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FOREWORD

Dr. Sobhan Niyogi

Associate Professor and Officer in Charge

Krishnagar Government College

*It gives me immense pleasure to announce that volume XII of **Conscientia**, the academic journal of Krishnagar Government College is being published. Over the past 176 years- ever since the days of the East India Company rule to the present, this college has uninterruptedly carried forward the legacy of quality education in India. Today about 3,500 students enjoy the privilege of using and sharing the same abode of learning that greats such as D.L.Roy, Umesh Dutta, Jadunath Mukherjee, Jadunath Bhattacharjee, Lalit Kumar Banerjee, Satish Chandra Dey and a host of others have used in bygone decades. Teachers deliver lectures from the podium which had once been used by stalwarts like Pandit Madan Mohan Tarkalankar, Babu Ramtanu Lahiri, Suresh Chandra Sengupta and many other names remembered with reverence. I personally feel honoured at obtaining the opportunity to further promote the excellence of this heritage institution, which has witnessed more than 70 eminent Principals (like Roy Bahadur Jyoti Bhusan Bhaduri, Satish Chandra Dey, J.M. Sen and several others) over the course of its 176-year old history thus far. In less than the last ten years this College has secured “A” grade twice in NAAC evaluation and very recently the University of Kalyani has declared this College as the “Best Performing College” of Nadia District. The faculty members of the College have been contributing significantly in academic research through regular publications at various levels.*

***Conscientia**, the interdisciplinary journal of research findings launched by our College in 2011 strives to publish high quality articles, since the time of its inception. This journal is an interdisciplinary and multilingual publication and articles include scientific research findings, socially relevant issues as well as literary contributions from the various Humanities Departments. This volume is expected to evoke interest among myriad groups of readers, who will hopefully find the articles academically enriching and stimulants for intellectual discourse.*

I wish to thank all the contributors from various Higher Educational Institutions for their submissions, the Editorial Board Members from our College, the Advisory Board Members from various well known Universities and Institutes of West Bengal and India for their active role for the publication of this particular volume.

***Conscientia**, December 2023 Vol. XII*

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Wetlands and Ramsar Sites in India with special reference to West Bengal: From Crisis to Cure

Hemen Biswas*

ABSTRACT

Wetlands are defined as areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters (As per article 1.1 of Ramsar Convention). In addition, it may incorporate riparian and coastal zones adjacent to the wetlands and islands or bodies of marine water deeper than six meters low tide lying within the wetlands (As per article 2.1 of Ramsar Convention). This article includes some serious findings like importance of wetlands in ecosystem services, perspectives of Ramsar Convention and its membership along with its global commitments. This article also contributes to the understanding on international cooperation of wetland conservation as well as galvanising the consolidated idea on Ramsar Sites of West Bengal.

Keywords: Wetlands, marsh, fen, peat, fresh, brackish, salt, riparian, coastal, islands, ecosystem services

Introduction

Wetlands are among the world's most productive environments. They are the cradles of biological diversity, providing water and the primary productivity, upon which countless species of plants and animals depend for survival. They support high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species. Of the 20,000 species of the fish in the world, more than 40% live in fresh water. Wetlands are also important storehouses of plant genetic material. Rice, for example which is a common wetland plant, is the staple diet of more than half of the human race.

Wetland Values

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The interactions of physical, biological and chemical components of a wetland such as soil, water, plants and animals enable the wetland to perform many vital functions, for example: water storage; storm protection and flood mitigation; shoreline stabilisation and erosion control; groundwater recharge (the movement of water from the wetland down into the underground aquifer); groundwater discharge (the movement of water upward to become surface water in a wetland); water purification through retention of nutrients, sediments and stabilisation of local climate conditions; particularly rainfall and temperature.

Traditionally, wetlands were considered as wastelands that bred mosquitoes. They were drained and developed for agriculture, fish farming and habitations. Now, their value as providers of ecosystem services is being realised. Final ecosystem services are components of nature, directly enjoyed, consumed, or used to yield human well-being (Boyd *et al*, 2007).

Wetlands are land surfaces covered or saturated with water for a part or whole of the year. They are shallow systems with black and reach sediments and abundant nutrients. They have vegetation adapted to thrive in saturated conditions.

Wetlands control flooding by holding excess water and realizing slowly. They help in recharging groundwater and in purifying water by trapping and holding pollutants in the soil. They are the major breeding, nesting, foraging and migration staging areas for many birds. Lot of wetlands in Gujarat and Bharatpur are the first stop for most of the migratory birds (Agarwal, 2011).

Wetlands add moisture to the atmosphere, which could fall back as rain. They can even be used as sewage treatment plants that require little technology, investment and maintenance.

Wetlands provide tremendous economic benefits, for example: water supply (quantity and quality); fisheries (over two thirds of the worlds fish harvest is linked to the health of coastal and inland wetland areas); agriculture through the maintenance of water tables and nutrient retention in floodplains; timber production; energy resources such as peat and plant matter; wildlife resources; transport; and recreation and tourism opportunities.

In addition, wetlands have special attributes as part of the cultural heritage of humanity. They are related to religious and cosmological beliefs, constitute a source of aesthetic inspiration, provide wildlife sanctuaries, and form the basis of important local traditions.

These functions, values and attributes can only be maintained if the ecological processes of wetlands are allowed to continue functioning. Unfortunately, in spite of important progress made in recent

decades, wetlands continue to be among the world's most threatened ecosystems, owing mainly to ongoing drainage, conversion, pollution, and over exploitation of their resources.

Wetlands, or the lack thereof, were a significant factor in the severe flooding in the Upper Mississippi and Missouri River Basins in the summer of 1993 (Parrett and others, 1993). Damages associated with the flooding were undoubtedly worse than they would have been if flood-plain wetlands had still been in place. Human modification of the original wetlands (a common practice in the early part of this century) had destroyed the ability of the wetlands to modify flooding.

