil carbon sequestration through the cultivation of forage legumes can all be accomplished without compromising the long-term soil fertility base of the soil resources.

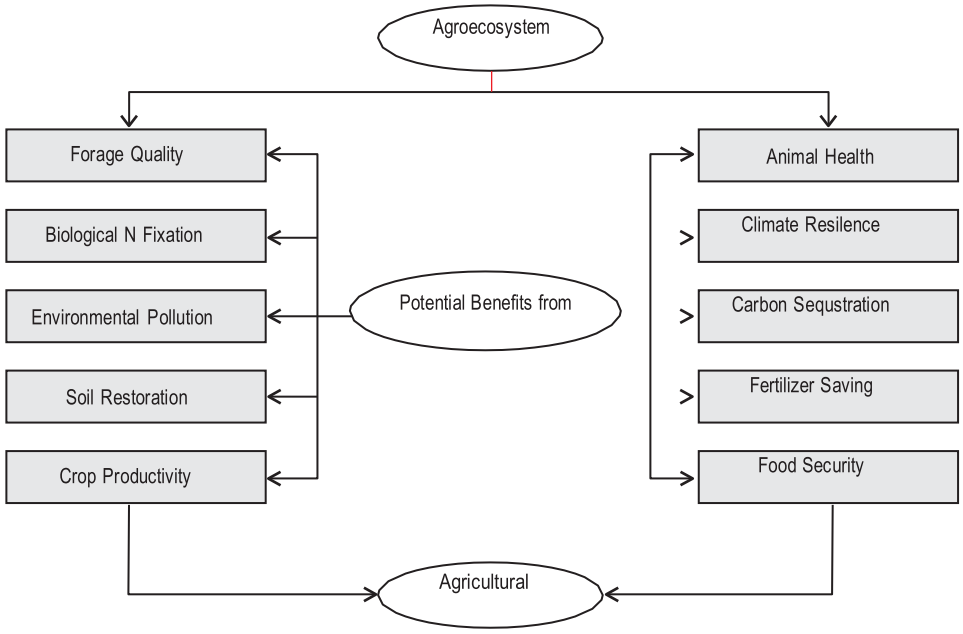


Figure 5.1: Flow diagram showing multiple agro-ecosystem services of forage legumes toagricultural production system

5.4 Inclusion of fodder crops in cropping systems for year-round fodder supply:

Less than 4.5% of India's total cultivated land area, or about 8.6 million hectares, can be used for growing fodder. However, increasing competition for the country's arable land makes expanding the acreage dedicated to fodder crops impractical. Increasing crop yield per unit land area and incorporating fodder crops into existing cropping systems may be the only method to meet the feed needs of animals. Consistently growing berseem, inter-planted with hybrid Napier in spring, and intercropping the inter row spaces of the grass with cowpea in summer after the final harvest of berseem on same piece of land in a calendar year ensures a steady supply of green fodder for dairy animals all year long. However, a large production of green nutritious feed and sustained soil fertility can be achieved by growing seasonal legume fodder crops, interplanted with perennial grasses (Hybrid Bajra Napier + Cowpea - Berseem). Accordingly, ensuring the production of grain, fodder, and other agricultural goods in a rainfed condition can be accomplished through the incorporation of forages into existing crop geometries. Higher and more consistent green fodder availability over a longer period of time is ensured by planting a mix of perennial and annual forage species that draws water and nutrients from multiple soil depths. Intercropping systems using sorghum and lima beans resulted in higher dry matter yields at varying sorghum-to-lima bean ratios. Intercropping pearl millet and cluster bean increased forage productivity and enhanced forage quality while maximizing the use of land and other resources (Ali *et al*., 2016). It is also well established that forage and fodder crops are more productive in cereal-legume intercropping systems (Raj *et al.*, 2021). Reduced inorganic nitrogen application, increased soil carbon stocks, decreased runoff losses, greater drought resistance, and increased livelihood and profitability are just a few of the ways that forage production based on cereal-legume cropping systems lessens the world's carbon footprint

(Kebede, 2020).

However, in the developed countries, cereal-legume based fodder cultivation has increased in the last two decades due to growing interests in conservation agriculture and growing feed demand for intensive dairy-based farming.

5.5 Legume Forages' Contribution to Food Safety:

As of 2050, the world's population is projected to reach over 9 billion, making food security a pressing issue. The demand for livestock products, such as milk, meat, and eggs, has increased dramatically as a result of urbanization (Magrini *et al.,* 2021). Consumption of meat and milk are predicted to increase by 2.8% and 3.3% annually in developing countries like India, respectively. In 2050, the demand for milk will be over 400 metric tons, and the demand for meat will be around 14 metric tons, while production in 2011 was around 122 metric tons and 6 metric tons, respectively. Food security in the face of climate change is one of humanity's greatest concerns, as the effects of climate change are widespread and severe. A climate-friendly approach and resilient agricultural practices under hazardous climate change need immediate consideration to ensure sustainable agricultural production (Zafar *et al.,* 2018; Ahmad *et al*., 2019), but the problems associated with climate change are only beginning to emerge now. Cultivated forage and range legumes are an essential component for increasing the availability of high-quality animal protein, which in turn increases milk production and protects the health of animals. Around 40% of the global value in agricultural production comes from it, and it provides nutrition and food security to humans. This has a direct impact on the lives of about a billion people around the world, as well as on the diets and health of many more (Downing *et al*., 2017).

The demand for protein-rich and nutrient-dense food and meat is expected to rise dramatically due to significant progress in all developing nations. Alterations in the fatty acid profiles of livestock products like milk (Benbrook *et al.,* 2018) and meat (Fruet *et al.,* 2018) are a result of forage-based diets, especially in grass-legume combinations. Animals on a diet rich in fresh legumes and grass produce milk with higher levels of omega-3 fatty acids and conjugated linoleic acid (CLA), both of which are beneficial to human health by reducing the risk of cardiovascular disease. The perennial legume crop alfalfa (*Medicago sativa* L.) is currently the best global source of forage and feed. Alfalfa is utilized as a tonic because of the high quality proteins (60.5%), minerals, enzymes, vitamins, etc. it contains. Amylase, emulsion, coagulase perxidase, erepsin, lipase, invertase, and pectinase are only few of the alfalfa enzymes that have been documented. Cowpea [*Vigna unguiculata* (L.) Walp.] is a staple crop in sub-Saharan Africa (especially West Africa) and India, where the green leaves are used as nutritious livestock feed because they contain 29-43% protein on a dry weight basis. Because of their high protein and low fat content, cowpea plants are widely farmed throughout Asia for use as fodder, particularly in India (Samireddypalle *et al.,* 2017). Grain contains a variety of minerals and vitamins, including iron (33.6-79.5 mg/kg), zinc (22.1-58 mg/kg), phosphorus (3450-6750 mg/kg), calcium (310-1395 mg/kg), magnesium (1515-2500 mg/kg), and potassium (11,400-18,450 mg/kg) in addition to its protein content of up to 32% on a dry weight basis. In addition to being used as a grain, rice beans can also be used as fodder legume for animals (Khanal *et al*., 2009). Rice bean dry seeds are high in protein (18-26%) and relatively high in lysine (more than 6% of the protein) but low in sulphur-containing amino acids. They can be boiled and eaten with rice

or used as a substitute for rice in stews and soups. Grass pea, also known as Lathyrus, has a high protein content (18–35%) in its seeds and 17% in its mature leaves, making it a promising candidate for the category of "functional food" (Llorent-Martnez *et al*., 2017). It can be used as feed and fodder for livestock, as well as a human food consumed whole or processed for split dal. Forage legumes have great potential to offer a balanced feed for cattle and to survive in a broad variety of climates, and this discussion has shown that their widespread use can help reduce global hunger and malnutrition.

5.6 Contribution of Legume Forage Crops on Climate Change Adaptation:

The concentration of atmospheric greenhouse gases (GHGs) like methane, carbon dioxide, and nitrous oxide has profoundly affected human societies and the natural environment, making agriculture extremely vulnerable to these changes (IPCC 2019). GHGs are responsible for warming the planet and contributing to extreme weather events. In order to guarantee long-term production, it is crucial to evaluate how climate variability affects agricultural productivity and devise adaptation techniques to deal with the risks posed by climate change. Domestic animals like temperatures between 10 and 30 degrees Celsius, and their feed consumption decreases by 3 to 5 percent for every additional degree over that. The productivity of animals would also be severely impacted by climate change scenarios due to drought and heat stress (van Wettere *et al.,* 2021). The development of adaptation and mitigation measures faces significant obstacles, chief among them the reduction of greenhouse gas emissions from agriculture and the production of additional food (Fujimori *et al*., 2021). In addition, legumes are highly efficient at reducing energy input needs and will lessen potentially dangerous greenhouse gas (GHG) emissions from agricultural land (Ray *et al.,* 2020). The cultivation of legumes, thanks to their biological nitrogen-fixing ability, can reduce the application of fertilizer N, which in turn reduces GHGs emissions (Sánchez-Navarro *et al.,* 2020; Sheoran *et al*., 2021), and is thus a good option towards climate change mitigation. The use of chemical fertilizers and the production of rice both contribute to the release of greenhouse gases into the atmosphere, making it imperative that both practices be reined in as soon as possible.

(Allen *et al*., 2020). Current annual N_2O emissions are close to 17 million t (Schlesinger, 2009). As a result of increased nitrogen fertilizer use, it is predicted that worldwide N_2O emissions would increase to four times their current level by 2100 (Kahrl *et al.,* 2010). In grasslands, forage legumes can cut down on N_2O emissions because the reactive form of nitrogen in the soil is not easily available in the symbiotically fixed N found in legume nodules. However, carbon sequestration, bioenergy use, enhanced nitrogen management, and efficient fertilizer use are all examples of mitigating techniques that can help boost agricultural yield. The impact of modern research techniques on the development of forage crops can be seen in the creation of new varieties as well as the diversification of production systems, both of which are useful in preventing the spread of diseases and pests related to the altered climate. Because all of the carbon required for symbiotic N_2 fixation can be obtained from the atmosphere through photosynthesis, legumes are viewed as "greenhouse gas neutralizers" and offer many benefits. As a further technique for SOC/terrestrial sequestration, using forage legumes can help in net carbon sequestration, which aids in preserving soil organic carbon stocks and can provide a positive soil carbon budget. Scientists have shown that as temperatures rise, the nutritional value of grasses drops and ruminant cattle produce more greenhouse gases (CH_4 and methane) than usual (Lee *et al.,*

2017). Ingesting forage legumes can help reduce methane emissions from animals. Supplementing the diet with legumes has been shown to further lower CH_4 emissions by 15-30% per unit of meat or milk produced (Galloway *et al.*,2008).

This is because legumes contain fewer structural carbs and more condensed tannins than grass. The benefits of the legume in the diet in lowering methane emissions per unit gain were demonstrated by the methane emissions of Lucerna heifers fed a Leucaena leucocephala-stargrass mixture or grass only (Molina *et al.*, 2016). Because of the widespread availability of high-quality seed varieties, alfalfa, berseem, cowpea, and stylosanthes are among the most important contributors to forage production. Leguminous forages also provide a source of biological nitrogen fixation, which is useful for enriching soil, slowing the degradation of land, and mitigating the effects of climate change.

5.7 Conclusion:

Soil sustainability is increased, and the soil's health is improved with less chemical inputs thanks to forage legumes, which also benefit animals. Integrating forage legumes into crop production systems is crucial for long-term sustainability because of the many ways in which they boost crop-livestock production systems. Forage legumes increase soil quality, which benefits the ecosystem while also bolstering food and nutritional security. Therefore, long-term and multi-disciplinary approaches are required to evaluate the impact of forage legumes under altered climatic conditions on the production of high-quality animal feed, the preservation of natural resources, and, most importantly, the maintenance of food security.

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6. Silver Society: Analyzing the Societal Impact of India's Aging Population

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Abstract:

India's aging population is growing exponentially as a result of the society's remarkable advancements in terms of longer life expectancies. Many senior citizens will require better access to physical infrastructure in the coming years due to rising life expectancy and incapacitating chronic conditions. The elderly's social and financial security has been greatly aided by the traditional Indian society, which has a long-standing joint family structure. The less money the government spends on the social security system, the more vulnerable the elderly are in India. The elderly population is diverse and divided between urban and rural areas. Due to the continued importance of the joint family system, they are less at risk in rural areas than in metropolitan ones. As the elderly in the nation age, it is crucial to comprehend the societal elements that affect them. Rising life expectancy, increased urbanization, and lifestyle changes have caused a variety of issues for India's older population.

Keywords:

Ageing, geriatric, social support, social inequality, etc.

6.1 Introduction:

India's ageing population is growing exponentially as a result of the society's remarkable advancements in terms of longer life expectancies. The need for holistic care seems to increase as the older population increases. In emerging nations, there are projected to be 840 million elderly people by 2025 [1]. According to projections [2,] the percentage of Indians 60 and older will increase from 7.5% in 2010 to 11.1% in 2025. India had about 91.6 million senior people in 2010, and it is anticipated that number will increase to 158.7 million by 2025 [2]. India's demographic change reveals disparities and difficulties within several states. This has been explained by the disparities in political environments, cultural norms, and socioeconomic levels. Therefore, addressing geriatric care that will take into consideration all these characteristics will be a mammoth undertaking for policymakers. Elderly care is quickly becoming a vital aspect of both public and private concern. The seeming success of medical science is typically followed in older people by a number of social, economic, and psychological issues in addition to the medical issues. It is important to remember that many of these issues necessitate ongoing medication treatment, ongoing physical therapy, and ongoing rehabilitation [3].

Depending on the clinical problem, aged people may get care in a variety of locations, including their homes, nursing homes, daycare centers, medical units, critical care units, or geriatric outpatient departments. Addressing a number of societal concerns is necessary for aged care. The requirements and issues that older people face can differ significantly depending on their age, socioeconomic level, health, living situation, and other background factors. Social rights are ignored, and they are frequently violated without being reported.

6.2 Limited infrastructure for senior citizens:

In the approaching years, many senior folks will require better access to physical infrastructure due to rising life expectancy and incapacitating chronic conditions. Physical infrastructure is a major barrier to providing elderly people with comfort. Both in their own homes and in public areas, many senior individuals require easier access to physical infrastructure. In India, where there is no system of affordable health care, untreated chronic disease, unaffordable drugs and treatments, and starvation are commonplace. The public health system places a small amount of emphasis on geriatrics and offers few specialized geriatric care. The public health system's other problems include a lack of facilities, a labour shortage, poor care quality, and facility overpopulation as a result of the current emphasis on caring for the elderly [4].

6.3 Shifting Family Composition:

The elderly has been protected from social and economic insecurity, thanks to the traditional Indian society and its long-standing joint family arrangement. The traditional beliefs and customs of Indian society also placed a strong emphasis on caring for the elderly and demonstrating respect for them. However, as nuclear families have become more common in recent years, elderly people are more likely to experience mental, physical, and financial insecurity in the years to come. The percentage of elderly people living alone or exclusively with their spouses has increased from 9.0% in 1992 to 18.7% in 2006 [5]. As the country's economy grows and modernizes, it appears that the amount of family care for the elderly will decline.

6.4 Inadequate Social assistance:

The government in India spends less on the social security system, making the elderly far more vulnerable. In an increasingly hectic and busy metropolis, the elderly in metropolitan areas rely mostly on hired domestic help to meet their basic needs. Loneliness and social isolation are on the rise [6].

In India, elderly-specific insurance coverage is essentially nonexistent. Furthermore, preexisting conditions are frequently not covered, making insurance coverage unprofitable for elderly people. Pensions and social security are also only available to people who have worked in organized business or the public sector. Nearly half of the respondents to a research by Lena et al. [7] felt abandoned and depressed and thought that people had a different attitude towards the elderly. Additionally, it was discovered that 36.2% of respondents believed they were a burden to their families and 47.5% felt unhappy about their lives.

6.5 Social Inequality:

The elderly are a diverse group, divided between urban and rural areas. Due to the continued importance of the joint family system, they are less at risk in rural areas than in metropolitan ones. As the government categorizes these people based on caste and other socio-cultural factors, not all the old are viewed from the same perspective, and their needs and concerns are disregarded to a significant degree. In a case study, it was discovered that a significant portion of elderly women were poorer, had the lowest income per person, had the highest percentage of only having completed kindergarten, had the highest levels of negative affective psychological conditions, were the least likely to have health insurance coverage, and had the lowest consumption expenditures[8].

6.6 Availability, Accessibility and Affordability of Health Care:

Elder care management is becoming increasingly challenging due to the tendency towards nuclear households, particularly for working adult children who feel responsible for their parents' well-being. Nursing agencies, physiotherapists, and medical suppliers are just a few of the small, unorganized players that offer subpar care, making managing home care for the elderly a huge challenge. In India, hospitalization is essentially the extent of health insurance coverage. Geriatric care has continued to be a medical specialty that is underutilized in the nation. Even though the population is ageing, geriatric care is still a relatively new concept in many developing nations, such as India, and many practicing doctors are unaware of the clinical and functional effects of ageing [9–11].