The Ramsar Convention

The Convention on Wetlands is an intergovernmental treaty adopted on February 2, 1971 in the Iranian city of Ramsar on the southern shore of the Caspian Sea. Thus, the Convention is popularly known as "Ramsar Convention". Ramsar is the first of the modern global inter-governmental treaties on conservation and wise use of natural resources. The official name of the treaty is The Convention of Wetlands of International Importance especially as Waterfowl Habitat and reflects its original emphasis on the conservation and wise-use of wetlands primarily to provide habitat for water birds. Over the years, however the convention has broadened its scope to recognising wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well being of human communities. There are at present 172 contracting parties to the Convention, with 1,674 wetland sites, totaling 150 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance.

Membership in the Ramsar Convention

- Entails an endorsement of the principles that the Convention represents, facilitating the development at national level of policies and actions, including legislation that helps nations to make the best possible use of their wetland resources in their quest for sustainable development.
- Presents an opportunity for a country to make its voice heard in the principal intergovernmental forum on the conservation and wise use of wetlands.
- Brings increased publicity and prestige for the wetlands designated for the List of Wetlands of International importance, and hence increased possibly of support for conservation and wise use of the measures.
- Brings access to the latest information and advice on application of the Convention's internationally accepted standards such as criteria for identifying wetlands of international

importance, guidelines on application of the wise use concept, and guidelines on management planning in wetlands.

- Brings access to expert advice on national and site-related problems of wetland conservation and management through contacts with Ramsar Bureau personnel and consultants and through application of the Ramsar Advisory Mission mechanism when appropriate.
- Encourages international cooperation on wetland issues and brings the possibility of support for wetland projects, either through the Conventions own small Grants Fund or through the Conventions contacts with agencies.

The Commitments of Contracting Parties Joining the Ramsar Convention

When countries join the convention, they are enlisting in an international effort to ensure the conservation and wise use of wetlands. The treaty includes four main commitments that the contracting parties have agreed to by joining.

1. Listed Sites

They have to designate at least one wetland for inclusion in the List of Wetlands of International importance (the “Ramsar List”) and to promote its conservation, including, where appropriate, its wise use. Selection for the Ramsar List should be based on the wetland’s significance in terms of ecology, botany, zoology, limnology, or hydrology.

2. Wise Use

They have to include wetland conservations in their national land use planning and to formulate and implement this planning and to formulate and implement this planning for, “the use of wetlands in their territory”, which has been interrupted as being synonymous with “sustainable use”. The wise use of wetlands includes:

- Water allocation, and river basin management, including establishing national wetland policies and plans;
- Reviewing and harmonising the framework of laws and financial instruments affecting wetlands;
- Undertaking inventory and assessment;
- Integrating wetlands into the sustainable development process;
- Ensuring public participation in wetland management and the maintenance of cultural values by local communities and indigenous people;

- Promoting communication, education and public awareness;
- Increasing private sector involvement; and
- Harmonising implementation of the Ramsar Convention with other multilateral environmental agreements;

3. Reserves and Training

They have to establish nature reserves in wetlands, and to promote training in the fields of wetland research, management and protection.

4. International Cooperation

Contracting parties have also agreed to consult with others, especially in regard to Trans frontier wetlands, shared water systems, and shared spaces.

Criteria for Identification of Wetlands

A wetland should be considered internationally important if it:

Criterion 1: Contains a representative, rare, or unique example of a natural or near natural wetland type found within the appropriate biogeographic region.

Criterion 2: Supports vulnerable, endangered or critically endangered or critically endangered species or threatened ecological communities.

Criterion 3: Supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

Criterion 4: Supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Criterion 5: Regularly supports 20,000 or more water birds.

Criterion 6: Regularly supports 1% of the individuals in a population of one species or subspecies of water bird.

Criterion 7: Supports a significant proportion of indigenous fish subspecies, species or families, life–history stages, species interactions and/or populations that are representative of wetland benefits and/or wetland benefits and/or values and thereby contributes to global biological diversity.

Criterion 8: It is an important source of food for fishes, spawning ground, nursery and/or migration path, on which fish stocks, either within the wetland or elsewhere, depend.

The Ramsar Sites in India

India became a contracting party to the Ramsar Convention in 1981. On February 2, 2006, the World Wetland Day, India has designated six new wetlands to the Ramsar Convention on wetlands list of international importance, viz., Hokera Wetland and Surinsar-Mansur lakes in the northwestern Himalayan province of Jammu and Kashmir; Chandertal Wetland and Renuka in Himachal Pradesh; Rudrasagar Lake in the northeastern state of Tripura; and Upper Ganga River in Uttar Pradesh. The designations bring the number of Ramsar sites in India to 75. The current list of Ramsar sites in India only represent a fraction of the diversity of wetland habitats existing in the country. There is, therefore, still a need for identifying additional wetlands for listing under the Ramsar Convention, and for selecting these from the under-represented wetland categories in the country and managing the designated sites along the Ramsar guidelines.

India added five more Ramsar sites to its portfolio ahead of this year's World Wetlands Day on February 2, 2024 taking its total tally to 80 from the existing 75. The newly declared sites include Karaivetti Bird Sanctuary and Longwood Shola Reserve Forest in Tamil Nadu, and Magadi Kere Conservation Reserve, Ankasamudra Bird Conservation Reserve and Aghanashini Estuary in Karnataka. The Ramsar tag bestows these ecosystems with international recognition, gives them access to international management practices and increases the possibility for international funding.

Challenges Faced by Wetlands in India/West Bengal

Many of the wetlands in our country and state as well are subject to anthropogenic pressures and environmental challenges, including land use changes in the catchment; pollution from industry and households; encroachments; tourism; and over exploitation of their natural resources. Loss in wetland area results in adverse impact on the key functions (ecosystem goods and services) performed by wetlands (Zedler and Kercher, 2005). Worldwide, the main causes of wetland loss have been: urbanization; land use changes; drainage to agricultural use; infrastructure development; pollution from industrial effluent and agricultural runoff; climate change and variability.

Urbanization exerts significant influences on the structure and function of wetlands, mainly through modifying the hydrological and sedimentation regimes, and the dynamics of nutrients and chemical pollutants. Impact of urbanization is equally alarming on natural water bodies in the cities. A

study found that out of 629 water bodies identified in the National Capital Territory (NCT) of Delhi, as many as 232 cannot be revived on account of large scale encroachments.

As a result of intensification of agricultural activities over the past four decades, fertilizer consumption in India has increased from about 2.8 million tonne in 1973–1974 to 28.3 million tonne in 2010–2011 (Data Source: Indiatat). As per estimates, 10–15% of the nutrients added to the soils through fertilizers eventually find their way to the surface water system (Indian Institute of Technology, 2011). High nutrient contents stimulate algal growth, leading to eutrophication of surface water bodies.

The challenges made by global climate change are expected to become an important driver of loss and change in wetland ecosystem (MEA, 2005, UNESCO, 2007). These findings are important for Indian subcontinent where the mean atmospheric temperature and frequency of occurrence of intense rainfall events has increased, while the number of rainy days and total annual amount of precipitation have decreased due to increase in the concentration of greenhouse gases such as CO₂, CH₄ and N₂O in the atmosphere (Bates et al., 2008).

Role of the Ramsar Convention in Addressing Challenges in Global and Indian Contexts

The progenitors of Ramsar Convention were far-sighted in phrasing wise use as the central tenet for wetlands management. Coined prior to Stockholm Conference, this was a philosophy that marked a novel framing of human-nature interdependency as the basis of delivering conservation as well as sustainable development outcomes.

In the 1960s and 1970s, when the Convention took shape, concerns related to wetlands were centered on decline on species. The Anthropocene, however, has engendered notions of increased connectivity and coupling between individuals, societies and environmental change.

Managing wetlands in this era of rapid human-mediated transformation requires analytical approaches, which consider integrated systems of human and nature as a unit of analysis, overcoming the human-nature dualism which has underpinned conservation approaches in global scenario so far.

The predominant ecological construct of wise use today results in a partial view based on stationarity, but this needs to be updated, building on multiple values on a worldview perspective that defines human-wetlands linkages. The full scales of values, from intrinsic, instrumental to relational, from diverse epistemologies, from indigenous to western, needs to be embraced in the framing of wise use.

The most critical challenge for wetlands now and into future is to enable governance transformations in a world where wetlands change in an uncertain environment will be the norm, and surprise rather than predictability will face wetlands managers.

In India, the key characteristics of wetlands governance that are likely to be suited in such complex polycentric contexts are being: interactive (consciously interacting with decision-making centers to define as well as realize wetlands wise use goals); reflective (reassessing management practices and adjusting governance mechanism enabled by continuous learning); reflexivity (by calling into question the governance foundations and envisioning alternatives and shaping the foundations) and inclusion (supported by democratic institutions, participation and policy coherence). There are other significant roles of joining the Ramsar Convention.

- Elevates the importance of the site at the international level
- Encourages international cooperation
- Brings access to expert advice and latest information
- Provides an opportunity for learning the best global practices for wise use of wetlands
- Opportunity for getting international guidelines on various wetland conservation themes
- Represents a contribution to global environment protection and maintenance of global biodiversity

The Ramsar Sites in West Bengal

1. The East Kolkata Wetlands (EKW)

The wetlands to the east of Kolkata are well known over the world for their multiple uses. The resource recovery systems, developed by the local people through ages using wastewater from the city, are the largest in the world. In the process, it treats the wastewater and has saved the city of Kolkata from constructing and maintaining a wastewater treatment plant. Kolkata is the only metropolitan city in the world where the state government has introduced development controls to conserve the water bodies. The wetland is largely human made, comprising inter-tidal marshes, salt meadows with significant waste water treatment areas like sewage farms, setting ponds oxidation basins, the East Kolkata Wetlands has been designated as a Ramsar site in November 2002. The East Kolkata Wetlands is a perfect example of wise-use wetland ecosystem where usage of city sewerage for traditional practices of fisheries and agriculture is practiced. The wetland ecosystem is one of the rare examples of combination of environmental protection and development management where the local farmers have adopted a complex ecological process by mastering the resource recovery activities. It is the largest ensemble of sewage fed fishponds in the world

in one place. There are about 100 plant species which have been recorded in and around the East Kolkata Wetlands. These include giant arrowhead (*Sagittaria montividentis*), water trumpet (*Cryptocoryne ciliate*), flatsedges (*Cyperus spp.*), golden leather fern (*Acrostichum aureum*), kangkong (*Ipomoea aquatic*), etc. Amongst the rare mammals marsh mongoose (*Herpestes palustris*) and small Indian mongoose (*H. auropunctatus*), common palm civet (*Paradoxurus hemaphroditus*) and small Indian civet (*Viverricula indica*) are significant in and around the East Kolkata Wetlands area. About 20 mammals are reported from this region. Threatened reptiles like Indian mud turtle (*Kinosternon chitra*) are also reported occasionally from the adjacent locality. Presently, more than 40 bird species comprising of both local and migratory types are reported to visit these cluster of wetlands. Among these little grebe (*Tachybaptus ruficollis*), common coot (*Fulica atra*), darter (*Anhinga rufa*), Indian shag (*Phalacrocorax fuscicollis*), little cormorant (*P. niger*), teals (*Anas crecca*), little egret (*Egretta garzetta*), bronze-winged jacana (*Metopidius indicus*), white-breasted waterhen (*Amaurornis phoenicurus*) and white-throated kingfisher (*Halcyon smyrnensis*) are significant.

1.1 Key Management Strategies in addressing successful conservation initiatives and facing ongoing challenges of the EKW

- Management zoning identifying entire wetland area as core zone and direct basin as buffer zone
- Establishing hierarchical and multiscalar inventory of hydrological, ecological, socioeconomic and institutional features to support management planning and decision making
- Ensuring hydrological connectivity of EKW with freshwater and coastal processes at basin level
- Regulating industrial effluent discharge as per Central Pollution Control Board's standards
- Environmental flows as basis for water allocation for conservation and developmental activities
- Biodiversity conservation through habitat improvement of endangered and indigenous species
- Ecotourism development for enhancing awareness, income generation and livelihood diversification
- Poverty reduction through sustainable resource development and utilization
- Formation of multistakeholder groups for planning, implementation and monitoring of Management Action Plan
- Strengthening East Kolkata Wetland Management Authority with adequate legal and administrative powers
- Capacity building at all levels for technical and managerial skills
- Result oriented monitoring and evaluation activity, outcome and impact levels