The geriatrics course is not offered by many institutions, and those who do enrol are few. The majority of government institutions, including nursery centers, senior living communities, counselling services, and recreation centers, are located in urban areas. The majority of tertiary care facilities offer geriatric outpatient department services [12]. Providing geriatric care to the 75% of elderly people who live in rural areas would be difficult. Dhar [13] has drawn attention to the relative neglect in the Indian context when it comes to the provision of facilities for patient care as well as training and development in geriatrics. According to Dey et al. [14], the main obstacles to senior population access and adorability include limited mobility, social and structural impediments, wage loss, familial dependency, and declining social involvement. Along with the physiological and social issues that the aged frequently deal with, such as dementia, depression, incontinence, and widowhood, the stigma of ageing is another social obstacle to accessing health care [15].

6.7 Economic Dependency:

According to the 52nd round of the National Sample Survey Organization, 20% of the elderly are partially dependent on others for their financial requirements, while nearly 50% are completely dependent on others [16]. Approximately 85% of the elderly required daily care from others. For older ladies, the situation was substantially worse [17]. Elderly people who live with their relatives rely heavily on the financial strength of the family to ensure their financial security and well-being. In India, elderly people lack adequate pension protection and other forms of social security. Poverty, which increases the danger of abuse, is the single biggest obstacle to the welfare of older people [18].

Elderly people have a low priority for their own health even though they are most susceptible to illnesses due to their financial dependence. Even in the Indian setting, the need for old age homes seems more pressing due to migration of the younger generation, inadequate family care, rented housing, economic difficulties, and dissolution of joint families [19].

As the elderly in the nation age, it is crucial to comprehend the societal elements that affect them. Rising life expectancy, increased urbanization, and lifestyle changes have caused a variety of issues for India's older population. It must be kept in mind that only with the participation and cooperation of family, community, and the government is comprehensive care for the elderly possible. India needs to get ready to handle the increasing burden of caring for its ageing population. In order to enhance the quality of life for the elderly, all social service organizations across the nation must address the social issues surrounding their care. In order to ensure that the elderly can live with dignity, it is necessary to launch the necessary and more suitable social assistance services. To address the care requirements and issues faced by the elderly in India, it is also necessary to establish an integrated and responsive system.

6.8 Conclusion:

India is facing significant challenges in providing adequate care for its ageing population. The country's remarkable advancements in healthcare have resulted in longer life expectancies, leading to a growing number of elderly individuals in need of holistic care. However, several societal factors hinder the provision of comprehensive care for the elderly.

One major challenge is the lack of physical infrastructure that caters to the specific needs of older people. Both in their own homes and public areas, elderly individuals require improved accessibility and facilities. The public health system's limited emphasis on geriatrics exacerbates this issue, with a shortage of specialized care and poor-quality services. The changing family structure, characterized by the shift from joint families to nuclear ones, has also contributed to the elderly's social, physical, and financial insecurities. Traditional values of caring for the elderly and strong family support are gradually eroding, leaving them vulnerable to neglect and isolation. Moreover, the lack of social support, including social security, insurance coverage, and pensions, further adds to their vulnerability and loneliness. Social inequality is another significant concern, as the elderly population in rural areas generally face fewer risks compared to those in metropolitan areas. Categorization based on caste and socio-cultural factors leads to neglect of certain groups, and their needs and concerns are often disregarded. This creates disparities in income, education, healthcare access, and overall well-being among the elderly.

The availability, accessibility, and affordability of healthcare services specifically tailored to the elderly are inadequate in India. Home care management for the elderly is challenging, with unorganized and subpar services. Geriatric care remains underutilized and underdeveloped as a medical specialty, and there is a lack of awareness and training among healthcare professionals regarding the unique needs of older adults. Moreover, the majority of geriatric care facilities are concentrated in urban areas, posing difficulties for rural elderly populations to access appropriate care.

Economic dependency is a pressing issue, with a significant portion of the elderly relying on others for their financial needs. Limited pension protection and social security systems contribute to their financial insecurity and dependence on family support. Poverty among the elderly increases the risk of abuse and neglect, and their own health often takes a back seat due to financial constraints.

To address these challenges and ensure a higher quality of life for the elderly, a comprehensive approach involving the participation and cooperation of families, communities, and the government is necessary. Social service organizations must prioritize and address the social issues surrounding elderly care, launching suitable assistance services that promote dignity and well-being. Additionally, an integrated and responsive care system, considering the unique needs and circumstances of the elderly, should be established to provide comprehensive support across the nation.

India must proactively prepare to manage the increasing burden of caring for its ageing population. By acknowledging and addressing the societal factors discussed in this paper, India can work towards creating a society that values and supports its elderly citizens, enabling them to age with dignity and a higher quality of life.

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7. Impacts of Environment Pollutants on Pregnancy & Preventive Measures

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7.1 Introduction:

Health hazards associated with environment pollutants is well recognised around the world[1]. According to the World Health Organization, death due to toxic health impacts of environment pollutants is more than the total number of death occurring around the world due to various diseases like malaria, HIV, tuberculosis etc./, taken together[2]. WHO reports approximately 7 million deaths around the world due to pollution[2]. Most badly affected by health ailments due to pollution are the developing countries of the world. Studies show that more than 95% of pollution related death primarily due to air pollution occur in the low and middle income countries[3]. Toxic pollutants are added to the environment either naturally or due to human activities. Human activities are known to influence the environment and alter its natural constituents. These toxic substances are termed as pollutants as they pollute the environment[4].Exposure to these toxic pollutants are harmful for human, animals and plants on the planet earth. Exposure of pregnant women directly affects the maternal and fetal health. Increased morbidity and mortality with exposure to toxic pollutants is reported[5] [Figure 7.1].

Exposure to toxic pollutants at early stages of development in embryonic stage may cause maximum possible damages in the foetus[6]. These damages are mostly irreversible and the impacts may prevail in the infant, teen, adult and even for the rest of the life of the individual[7,8]. Studies show that exposure to toxic pollutants at early stages of fetal life causes

remarkable developmental defects and damages. Damages caused at the developmental stages in fetus may cause behavioural, anatomical and metabolic disorders in the embryo and those may persist in the adulthood[8].Neurobehavioral alterations are reported to occur due to impacts of toxic exposures during fetal developmental stages[7].Other health ailments like asthma in childhood and adult days, diabetes, obesity, hypertension, cardiovascular disorders may occur due to the adverse impacts of toxic pollutants in the early days of development during fetal stage in mother's womb[6-8]. Maternal hypertension and associated disorders as well as preterm birth are also reported with exposure to environmental pollutant exposure of pregnant women[9] [Figure 7.1].

7.2 Impact of Air Pollution on Pregnancy:

Air pollutants enter a pregnant mothers' body mainly through the respiratory system[10]. (Particulate Matter) PM 2.5, PM 10 or 2.5 and ultrafine particles may be fatal to maternal health and may cross the various membrane barriers and also the placenta[11].Studies show that gestational exposure to Particulate Matter 2.5 (PM2.5) causes spatial memory dysfunction and impairment of neurodevelopment in Hippocampus of offspring of mice[11].Gestational exposure to oxides of sulfur, nitrogen, ozone, PAh or oxides of carbon may not only affect maternal health, metabolism but also is reported to affect the fetal health. Scientific reports suggest that gestational exposure to toxic pollutants as mentioned may affect fetal birth weight. Low birth weight, abnormal fetal growth, reduced head circumference, are quite common[12]. Mothers exposed to air pollutants may suffer from stress, diabetes, anemia, polyhydramnios, oligohydramnios, intrahepatic cholestasis, hypohepatia, respiratory distress, hypertension and preeclampsia, preterm birth of low birth weight baby and stillbirths[13,14]. Exposure of pregnant mothers to air pollution is known to be associated with risk of development of congenital heart defect in those pre-pregnancy over weighted women[15]. Babies born to mothers exposed to toxic air pollutants are victim of low vitamin D, coronary heart disease, hypertension and even non-insulin dependent diabetes melitus[16].During pregnancy maternal exposure to repairable toxic gasses and dusts may affect the immune system of the female. Innate immune cells, t-lymphocytes and Nk cells may show altered immune responses and IgE levels may show hypersensitive responses[16] [Figure 7.1].

Once entering the maternal circulation, air pollutants may generate oxidative stress that may cause damages to placental barrier, blood brain barrier and vascular endothelium damage which may be reflected as systematic and pulmonary hypertension, placental abruption, placenta Previa and accrete. Indeed, normal fetal demand for nutrients, gas transport and excretory functions as well may be at a stake in such case[17]. Exposure to particulates has been reported in expression of hippocampal proinflammatory cytokines resulting in altered hippocampal neural morphology leading to neural stress[18].Fetal neural development may be at a distress and the child may be a victim of neurodevelopmental disorder, attention deficit hyperactivity disorder, altered cognitive function and addictive behaviour due to maternal exposure to air pollutants[19]. Moreover, oxides and sulfides of ambient gasses, fly aces and PAH easily caused oxidative damage to fetal tissues, DNA damage, P450 enzyme activation[20]. These altogether may cause teratogenic effects in the fetus, birth malformations, limb defects, and carcinogenic insults. Maternal endocrine disruption may also be reflected in fetal genital function, thyroidal tissue, leptin, adiponectin function and fetus may suffer from obesity [Figure 7.1][20].