2. The Sundarbans Wetlands

The Sundarbans (Bangladesh and India), Mekong river delta (Vietnam), and southern Ontario (Canada) are examples of major wetland complexes where the effects of climate change are evolving in different ways (Erwin *et al*, 2009). The Sundarbans a UNESCO World Heritage Site is located at the south eastern tip of the district of South 24 Parganas of West Bengal about 110 kilometers from Kolkata, the capital of the state of West Bengal. It is named after one of the mangrove plants known as Sundari (*Heritiera littoralis*) owing to the dominance of the tree species and the largest single block of tidal, halophytic mangrove forests in the world. The Sundarban wetlands are located on the world's largest delta, formed by the mighty rivers Ganga, Brahmaputra and Meghna (CSE, 2012). Mangroves are able to sequester approx 1.5 metric tonne of C/ha/year (Kathiresan *et al*, 2008; <http://mangroveactionproject.org>, 2017).

The Sundarbans spans a vast area covering 4264 sq. km in India alone. It is the largest tiger reserve and national park of its kind, home to one of the India's most iconic wildlife species-the Royal Bengal Tiger.

Apart from being a unique mangrove ecosystem, the Sundarbans is also the world's largest estuarine forest criss-crossed by hundreds of creeks and tributaries, interconnected by a network of tidal waterways, small islands of salt-tolerant mangrove forests and mudflats.

The wetlands of Sundarbans house a handful number of flora and fauna. Its marshy vegetation consists of Sundari (*Heritiera sp.*), Garjan (*Rhizophora sp.*), Kankra (*Bruguiera sp.*), Goran (*Ceriops sp.*), Baen (*Avicennia sp.*), Keora (*Sonneratia sp.*), Gengwa (*Exoecaria sp.*), Dhundul (*Carapa sp.*), Hental (*Phoenix sp.*), Golpata palm (*Nypa sp.*), Kripa (*Lumnitzera sp.*), Passur (*Xylocarpus sp.*), Habli (*Thespesia sp.*), Kulsi/Khalshi (*Aegiceras sp.*), the best honey maker and Jhau (*Tamarix sp.*). The ecosystem services provided by mangroves are often ignored in the ongoing process of mangrove conversion (Badola *et al*, 2005).

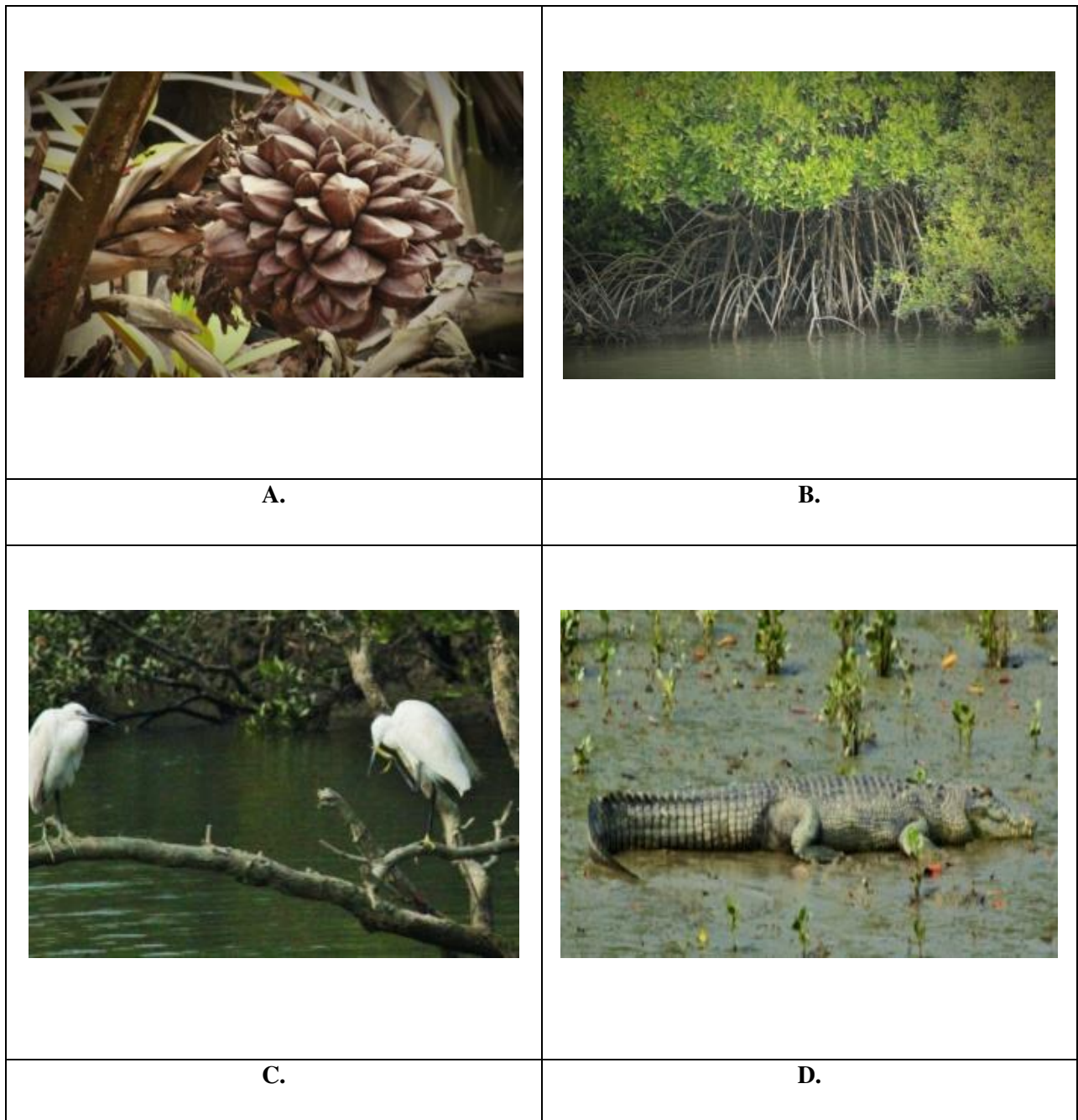


Figure: A few glimpses of the Sundarbans Wetlands (**A:** Fruit of Golpata palm; **B:** Stilt roots of Garjan; **C:** Little egrets; **D:** Estuarine/salt water crocodile) **Photo credits: The author**

Sundarbans, with its vast mangrove habitat and the massive water bodies provides excellent habitat to a number of animals starting from the zooplanktons to the larger mammals like tiger and spotted deer. Its faunal resources comprise the Bengal tiger (*Panthera tigris*, Endangered), fishing cat (*Felis viverrimus*), wild boar (*Sus scrofa*), spotted deer (*Axis axis*), only non-human primate i. e. the Rhesus

macaque monkey (*Macaca mulatta*), fulvous fruit bat (*Rousettus leschenaultii*), Asian small-clawed otter (*Aonyx cinereus*), aquatic mammals include Gangetic dolphin (*Platanista gangetica*), Indo-Pacific hump-backed dolphin (*Sousa chinensis*), Irrawaddy dolphin (*Orcaella brevirostris*), finless porpoise (*Neophocaena phocaenoides*). Noteworthy resident avian species are Asian openbill stork (*Anastomus oscitans*), white-collared kingfisher (*Halcyon chloris*), black-capped kingfisher (*H. pileata*), brown-winged kingfisher (*Pelargopsis amauroptera*), lesser pied kingfisher (*Ceryle rudis*), little cormorant (*Phalacrocorax niger*), great egret (*Ardea alba*), goliath heron (*A. goliath*), yellow bittern (*Ixobrychus sinensis*), lesser adjutant (*Leptoptilos javanicus*), gadwall (*Anas strepera*), Brahminy kite (*Haliastur indus*), lesser sand plover (*Charadrius mongolus*), whimbrel (*Numenius phaeopus*), terek sandpiper (*Xenus cinereus*), black-headed gull (*Larus ridibundus*), common tern (*Sterna hirundo*), Oriental scops owl (*Otus sunia*), Indian pitta (*Pitta brachyuran*), blue-winged pitta (*P. moluccaensis*), purple sunbird (*Nectarinia asiatica*), Asian green bee-eater (*Merops orientalis*), chestnut-headed bee-eater (*M. leschenaultia*), blue-tailed bee-eater (*M. philippinus*), lesser whistling duck (*Dendrocygna javanica*) and palm swift (*Cypsiurus parvus*). The Sundarbans is also a habitat of a large number of herpeto fauna including river terrapin (*Batagur baska*), olive Ridley turtle (*Lepidochelys olivacea*), estuarine/salt water crocodile (*Crocodylus porosus*), monitor lizard (*Varanus flavescens*), water monitor (*V. salvator*). The creeks of the Sundarbans are spawning site for some 90 ichthyo fauna including blue-spotted mudskipper (*Boleophthalmus boddarti*) and support a remarkable number of invertebrates like prawns (*Penaeus monodon*), mud crab (*Scylla serrata*), fiddler crab (*Uca spp.*), horse-shoe crabs (*Carcinoscorpius rotundicauda*), telescope snail (*Telescopium telescopium*), etc.

The region comprising 102 islands serves as a crucial protective barrier for the inhabitants in and around Kolkata against the floods that result from cyclones which are regular occurrence in south Bengal.

Conclusion

The Ramsar Sites offer specific recommendations in the tremendous potential for future research and demand immediate conservation actions for securing freshwater and marine aquatic biodiversity, improving moisture regimes, replenishing aquifers and developing eco-tourism sites has remained grossly under-tapped, and demands immediate attention. It is expected that adequate number of significant wetlands will be identified in each of the States including West Bengal and Union Territories and will act as catalytic factors in eliciting the required budgetary and non-budgetary support from State Governments and other stakeholders. Further, majority of research on wetland management in India relates to the limnological aspects and ecological/environmental economics of wetland management. But, the physical

(such as hydrological and land use changes in the catchment) and socio-economic processes leading to limnological changes have not been explored substantially (Garg *et al.*, 1998).

It may be proposed to implement a definite set of obligations on both the Central and State Governments in terms of allocation of financial resources, trained and well-equipped manpower, robust interface between researchers and managers, sound and systematic database, methodical monitoring, conduct of insightful economic valuation studies, and independent and impartial evaluation processes.

It is desirable to formulate a combination of promotional and regulatory measures backed by financial and administrative commitment will result in generation of optimal efforts in the direction of conservation of the freshwater and marine aquatic entities of various types which are collectively known as Wetlands.

So far, India has designated 75 wetlands sites as Ramsar Sites of International Importance. The total area covered under the 75 sites is around 1,083,322 hectares. To facilitate the process of designating new sites, the Ministry of Environment and Forests and WWF-India are making joint efforts to designate more and more sites from this country as Ramsar sites. WWF is helping the government in documentation of selected sites and also cartographic help to make the maps as per designated Ramsar sites. This will facilitate information on the designated sites for their conservation and management and can be used by any user agency interested in wetland conservation programme.

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Construction of a novel ceRNA network and identification of lncRNAs LINC-PINT regulator of miRNA and coding gene expression in glioblastoma cancer

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ABSTRACT

Temozolomide, an oral alkylating prodrug which delivers a methyl group to purine bases of DNA (O6-guanine; N7-guanine and N3-adenine), is frequently used together with radiotherapy as part of the first-line treatment of high-grade gliomas. The main advantages are its high oral bioavailability and small size that confer the ability to cross the blood-brain barrier. Temozolomide in glioblastoma results in a median patient survival of 14.6 months. Treatment failure has been associated with tumor drug resistance. Therefore, novel strategies to overcome chemo resistance are desperately needed for improved treatment of human GBM. Recent studies have demonstrated that long non-coding RNAs are closely related to resistance to cancer chemotherapy. Long non-coding RNA (lncRNA) are molecules with lengths of 200 or more nucleotides. Long non-coding RNAs (lncRNAs) are implicated as molecular mechanisms underlying human genomic activity in various physiologic and pathophysiologic conditions such as cancers.