7.3 Impact of Water Pollution on Pregnancy:

Studies show that consumption of contaminated drinking water during pregnancy leads to adverse maternal and fetal health effects. During treatment of water with chlorine leads to formation of Trihalomethanes (THMs) which when enters the maternal body, causes cardiac ailments, preterm delivery, low birth weight, neural tube defects, oral clefts and spontaneous abortion[21]. Contamination of drinking water with pollutants like chemical pollutants and radioactive substances may impose serious health hazards for pregnant women. Contamination of water with certain microorganisms including virus, bacteria, and parasites may also lead to serious troubles in pregnant women which include miscarriage, preterm delivery and still birth[22].

Prenatal exposure to contamination of drinking water with chemicals like Tetrachloroethylene (PCE), is reported to cause serious health effects in pregnant women and the fetus. Among these, worth mentioning are increased risks of abruption of placental, delayed time-to-pregnancy, and stillbirths because of placental dysfunction, and certain birth defects. Anyways, no associations of prenatal exposure to PCE with pregnancy loss, birth weight, and gestational duration are reported[23].

An increased risk of pregnancy loss during the first trimester due to exposure of pregnant mothers to nitrate is observed. The risk is reported to be highest due to exposure to water with nitrate concentration in between 1 and 10 mg/L[24]. Exposure of pregnant mother to contaminated water with certain pollutants like lead, pesticides as well as the byproducts of processes used for disinfection of water supplies can harm the baby and may result in retarded mental development, improper and retarded growth and may lead to various birth defects[25].

Heavy metals like lead, mercury, cadmium, etc., are known to have adverse effects on the vital organs like heart, liver, kidneys and other organs and lead to toxic effects on the health of the exposed individuals[26-28]. Contamination of drinking water with heavy metals causes serious toxic impacts on the health of the pregnant mother and the fetus[25]. Significant effects on birth weights and gestation of infants due to exposure of pregnant mothers to contaminated and polluted water is reported [Figure 7.1][29].

Lead, nitrate, atrazine, manganese and chlorine are recognised as the five most toxic contaminants of water[30]. Exposure of pregnant women to manganese contaminated water is known to cause adverse health effects on the mother and the fetus[31]. Another study reveals that no significant association between low birth weight and maternal exposure to chlorinated water is noted[32].

Studies also show that maternal exposure to the by-products of water disinfection may lead to an enhanced risk of birth defects which include anencephalus which is actually a fatal condition in which major portion of the upper part of the brain and the skull does not develop. The other birth defects due to exposure to contaminants which are the by-products of water purification are defects of the wall separating the ventricles of the heart. Cleft palate is also reported in the new born who have been exposed to the by-products of water purification in fetal stage due to maternal exposure to such drinking water [Figure 7.1][33].

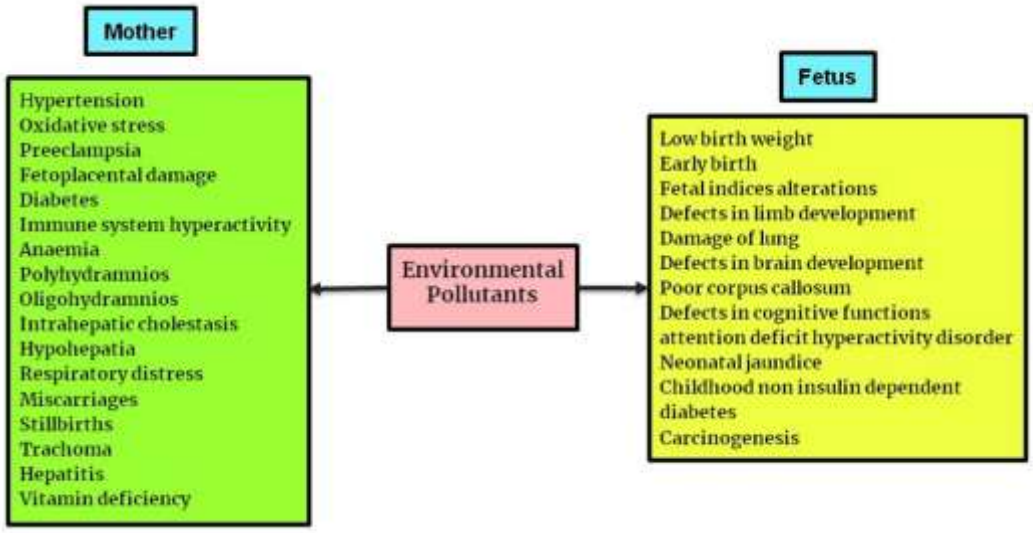

Figure 7.1: Impacts of toxic environment pollutants on pregnant mother's health and fetal health.

7.4 Impact of Soil Pollution on Pregnancy:

Concentration of certain toxic pollutants especially heavy metals in soil around the home or residence of pregnant women is known to enter the body of those women through water and other resources and is reported to cause low birth weight of the babies of those mothers. Studies show that there exists a statistically significant relationship between the concentrations of arsenic in the soil around the home of pregnant women and an enhanced risk of low birth weight for her infant[34].

Low birth weight is a very significant parameter for determining good health of the new born. Low birth is known to be associated with increased risk of morbidity and mortality of the new borns[35].Epideniological studies show that the soil pollutants enter the body of the residents of a place from hand to mouth route and also though the food chain though consumption of the vegetation's grown in the soil contaminated with toxic pollutants[36].In pregnant mothers, certain toxic pollutants which enters the body through hand to mouth route or through the food chain are simply passed on to the growing fetus in her womb through the placenta[35,37]. There have been several studies on the impact of low dose exposure of pregnant women to toxic heavy metal contaminants of the soil. The studies report that exposure of pregnant mothers to low level of heavy metals in the soil leads to low birth weight in the new born babies[38]. A study conducted using experimental rats show that the offspring of the rats exposed to polluted and contaminated soil of urban region during pre-pregnancy caused significant alterations in growth pattern, weight gain,

development length and a reduction in the count of platelets compared to those in the control group of experimental rats. The same study also reveals that exposure of pregnant mothers to contaminated urban soil during pregnancy results in low birth weight, weight gain during the growth incisor eruption, development length, and also caused opening of the ears.

The pups born to those mothers exposed to contaminated soil during pregnancy also are found to have reduced physical performance and also a change in the count of lymphocytes [Figure 7.1][39].

7.5 Preventive Measures of the Impact of Pollutants on Pregnancy:

The best and most effective way to prevent the impacts of pollution on mothers' and fetal health is firstly to prevent pollution as much as possible. We need to restrict emission of pollutants into the environment as much as possible in order to make earth a better place for life to survive. The priority may be to remove the pregnant women to a safer place with lower level of air, water and soil pollution. Several measures have already been made by the Government in India for preventing and reducing pollution[40]. Wide spread consideration of alternative energy and renewable energy needs to be implemented in order to reduce environmental pollution[40]. Also, supplementation of vitamins and antioxidants in daily diet of pregnant mothers may help to maintain a healthy pregnancy, good health of both mother and fetus[41]. These supplementations may help to combat the adverse impacts of toxic pollutants on maternal and fetal health. Good and balanced diet, improved lifestyle and self-care is known to be significant for maintaining women health[42]. A mother's diet should be rich in foods containing vitamins, minerals and the food must be adequate enough to meet her calorie requirements[43].

During pregnancy the developing embryo gets all its nutrition from the mother's body[44]. Thus, the toxic pollutants which enters the pregnant woman's body from air through respiration, from contaminated drinking water or from polluted soil through hand to mouth route or through the food chain may easily reach the developing embryo through the placenta and causes adverse effects on the growing embryo. Toxicants like fluoride is known to adverse effect the growth of the brain and the nervous system[45].Pregnant women residing in regions with increased environment pollution are at a high risk to develop health issues due to constant exposure to toxic environment pollutants. Pregnant women if possible need to be removed from highly polluted place. Use of mask may be recommended for outdoor activities. Also consumption and supplement of certain antioxidant herbs and spicy vegetables along with purified antioxidant compounds may be beneficial in addressing toxic pollutant induced oxidative stress mediated adverse health conditions[46] of pregnant mother and developing fetus. Medicinal herbs like Tulsi are also known to have protective effects against heavy metal induced oxidative stress mediated health effects[47].

Other spice herbs like *Coriandrum* are known to protect against certain chemical induced oxidative damages mediated health issues[48-50]. Hence, such medicinal spice herbs may be recommended for pregnant women who are regularly unavoidably getting exposed to toxic environment pollutants including toxic heavy metals like lead, cadmium, arsenic and mercury. Proper source of pure, pollution free drinking water needs to be assured for pregnant women in order to safe guard them against contaminated water induced health ailments. Hand should be washed before and after every meal in order to avoid soil pollutants induced toxicity in pregnant women. Hygiene needs to be assured for pregnant mothers. Use of sanitizers may be recommended to combat the risk of microbes induced health ailments in pregnant women and the growing fetus. Thus, the basic preventive and protective measured needs to be adapted in order to prevent the impacts of toxic environment pollutants on maternal and fetal health.

7.6 Conclusion:

Increasing pollution is a serious concern around the globe. Air pollution is known to aggravate other respiratory diseases including COVID-19[51,52]. Soil and water pollution also impose fatal health impacts. Pregnant women at higher risk of toxic environment pollutant induced adverse health effects. Also, the growing embryo in the mother's womb who is getting exposed to toxic environment pollutants, suffer from the ill effects of the toxicants. Proper human health risk assessment methods should be considered in order to assess the levels of various environment toxicants and the human health risk associated with them[53]. Also, regular health checkup of pregnant women under proper medical supervision is necessary to assure early detection of any kind of health issue of the mother and the growing fetus. Early medical intervention may help to overcome certain health conditions. Also, recognition of the cause for the same will help to take necessary preventive and protective measures to protect the mother and the baby against toxic environment pollutant exposure.

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8. भारत में सतत विकास: एक अवलोकन (पर्यावरण के विशेष संदर्भ में)

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सबलगढ़ जिला मुरैना.

प्रस्तावना:

किसी ने सच ही कहा है कि इस पृथ्वी पर सबसे खतरनाक जीव मनुष्य ही है, जिसने अपने स्वार्थ और सुविधाओं या अपने जीवन यापन को आरामदायक बनाने के लिए प्रकृति (प्राकृतिक संसाधनों) के साथ खिलवाड़ करना आरंभ कर दिया है। वह (मनुष्य) दिन-प्रतिदिन प्रकृति के साथ खिलवाड़ करता जा रहा है और प्राकृतिक संसाधनों को नुकसान पहुंचाता जा रहा है, जिसकी वजह से पर्यावरण क्षति (प्रदूषण) और प्राकृतिक संसाधनों की मात्रा कम या नष्ट होती जा रही है। इसीलिए पर्यावरण संरक्षण तथा प्राकृतिक संसाधनों को सुरक्षित रखने के लिए सतत विकास की अवधारणा को अपनाया जा रहा है। सतत या धारणीय विकास, एक बहुउद्देशीय अवधारणा है, जिसमें मनुष्य की बुद्धिमत्ता, कल्पना शक्ति, नियोजन एवं प्रबंधन, निर्णय लेने की क्षमता, उद्यमशीलता, उत्पादन और पर्यावरण को संरक्षित रखना आदि शामिल है चूंकि यहां केवल पर्यावरण संरक्षण पर ध्यान आकर्षित किया गया है, इसीलिए सतत विकास का उपयोग पर्यावरण संरक्षण के संबंध में किया गया है।

सामान्य शब्दों में सतत विकास वह विकास है, जिसके अंतर्गत हमें प्राकृतिक संसाधनों का इस प्रकार से उपयोग करना है, जिससे हमारी जरूरत पूर्ण होने के साथ-साथ भविष्य की पीढ़ी के लिए भी यह (प्राकृतिक संसाधन) सुरक्षित रह सके। सतत विकास की पहली परिभाषा **सन 1987 में ब्रंटलैंड रिपोर्ट में इस प्रकार दी गई है:-**सतत विकास, विशेष रूप से, समाज को संगठित करने का एक तरीका है, जिससे कि यह (समाज) लंबी अवधि तक अस्तित्व में रह सके। अर्थात वर्तमान एवं भविष्य दोनों में स्थित लोगों की आवश्यकताओं को ध्यान में रखते हुए प्राकृतिक या पर्यावरण संसाधनों को सुरक्षित एवं संरक्षित रखना है।(1)

हालांकि विश्व में सतत विकास की अवधारणा की जड़ें सन 1960 के दशक में विभिन्न लेखकों एवं सामाजिक आर्थिक दार्शनिकों के लेखों में पाई गई थी। लेकिन इसका (सतत

विकास) **पहली बार उपयोग सन 1980 में प्राकृतिक संसाधनों के संरक्षण हेतु अंतरराष्ट्रीय संघ द्वारा प्रस्तुत विश्व संरक्षण रणनीति के तहत किया गया था।(2)** सतत विकास की इस श्रृंखला में भारत भी पीछे नहीं है। भारत वर्ष 2020 से सतत विकास के लक्ष्यों को प्राप्त करने के लिए निरंतर रूप से प्रयत्नशील है। इसे आगे बढ़ाने में हमारी वर्तमान कालीन सरकार (श्री नरेंद्र मोदी) का योगदान रहा है। इस संबंध में (सतत विकास) **श्री नरेंद्र मोदी जी ने कहा है कि-**संपूर्ण वैश्विक समुदाय में भारत का छटवा हिस्सा है। इस दृष्टि से भारतीय लोगों ने विकास संबंधी सुविधाओं को प्राप्त करने के लिए बहुत लंबा इंतजार किया है। इसलिए हमने इसे **एक स्वच्छ एवं हरित** तरीके से उम्मीद से पहले करने का प्रयास किया है।(3)

यह शोध पत्र सतत विकास (पर्यावरण के संदर्भ) की अवधारणा पर आधारित है, जिसमें हम इसके ऐतिहासिक पक्ष पर दृष्टि डालते हुए सतत विकास की अवधारणा क्या है?, को समझते हुए यह जानने का प्रयास करेंगे कि इस श्रृंखला में भारत कहां पर खड़ा है?, आदि।

8.1 अध्ययन के उद्देश्य:

भारत में सतत विकास की अवधारणा नामक शोध पत्र को पूर्ण करने के लिए मैंने निम्नलिखित उद्देश्य का निर्धारण किया है।

1. ***सतत विकास के ऐतिहासिक पक्ष पर, दृष्टि डालना।***
2. ***सतत विकास की अवधारणा पर, दृष्टि डालना।***
3. ***सतत विकास की श्रृंखला में भारत कहां पर है?, पर दृष्टि डालना।***

अध्ययन की सामग्री:

यह शोध पत्र पूर्ण रूप से द्वितीयक समंको पर आधारित है, जिसे पूर्ण करने के लिए मैंने विभिन्न समाचार पत्रों, पत्र-पत्रिकाओं, पुस्तकों, शोध जर्नलो और इंटरनेट पर उपलब्ध विभिन्न वेबसाइटों से सामग्री एकत्रित की है।

8.1.1 एतिहासिक परिपेक्ष्य:

मैं यह समझता हूं कि, जो विद्यार्थी अर्थशास्त्र विषय का अध्ययन करते हैं, उन्हें सतत विकास क्या है?, के बारे में अच्छी तरह से मालूम होगा। अर्थशास्त्र में यह अवधारणा एक अनुशासन के माध्यम से सदियों से संचालित है। लेकिन जब सतत विकास की अवधारणा को पर्यावरण के संदर्भ में देखा जाता है तो यह ज्ञात होता है कि **सन 1960 के दशक के**

अंत एवं 1970 के दशक के आरंभ में पर्यावरणविदों से लेकर कई गैर-सरकारी संगठनों ने पर्यावरण स्थिरता पर चिंता व्यक्त करते हुए लोगों के सामने रखा और उन्हें जागरुक करने का प्रयास किया।(4) इसके बाद सन् 1962 में राचेल कार्सन की पुस्तक **द साइलेंट स्प्रिंग** प्रकाशित हुई(5), जिसने संपूर्ण दुनिया में पर्यावरण संरक्षण के बारे में तहलका मचाते हुए पर्यावरण के प्रति लोगों की आंखें खोल दी थी। ठीक उसी समय एक और उल्लेखनीय प्रकाशन, जिसके अंतर्गत एक पुस्तक **द लिमिट्स टू ग्रोथ।(6)** के अंतर्गत भी पर्यावरण संरक्षण संबंधी उल्लेख शामिल था। मैसाचुसेट्स में स्थित एक प्रौद्योगिकी संस्थान की टीम, जिसमें डोनाल्ड और डोनेला मीडोज शामिल थे, ने एक कंप्यूटर तकनीक की मदद से उत्पादन, जनसंख्या और प्रदूषण संबंधी आंकड़े इस आशा से डाले गए कि भविष्य में यह तीनों कारक (जनसंख्या, उत्पादन, प्रदूषण) तेजी से बढ़ते रहेंगे। जब टीम ने अपने निष्कर्ष प्रस्तुत किए कि यदि जनसंख्या वृद्धि के साथ भविष्य में प्राकृतिक संसाधन कम होते रहेंगे तो मनुष्य से लेकर समाज तक पर गंभीर परिणाम हमारे सामने प्रकट होंगे। अर्थात विकास करने की सीमाएं प्रदूषण और पारिस्थितिकी तंत्र के क्षरण का कारण बनेगी। **जब यह निष्कर्ष लोगों के सामने आया तो संपूर्ण वैश्विक समुदाय का ध्यान सतत या स्थिरता की अवधारणा की ओर आकर्षित हुआ था।(7)**