Keywords: Temozolomide resistance in glioblastoma, ncRNA, lncRNA, miRNA, transcription factor, ceRNA-miRNA-transcription factor network

Introduction

Temozolomide, an oral alkylating prodrug which delivers a methyl group to purine bases of DNA (O6-guanine; N7-guanine and N3-adenine), is frequently used together with radiotherapy as part of the first-line treatment of high-grade gliomas [1, 2]. The main advantages are its high oral bioavailability (almost 100% although the concentration found in the cerebrospinal fluid was approximately 20% of the plasma concentration of temozolomide), its lipophilic properties, and small size that confer the ability to cross the blood-brain barrier [3]. Furthermore, this agent has demonstrated activity not only in brain tumors

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but also a variety of solid tumors. However, conventional therapy using surgery, radiation, and temozolomide in glioblastoma results in a median patient survival of 14.6 months. Treatment failure has been associated with tumor drug resistance. Temozolomide is an oral alkylating agent used to treat glioblastoma multiforme (GBM) [4] and astrocytomas. However, at least 50% of temozolomide treated patients do not respond to temozolomide [5, 6]. This is due primarily to the over-expression of O6-methylguanine methyl transferase (MGMT) and/or lack of a DNA repair pathway in GBM cells [7]. This phenomenon has been linked to the expression of O6-methylguanine-DNA methyl transferase [8], but the mismatch repair system and the presence of cancer stem-like cells in tumors have also been related to temozolomide resistance.

Temozolomide is a prodrug and it is metabolized into the active molecule, MTIC (5-(3-methyltriazene-1-yl) imidazole-4-carboxamide). Temozolomide is a nonspecific cell cycle alkylating agent. As with temozolomide, the expression of O6-methylguanine-DNA methyltransferase from MGMT reverses tumor DNA damage. MGMT promoter methylation is the key mechanism of MGMT gene silencing and predicts a favorable outcome in patients with glioblastoma who are exposed to alkylating agent chemotherapy [8]. An enhancer, located between the promoters of Ki67 and O6-methylguanine-DNA-methyltransferase (MGMT) genes, has been reported [9], is activated in temozolomide-resistant patient-derived xenograft (PDX) lines as well as in recurrent tumor samples. Activation of the enhancer correlates with increased MGMT expression, a major known mechanism for temozolomide resistance. The forced activation of the enhancer in cell lines with low MGMT expression results in elevated MGMT expression. Deletion of this enhancer in cell lines with high MGMT expression leads to reduced levels of MGMT and Ki67, increased temozolomide sensitivity and impaired proliferation [10].

While O6-methylguanine-DNA methyltransferase repair activity and uniquely resistant populations of glioma stem cells are the most well-known contributors to temozolomide resistance, many other molecular mechanisms have come to light in recent years. Key emerging mechanisms include the involvement of other DNA repair systems, aberrant signaling pathways, autophagy, epigenetic modifications, microRNAs, and extracellular vesicle production [11].

Chemotherapy is one of the fundamental methods of cancer treatment. However, drug resistance remains the main cause of clinical treatment failure. The newly identified roles of long noncoding RNAs (lncRNAs) in oncobiology that are associated with drug resistance have been reviewed [12]. The expression of lncRNAs is tissue-specific and often dysregulated in human cancers. Accumulating evidence suggests that lncRNAs are involved in chemoresistance of cancer cells in ovarian cancer [13], gastric cancer [14] and non-small cell lung cancer [15]. The main lncRNA-driven mechanisms of

chemoresistance include regulation of drug efflux, DNA damage repair, cell cycle, apoptosis, epithelial-mesenchymal transition (EMT), induction of signaling pathways, and angiogenesis. LncRNA-driven mechanisms of resistance to various antineoplastic agents have been studied extensively. There are unique mechanisms of resistance against different types of drugs, and each mechanism may have more than one contributing factor.

Recent studies have demonstrated that non-coding RNAs (ncRNAs), especially microRNAs and long non-coding RNAs, are involved in drug resistance of tumor cells in many ways, such as modulation of apoptosis, drug efflux and metabolism, epithelial-to-mesenchymal transition, DNA repair, and cell cycle progression [16]. Exploring the relationships between ncRNAs and drug resistance will contribute to understand the mechanisms of drug resistance [17]. Due to the high cost and low efficiency of biological experimentation, many researchers have opted to use computational methods to identify ncRNA biomarkers associated with drug resistance. In this study, the recent discoveries related to ncRNA-mediated drug resistance in glioblastoma is highlighted by computational methods.

Non-coding RNAs (ncRNAs) are key regulators of many cellular processes, such as cell proliferation, migration, apoptosis, angiogenesis, cell cycle progression and immune responses [18, 19]. Dysregulation of ncRNAs is crucial for several complex diseases [20], including human cancers [21, 22]. Additionally, ncRNAs, especially the most studied subsets, microRNAs (miRNAs) and long non-coding RNAs (lncRNAs), are involved in the drug resistance mechanisms of tumor cells [23, 24].

Noncoding RNAs (ncRNAs), such as long noncoding RNAs (lncRNAs) and microRNAs(miRNAs), function as key regulators of gene expression, their involvement in various human diseases is being gradually revealed, and the multilayered regulatory networks [25] formed by cross-linked ncRNAs and mRNAs seemly provide new insights into their regulatory mechanism with regards to both physiology and pathology. The competing endogenous RNAs (ceRNAs) have been suggested to be involved in essential biological processes and play crucial roles in the initiation and development of neoplasms [26, 27] and they potentially serve as diagnostic and prognosis markers or therapeutic targets. Cancer involves complex etiology factors, multiple stages, and intricate gene mutations. Long non-coding RNAs (lncRNAs) are implicated as molecular mechanisms underlying human genomic activity in various physiologic and pathophysiologic conditions such as cancers [21]. Abnormally expressed lncRNAs can regulate miRNAs by acting as competing endogenous RNA (ceRNA), indirectly inhibiting target genes and important signal pathways and affecting cancer cell growth, metastasis, metabolism, and apoptosis [28]. MicroRNAs(miRNAs) is a class of small non-coding RNAs with lengths of 20–22 nucleotides and contain highly conserved sequences. MiRNA can affect target gene expression at both transcriptional and

post-transcriptional levels and are involved in the occurrence and development of many tumours. ceRNA networks are important for the interaction between lncRNA and miRNA. ceRNAs compete with miRNA response elements (MREs) for the same miRNA, thereby regulating the expression of target gene transcripts. In the regulatory mechanism of cancers, the interactions between lncRNAs, miRNAs, and mRNAs are extremely complex and collectively form a complex regulatory network [29]. The lncRNAs that harbor a miRNA response element can compete with other RNA transcripts and thus theoretically function as ceRNAs. A single miRNA can regulate multiple target RNAs that contain the specific miRNA response element and these RNAs can be regulated by multiple miRNAs. This lays the foundation for the construction of a ceRNA network. Actually, emerging evidence has revealed that ceRNA networks play a crucial role in tumor development, including chemo-resistance [30, 31].