वर्ष 1970 में वैश्विक स्तर पर दुनिया का पहला पृथ्वी दिवस समारोह का आयोजन किया गया, **जिसमें पर्यावरण को संरक्षित एवं सुरक्षित बनाए रखने के लिए पर्यावरण संबंधी मुद्दों को सार्वजनिक तौर पर जागरूक किया गया था।(8)** इस दिवस के अवसर पर लोगों के बीच पर्यावरण प्रदूषण को रोकने के लिए, एक जबरदस्त आवाज उठ खड़ी हुई। **जिसका परिणाम यह हुआ कि वैश्विक स्तर पर संचालित संयुक्त राष्ट्र संघ ने पर्यावरण विदों से लेकर गैर-सरकारी संगठनों द्वारा प्रस्तुत किए गए विचारों को शामिल किया गया था।(9)**

सन 1972 में मानव पर्यावरण पर स्टॉकहोम में एक संयुक्त संगोष्ठी का आयोजन किया गया, जिसमें स्वस्थ एवं उत्पादक पर्यावरण, साझा संसाधनों के सहकारी प्रबंधन, प्रदूषण और सीमापार उत्पन्न पर्यावरण प्रदूषण के निवारण हेतु विचार विमर्श किया गया तथा, एक ऐसी **रणनीति बनाई गई, जिससे सीमा पर स्थित पर्यावरण प्रदूषण को समाप्त किया जा सके।(10)** इसी अवधि में स्टॉकहोम में वैश्विक स्तर पर पर्यावरण संरक्षण हेतु संधि समझौते के लिए एक मंच तैयार किया गया था, जिसमें विश्व विरासत सम्मेलन, ओजोन परत पर बढ़ता खतरा, और घटते हुए प्राकृतिक संसाधनों पर एक सम्मेलन का आयोजन किया गया था।(11) इन सम्मेलनों का आयोजन इसलिए किया गया था, जिससे सतत या टिकाऊ विकास सिद्धांतों को अपनाया जा सके।

आपको ज्ञात होना चाहिए कि अर्थशास्त्र में जनसंख्या वृद्धि या विस्फोट पर एक अर्थशास्त्री **थॉमस माल्थस** ने अपनी अहम भूमिका अदा की थी, जिन्होंने अपने लेख में यह धारणा प्रस्तुत की थी, कि जिस गति से जनसंख्या में वृद्धि होती है, उस गति से प्राकृतिक संसाधन नहीं बढ़ते हैं। सन 1800 के दशक में इसी अर्थशास्त्री के विचारों को पर्यावरण संरक्षण हेतु सतत विकास की अवधारणा में प्रस्तुत किया गया था। इस अवसर पर विश्व के विभिन्न पर्यावरण विदों एवं लेखकों के बीच यह बहस हुई थी, कि थॉमस माल्थस ने अपने लेख में, जो धारणा प्रस्तुत की है, कि सीमित प्राकृतिक संसाधन, बढ़ती हुई आबादी के लिए पर्याप्त हैं या नहीं।(12) दरअसल थॉमस माल्थस ने 1798 में अपने एक निबंध में पर्यावरण के मौलिक सिद्धांतों को तैयार किया था, जिसमें उन्होंने बताया था कि मानव की आबादी एक ज्यमीतीय गति से बढ़ती है जबकि प्राकृतिक संसाधन या लोगों के लिए आवश्यक प्राकृतिक जीवन निर्वाह साधन केवल एक अंक में बढ़ते हैं। ऐसी स्थिति में भविष्य की पीढ़ियों के लिए प्राकृतिक संसाधन बचना संभव नहीं है। उनके इस सिद्धांत ने लोगों से लेकर पर्यावरणविदो एंव लेखकों में एक प्रकार की चिंता उत्पन्न कर दी थी और इन सभी लोगों का ध्यान पर्यावरण संरक्षण के लिए सतत विकास की अवधारणा की ओर आकर्षित कर दिया था।

वर्ष 1983 वह वर्ष था, जिसके अंतर्गत संयुक्त राष्ट्र संघ ने यह पता लगाने का प्रयास किया कि वैश्विक स्तर पर पर्यावरण की क्या स्थिति है?, यह प्राप्त करने के बाद एक वैश्विक पर्यावरण संरक्षण एजेंडा हेतु एक आंतरिक आयोग का गठन किया गया।(13) जिसने (आंतरिक आयोग) अपनी रिपोर्ट 3 साल बाद इस प्रकार प्रस्तुत की थी कि-**हमारा साझा भविष्य जारी है-**अर्थात भविष्य के लिए प्राकृतिक संसाधनों का संरक्षण हेतु प्रतिबद्ध हैं। बाद में इसमें सामाजिक-आर्थिक व राजनीतिक पहलुओं के अलावा विकास तथा स्थिरता जैसे शब्दों को एकजुट करके एक परिभाषा दी गई, जो इस प्रकार है-**भविष्य की पीढ़ियों की अपनी जरूरतों को पूरा करने की क्षमता से समझौता किए बिना वर्तमान की जरुरतो को पूरा करना है।(14)**

इस प्रकार संपूर्ण विश्व में पर्यावरण के संदर्भ में सतत विकास की अवधारणा का प्रभाव हुआ और वैश्विक स्तर पर पर्यावरण के संरक्षण व सुरक्षा हेतु सतत विकास के सिद्धांतों को अपनाया गया था।

8.1.2 सतत विकास की अवधारणा:

जब हम सतत विकास शब्द को ध्यानपूर्वक देखते हैं तो हमें इसमें दो शब्द नजर आते हैं। जैसे:-सतत+विकास, यहां सतत का मतलब हिंदी में लगातार या निरंतर से होता है जबकि

अर्थशास्त्र की भाषा में इसे स्थिरता या धारणीय नाम दिया गया है। दूसरा, विकास शब्द का मतलब पूर्व की स्थिति में परिवर्तन या धीरे-धीरे प्रगति की ओर अग्रसर होना है। इस प्रकार सतत विकास का अभिप्राय हुआ किसी भी क्षेत्र में स्थिरता या धारणीयता के संबंध में उत्तरोत्तर प्रगति करते रहना आदि।

हालांकि सतत विकास की अवधारणा एक बहुउद्देशीय अवधारणा है। अर्थात इसका उपयोग अर्थव्यवस्था के अनेक क्षेत्रों या विषय में किया जाता है, लेकिन यहां केवल सतत विकास की अवधारणा का उपयोग पर्यावरण के संदर्भ में किया गया है। **इस दृष्टि से सतत विकास की मूल अवधारणा, पर्यावरण और पारिस्थितिकी तंत्र से जुड़ी हुई है तथा मानव का पर्यावरणीय सीमाओं के भीतर रहेना सतत विकास का मूल सिद्धांतों में से एक है।(15)**

यदि हम इस अवधारणा (सतत विकास) को दूसरे दृष्टिकोण से देखे तो इसका मतलब एक स्वस्थ, मजबूत तथा न्याय पूर्ण समाज की स्थापना करना है। अर्थात समाज में जीवन यापन करने वाले सभी लोगों की जीवन निर्वाह संबंधी आवश्यकताओं को पूर्ण करना है, फिर वह चाहे, किसी भी धर्म, जाति संप्रदाय का क्यों ना हो, दूसरे शब्दों में हमें प्राकृतिक संसाधनों का इस्तेमाल इस प्रकार करना चाहिए ताकि वे समाप्त न हो और भविष्य की पीढ़ी को भी इसका (प्राकृतिक संसाधनों) लाभ प्राप्त हो सके।

विश्व के विभिन्न अर्थशास्त्रियों ने सतत विकास की अवधारणा को एक आर्थिक प्रक्रिया के रूप में स्वीकार किया है, जिसमें प्राकृतिक संसाधनों की मात्रा और गुणवत्ता, पारिस्थितिकी तंत्र के अंतर्गत जैव-भू-रासायनिक चक्र की अखंडता कायम रहती है, इत्यादि शामिल है।(16)