In this study, in the PubMed database with a list of keywords, such as ‘temozolomide resistance’, ‘drug resistance in glioblastoma cancer’, ‘ceRNA’, ‘microRNA’, ‘lncRNA’, ‘long non-coding RNA’, it has been searched to extract the knowledge about ncRNAs involved in temozolomide resistance glioblastoma cancer. The lncRNA for example, Long intragenic non-coding RNA p53-induced transcript (LINC-PINT) has been identified as important ncRNA related to temozolomide resistance glioblastoma cancer [32], [33]. Long intragenic non-coding RNA p53-induced transcript (LINC-PINT) is an lncRNA that functions as a tumor suppressor gene involved in various tumors and malignant activities. LINC-PINT is downregulated in adenocarcinoma [34], renal carcinoma, non-small cell lung cancer [35], glioblastoma [32], thyroid cancer, retinoblastoma, ovarian cancer, breast cancer, esophageal squamous cell carcinoma, osteosarcoma, gastric cancer [36], and pancreatic cancer. Furthermore, decreased LINC-PINT expression predicts poor prognosis and advanced clinical tumor stages [35].

Functional annotation of lncRNAs in diseases attracts great attention in understanding their etiology. Several web servers are available to researchers for systematic annotation of novel human lncRNAs such as AnnoLnc [37], Link2 function [38], ncFANv2.0 [39], LncRRISearch [40], lncRNAKB [41] and FGGA-lncetc [42].

Methods: For analyzing the role of long intragenic non-coding RNA p53-induced transcript (LINC-PINT) in temozolomide resistance glioblastoma cancer, several in-silico tools such as EVlncRNAs [43], RNAfold webserver [44], NcFANs v2.0 database [45] and LncRRISearch [46] are used.

A. Functional annotation of lncRNA LINC-PINT

EVlncRNAs (<https://www.sdklab-biophysics-dzu.net/EVlncRNAs3/#/>)[43] is a comprehensive, manually curated, high-quality and freely accessible resource of integrated sequence, structure, functional, and phenotypic information of experimentally validated long noncoding RNAs from all species. For analyzing the function of long intragenic non-coding RNA p53-induced transcript (LINC-PINT), this resource has been used.

B. Construction of ceRNA interaction network

Using NcFANs v2.0 database (<http://ncfans.gene.ac/>) [45], which is an updated and full-featured platform for the functional annotation of noncoding RNAs (ncRNAs), a ceRNA interaction network for the long intragenic non-coding RNA p53-induced transcript (LINC-PINT) has been constructed. By using an analytical tool, ncFANs-NET ceRNA interaction network is created.

C. Prediction of lncRNA-mRNA interaction

LncRRISearch [46], is a web server for comprehensive prediction of human and mouse lncRNA-lncRNA and lncRNA-mRNA interaction. This lncRNA-mRNA interaction has been identified from ceRNA interaction network considering LINC-PINT as hub ncRNA. The prediction is conducted using RIBlast, which is a fast and accurate RNA-RNA interaction prediction tool.

Results: From EVlncRNAs database [43], the information about lncRNA LINC-PINT shows that this ncRNA is present in Chromosome 7 and related with glioblastoma as shown in Table 1. Its expression pattern is down regulated. It is a peptide related CircRNA antisense RNA with length 87 amino acids. Circular RNAs (circRNAs) are a large class of transcripts in the mammalian genome. The optimal secondary structure of this lncRNA is generated from RNAfold webserver [44] with a minimum free energy of -132.00 kcal/mol is given in Figure 1.

Table 1: Information from EVlncRNAs database about LINC-PINT lncRNA

Name of lncRNA	Species	Related with diseases	Interacts with miRNA/ Transcription factor

LINC-PINT	Homo sapiens	heart failure / melanoma / chronic obstructive pulmonary disease / retinoblastoma / hepatocellular carcinoma / gastric cancer / hepatitis C / melanoma / hepatocellular carcinoma / rheumatoid arthritis / non-small cell lung cancer / gastric cancer / osteosarcoma / esophageal squamous cell carcinoma / hepatocellular carcinoma / asthma / colorectal cancer / ovarian cancer / osteosarcoma / lung cancer / hepatocellular carcinoma / thyroid cancer / colorectal cancer / pancreatic ductal adenocarcinoma / type 2 diabetes mellitus / Parkinson's disease / pemphigus foliaceus / non-small cell lung cancer / hepatocellular carcinoma / colorectal cancer / glioblastoma / gastric cancer / hepatocellular carcinoma / HCV related liver diseases	C/EBPβ / EZH2 / miR-155-5p / miR-208a-3p / miR-26a-5p / miR-29b-1 / miR-374a-5p / miR-425-5p / miR-524-5p / miR-543 / miR-654-3p / PAF1c / PTCSC3 / SOX9 / ATG5 / DDX24 / FOXM1 / IRF7 / miR-21 / miR-21 / miR-21 / miR-22-3p / miR-767-5p / SRPK2
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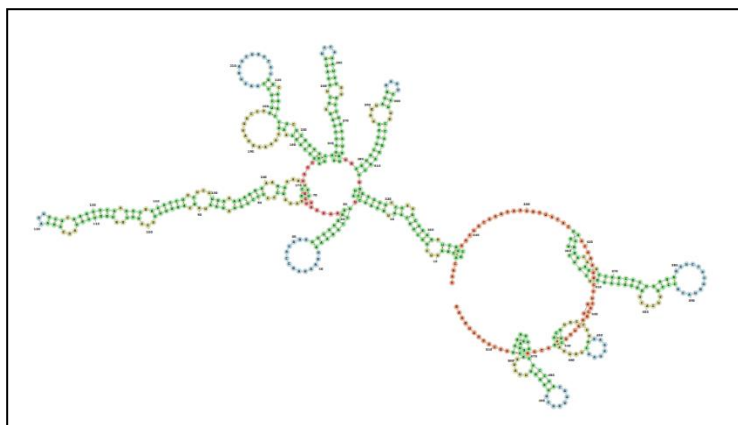


Figure 1: The optimal secondary structure of lncRNA LINC-PINT.