एक अर्थशास्त्री, जिनका नाम बेन डेन बर्ग (1996) है, ने अपनी सतत विकास की परिभाषा के अंतर्गत उन सब विज्ञानों से संबंधित विषयों को शामिल किया है, **जिसके अंतर्गत पर्यावरण या पारिस्थितिकी तंत्र से संबंधित विषयों का अध्ययन किया जाता है जैसे:-भौतिक पारिस्थितिकी, मानव पारिस्थितिकी, नव शास्त्रीय आर्थिक संतुलन, विकासात्मक पारिस्थितिकी आदि।(17)** इसके अलावा यह (सतत विकास) विज्ञान संकाय के विभिन्न विषयों जैसे:-प्राणीशास्त्र, वनस्पति, विज्ञान, जीव विज्ञान, पर्यावरण विज्ञान, भौतिक या प्राकृतिक विज्ञान तथा कला संकाय के दो विषयों, भूगोल, अर्थशास्त्र आदि से भी संबंधित है। इसीलिए इसका वर्णन करना असंभव है, लेकिन हां, आप किसी एक विषय को लेकर अध्ययन करना चाहते हैं, तो आप आसानी से यह कार्य कर सकते हैं।

जॉनपेजी के अनुसार-सतत विकास, प्राकृतिक संसाधनों से संबंधित मानवीय जरूरतों की एक श्रृंखला है, जिसमें प्रति व्यक्ति उपयोगिता में किसी भी प्रकार की गिरावट नहीं होगी।(18)

लेकिन इन सब परिभाषाओं के बावजूद सतत विकास की, जो परिभाषा प्रस्तुत की गई है, उनमें ब्रेटलैंड आयोग की सबसे अधिक मान्यता प्राप्त परिभाषा है, जो यह स्पष्ट करता है कि भविष्य की पीढ़ियों की अपनी जरूरतों को पूरा करने की क्षमता से समझौता किए बिना वर्तमान जरूरतों को पूरा करना है।(19) इसे इसलिए सबसे अधिक मान्यता दी गई है क्योंकि इसमें मानव से संबंधित सभी कल्याणकारी कार्यों को शामिल किया गया है। जैसे:-संपूर्ण मानव जाति के लिए आवश्यक प्राकृतिक जीवन निर्वाह सुविधाएं प्रदान करना, देश में व्याप्त गरीबी को समाप्त करना और पर्यावरण की रक्षा करने के साथ-साथ दुनिया भर के लोगों के लिए पर्याप्त भोजन की व्यवस्था करना आदि है, रिपोर्ट का कहना है कि जब तक हम धारणीय या टिकाऊ विकास की अवधारणा को नहीं अपनाएंगे तब तक इन पर्यावरणीय समस्याओं का समाधान संभव नहीं है।

8.1.3 भारत में सतत विकास की स्थिति:

भारत अपने सतत विकास के लक्ष्यों को प्राप्त करने के लिए निरंतर रूप से प्रयत्नशील रहा है। इसने (भारत) स्वच्छ ऊर्जा से लेकर स्वच्छ जल, स्वच्छ तकनीक, विशेष रूप से, कृषि क्षेत्र में इस्तेमाल करने पर बहुत जोर दिया है। ताकि टिकाऊ कृषि या कृषि क्षेत्र में अत्यधिक उत्पादन की संभावनाओं को जागृत किया जा सके। इसके अलावा। मानव से संबंधित कल्याणकारी योजनाएं भी समय-समय पर सरकार द्वारा संचालित की जा रही हैं, जिन्हें लागू करने में ना केवल केंद्र सरकार बल्कि राज्य सरकार और निजी क्षेत्रों ने भी अपनी अहम भूमिका अदा की है।

भारत में पिछले कुछ वर्षों से सतत विकास की अवधारणा पर विशेष बल दिया जा रहा है। **वर्ष 2020 में भारत सरकार के केंद्रीय वित्त मंत्री श्रीमती निर्मला सीतारमण ने वर्ष 2018-19 के अपने आर्थिक सर्वेक्षण में कहा है कि-**भारत पर्यावरण के प्रति अत्यधिक संवेदनशील है। अर्थात जलवायु परिवर्तन, संसाधन दक्षता और वायु प्रदूषण के समाधान हेतु विभिन्न नीतियों एवं कार्यक्रमों पर जोर दे रहा है।(20) इसमें भारत सरकार ने जलवायु परिवर्तन पर एक राष्ट्रीय कार्य योजना का निर्माण किया है, जो कि **सौर ऊर्जा के 8 प्रमुख मिशन पर आधारित है। जैसे:-पानी, आवास, हरित भारत, टिकाऊ कृषि जलवायु परिवर्तन, हिमालयी, पारिस्थितिकी तंत्र को बनाए रखना और ऊर्जा दक्षता में वृद्धि आदि।(21)** यह राष्ट्रीय कार्य योजना भारत के सभी राज्यों एवं केंद्र शासित प्रदेशों में एक साथ संचालित करने की योजना है। इसी प्रकार देश में व्याप्त वायु प्रदूषण जैसी ज्वलंत समस्या से निपटने के लिए भारत सरकार ने अपने सतत विकास लक्ष्यों के अंतर्गत **राष्ट्रीय स्वच्छ वायु नामक** कार्यक्रम का शुभारंभ किया है, जिसमें देश के तीन भागों या हिस्सों में वायु प्रदूषण की अत्यधिक समस्याएं व्याप्त है, जैसे:-ठोस अपशिष्ट, कचरा, लैंडफिल, ओधोगिक उत्सर्जन (नगरो या

महानगरों में स्थापित विशाल उद्योगों द्वारा काला धुआं, छोड़ना) सड़क की धूल, बायोमास आदि हेतु एक राष्ट्रीय स्तर की रणनीति तैयार की गई है(22), जिसका कार्य, शहरी क्षेत्रों में एकत्रित अपशिष्ट (कचरा) को समाप्त करना और जन-जन तक स्वच्छता के प्रति जागरूकता उत्पन्न करना है।

भारत के कुछ राज्य, जो की समुद्र तट पर स्थित हैं, विशेष रूप से, दक्षिण भारत, वहां पर आये दिन समुद्री तूफान एवं चक्रवात की समस्या बनी रहती है। इसलिए भारत सरकार ने एक राष्ट्रीय चक्रवात जोखिम परियोजना संचालित की है, जो कि भारत सरकार के सतत विकास लक्ष्यों में से एक है। इसके अंतर्गत विभिन्न समुद्री तूफानों या चक्रवात को रोकने या कम करने के लिए देश के तटीय राज्यों और केंद्र शासित प्रदेशों मे एक संरचनात्मक कार्य योजना, राष्ट्रीय आपदा प्रबंधन प्राधिकरण के सहयोग से संचालित की है। यह प्राधिकरण समय-समय पर समुद्रों की सैर करने वालों तथा मछुआरों को सूचित करता रहेगा ताकि जनहानि की समस्या से निपटा जा सके।

जल, जिसके बारे में यह कहा जाता है कि जल है, तो जीवन है, कि भी एक ज्वलंत समस्या उत्पन्न हो गई है। दिन-प्रतिदिन घटते जल स्रोत, मानव को यह संकेत दे रहे हैं कि एक दिन संपूर्ण विश्व, जल के लिए एक युद्ध (विश्व युद्ध) को आगाज देगा, भारत में पानी की समस्या अपना विकराल रूप धारण कर चुकी है। यदि हम शहरी तथा ग्रामीण क्षेत्रों के बीच पानी के मांग की तुलना करें तो यह पता चलता है कि शहरी क्षेत्रों की तुलना में देश के ग्रामीण क्षेत्रों में कहीं अधिक मांग है, क्योंकि यहां (ग्रामीणवासी) पर पानी का उपयोग जीवन जीने के साथ-साथ अजीबिका के लिए भी उपयोगी है। **जे.सत्या, पी.आर.शुक्ला तथा रवींद्ननाथन ने अपने एक लेख में उल्लेख किया है कि**-देश के ग्रामीण क्षेत्रों में लगभग 70 मिलियन लोग अपना जीविकोपार्जन कृषि से लेकर मत्स्य पालन, वन तथा विभिन्न प्राकृतिक संसाधनों जैसेः-तटीए क्षेत्र, घास के मैदान, जल व्यवस्था आदि पर सीधे निर्भर है, जो कि पानी की वजह से उपलब्ध रहते हैं।(23) यदि पानी का अभाव होगा तो ग्रामीण वासियों का जीवन यापन मुश्किल में पड़ जाएगा। इसीलिए भारत सरकार ने पानी की समस्या से निपटने तथा भू-जल संरक्षण प्रथाओं को बढ़ावा देने के लिए स्थानीय निकाय, पंचायती राज, के माध्यम से देश के ग्रामीण क्षेत्रों में चेक डैम, खेत तालाब, पहाड़ी क्षेत्रों में पानी एकत्रित करने, सतही जल संग्रह, तालाब, बरसात के समय छत के पानी को एकत्रित करने और बूंद-बूंद पानी को बचाने के लिए विभिन्न प्रकार के जन जागरूकता अभियान संचालित किए जा रहे हैं। इसके लिए भारत सरकार ने ग्रामीण स्तर पर संचालित ग्राम पंचायत, ग्राम स्वास्थ्य और स्वच्छता समिति, राष्ट्रीय ग्रामीण पेयजल गुणवत्ता, निगरानी और प्रेरणा इत्यादि निकायों को जिम्मेदारी प्रदान की है। आपको ज्ञात होना चाहिए कि पेयजल की

योजनाएं मध्य प्रदेश, महाराष्ट्र, कर्नाटक, आंध्र प्रदेश, तमिलनाडु और गुजरात इत्यादि में संचालित है। भारत सरकार ने अपने विकास लक्ष्यों को अपनाने के लिए **नामराई गंगे मिशन** नामक योजना संचालित की है जोकि पूर्ण रूप से पर्यावरण संरक्षण पर आधारित है। इसमें शहरी और ग्रामीण स्वच्छता, सीवरेज परियोजना प्रबंधन और ओधोगिक प्रदूषण, जल उपयोग, दक्षता और गुणवत्ता में सुधार तथा स्वच्छ गंगा निधि आदि इसको पूरा करने के लिए वर्ष 2015 से 2020 की अवधि तक कुल 20000 करोड रुपए का प्रावधान रखा है।(24)

भारत में हैंदराबाद में, स्थित, एक कृषि अनुसंधान संस्थान, ने भी पेयजल हेतु अपनी अहम भूमिका प्रस्तुत की है। इस संस्थान ने पानी से संबंधित वाटरसेड कार्यक्रमों का व्यापक आकलन किया गया, जिसमें यह पाया गया कि वर्ष 2000 से 2005 के बीच, बंजर भूमि में लगभग 8.58 मिलियन हेक्टेयर की कमी की पहचान की है।(25) इस समस्या के समाधान के लिए एकीकृत विकास की विभिन्न तकनीकों का उपयोग किया जा रहा है।

भारत सरकार ने अपने सतत विकास लक्ष्यों के अंतर्गत अपशिष्ट (कचरा) और प्लास्टिक से बने विभिन्न उत्पादों से निजात पाने के लिए एक संस्थान, जिसका नाम सतत विकास प्रौद्योगिकी और पर्यावरणीय परियोजना लिमिटेड है, ने एक ऐसी तकनीक का निर्माण किया है, जिसकी मदद से कचरा या प्लास्टिक को समाप्त करके पेट्रोलियम बनाया जा सकता है।

इसके लिए, एक ऐसे संयंत्र धारी, संस्था होनी चाहिए, जिनकी लागत 23 मिलियन अमेरिकी डॉलर है, प्रतिदिन 2500 लीटर पेट्रोलियम का उत्पादन कर सकते हैं।(26) मेरे ख्याल से सतत विकास के अंतर्गत पर्यावरण संरक्षण के लिए अपनाई गई यह तकनीक कहीं अधिक उपयोगी सिद्ध हो सकती है क्योंकि मानव स्वास्थ्य की दृष्टि से अपशिष्ट या प्लास्टिक, दोनों ही घातक है, यहां एक तरफ कचरा किसी भी व्यक्ति को गंभीर बीमारी की स्थित मैं पहुंचा सकता है तो दूसरी तरफ प्लास्टिक तुरंत नष्ट ना होने के कारण नालियों या सीवरेज के लिए हानिकारक हो सकता है।

भारत में जितने भी ओधोगिक संस्थान या विनिर्माण करने वाली कंपनियां स्थित हैं, वे सभी एक प्रकार का कार्बन उत्सर्जन नामक धुआं छोड़ने का कार्य करती हैं, जो कि मानव स्वास्थ्य, विशेष रूप से सांस की बीमारी या अस्थमा जैसी बीमारी, सृजित कर सकता है। इसलिए भारत सरकार ने अपने सतत विकास लक्ष्य के तहत इसे समाप्त या नष्ट करने का निर्णय लिया है। एक वेबसाइट के अनुसार-भारत अगले 10 वर्षों में कार्बन उत्सर्जन की मात्रा को कम या समाप्त करने के लिए 10% परिवहन इधन को, पर्यावरण के अनुकूल बनाने के लिए डोपिंग डीजल और खाद तेल के साथ बदलने की कोशिश कर रहा है।(27)

भारत सरकार ने इन सभी योजनाओं एवं नीतियों के अलावा भारत सरकार के मंत्रालय ने अपनी सतत विकास लक्ष्यों के अंतर्गत अन्य योजनाओं जैसे:-स्वच्छ भारत मिशन, स्मार्ट सिटी मिशन, शहरी क्षेत्रों में परिवर्तन के लिए अटल मिशन, मंत्री आवास योजना और रेल मेट्रो परियोजना इत्यादि भी लागू की है।(28)

भारत द्वारा अपने सतत विकास के लक्ष्यों को निरंतर रूप से प्राप्त करने के कारण सतत विकास सूचकांक में काफी सुधार हुआ है। भारत सरकार के नीति आयोग की नवीनतम रिपोर्ट के अनुसार-भारत में ऊर्जा, स्वास्थ्य तथा बुनियादी ढांचे के क्षेत्र में संयुक्त राष्ट्र संघ के सतत विकास लक्ष्यों की दिशा में लगातार अपनी प्रगति दर्ज की है।(29)

यही कारण है कि वर्तमान में भारत सतत विकास लक्ष्यों के सूचकांक में 6 अंकों का सुधार हुआ है। नीति आयोग की एक आधिकारिक विज्ञप्ति के अनुसार-भारत अपने सतत विकास लक्ष्यों के सूचकांक की दृष्टि से वर्ष 2019 के बाद काफी सुधार की स्थिति प्राप्त की गई है, अर्थात वर्ष 2021 में सतत विकास लक्ष्य सूचकांक 60 अंक था, जोकि अब बढ़कर 66 अंक हो गया है।(30)

इस प्रकार यह कहा जा सकता है कि संपूर्ण विश्व के सभी देशों के समान भारत ने भी सतत विकास के क्षेत्र में अपनी प्रगति दर्ज की है।

8.2 निष्कर्ष:

उपरोक्त विवरण के आधार पर यह कहा जा सकता है कि आज वैश्विक स्तर पर भारत की, जो स्थिति है, जिसे हम महाशक्ति अर्थात वर्तमान में संपूर्ण विश्व में भारत को महाशक्ति का दर्जा देते हैं और दुनिया के अधिकांश राष्ट्र भी, भारत को एक उभरती हुई अर्थव्यवस्था का दर्जा देते हैं, यह सब तभी संभव हो पाया है, जब हमने भारतीय अर्थव्यवस्था के प्रत्येक क्षेत्र पर अपना ध्यान आकर्षित किया है। जिसने सतत विकास के लक्ष्यों को प्राप्त करना भी एक महत्वपूर्ण कार्य रहा है। आपको ज्ञात होना चाहिए कि मोदी सरकार से पहले भारत बिजली के क्षेत्र में एक महत्वपूर्ण समस्या से जूझ रहा था। लेकिन जैसे ही मोदी सरकार आई, वैसे ही बिजली की समस्या का समाधान करने के क्षेत्र में एक महत्वपूर्ण विकल्प, जिसे हम, सौर ऊर्जा कहते हैं, ढूंढ निकाला और देश के जिन भागो या हिस्सों में बिजली की समस्या थी, हल हुई, यही नहीं, बल्कि भारत में ऊर्जा प्राप्त करने के लिए कचरे, अपशिष्ट का उपयोग करके पेट्रोलियम बनाने का कार्य किया है, वह काबिले तारीफ है, देश में अभी भी कई ऐसे उद्योग हैं, जो अपशिष्ट, फिर वह चाहे कागज हो या फिर प्लास्टिक, सभी को रीसाइक्लिंग करके, जो नए उत्पाद या ऊर्जा प्राप्ति को ध्यान में रखते

हुए यही कहा जा सकता है कि आज का भारत, एक विकसित भारत है और यदि भारत इसी तरह से आर्थिक या अर्थव्यवस्था के क्षेत्र में प्रगति करता गया, तो वह दिन दूर नहीं, जब भारत संपूर्ण विश्व में सबसे शक्तिशाली राष्ट्र के रूप में जाना जाएगा।

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