This peptide directly interacts with polymerase associated factor complex (PAF1c) and inhibits the transcriptional elongation of multiple oncogenes [33]. The expression of this peptide and its corresponding circ RNA are decreased in glioblastoma compared with the levels in normal tissues. The results establish the existence of peptidesen code dbycirc RNA sand demonstrates their potential

functions in glioblastomatumorigenesis. The relationships between lncRNA LINC-PINT in different diseases along with miRNAs are depicted in Figure 2.

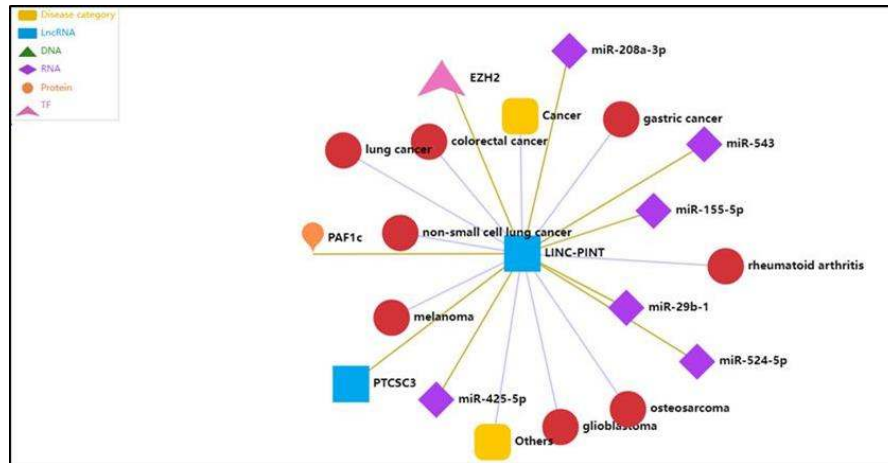


Figure 2: Regulatory network of lncRNA LINC-PINT for different diseases.

This network (Figure 2) shows that E2H2 is the only transcription factor linked with lncRNA LINC-PINT. E2H2 has been considered to be overexpressed in many cancer types and to be transcriptionally regulated by oncogenic signaling to promote cancer cell proliferation and disease progression.

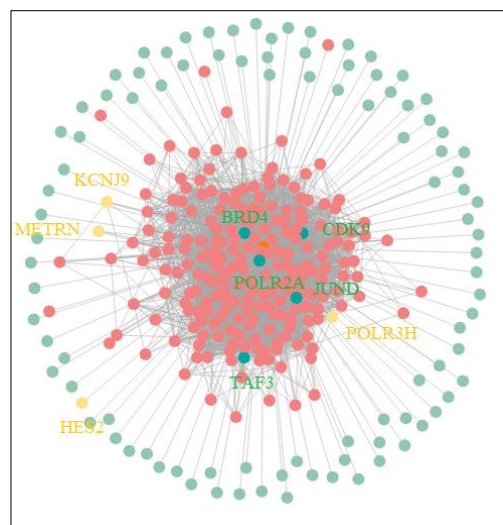


Figure 3: ceRNA-miRNA-transcription factor network for LINC-PINT.

For lncRNA LINC-PINT, four ceRNA (KCNJ9, HES2, METRN and POLR3H) and two hundred fifty-five related miRNAs are identified from NCFANs-NET database [45] as shown in Table 2. Using the same software for that lncRNA, five transcription factors namely CDK9, JUND, POLR2A, TAF3 and BRD4 are recognized and enlisted in Table 3. A ceRNA-miRNA-Transcription factor network for lncRNA LINC-PINT has been constructed and shown in Figure 3.

Table 2: List of interacting ceRNA, miRNA with lncRNA LINC-PINT

LncRNA_A_Name	ceRNA_Gene_ID	ceRNA_Transcript_ID	ceRNA_Name	LncRNA_miR_Num	ceRNA_miR_Num	Shared_miR_Num
LINC-PINT	ENSG00000162728	ENST00000368088	KCNJ9	255	795	130
LINC-PINT	ENSG00000069812	ENST00000377834	HES2	255	1003	151
LINC-PINT	ENSG00000103260	ENST00000568223	METRN	255	768	126
LINC-PINT	ENSG00000100413	ENST00000396504	POLR3H	255	978	157

Table 3: List of interacting transcription factors with lncRNA LINC-PINT

LncRNA_Name	TF_Name	Cell_line	Cell_type	Tissue	Data_Accession
LINC-PINT	BRD4	SUM159PT; MM1.S	Mammary carcinoma cell; B Lymphocyte;	Breast; Blood;	GSM2330580; GSM1070124;
LINC-PINT	TAF3	None	Epithelium;	Colon;	GSM1065008;
LINC-PINT	POLR2A	MM1.S	B Lymphocyte;	Blood;	GSM1038278;

glioblastoma, the interactions between lncRNA LINC-PINT, four ceRNA (KCNJ9, HES2, METRN and POLR3H) two hundred fifty-five miRNAs along with five transcription factors, collectively form a complex regulatory network. Among the five transcription factors, JUND is the only transcription factor, which is expressed in brain. This transcription factor is a proto-oncogene forming AP-1 transcription factor subunit. After forming heterodimer with FOS protein, it can enhance their DNA binding activity as transcriptional regulator. In brain, specifically its expression in white matter region controls various signal transduction pathways via MAPK10 protein. During the discussion on the mechanisms of temozolomide resistance in glioblastoma, Singh and coworkers [9] highlighted the role of dysregulation of specific molecular pathways. For example, MAPK (Mitogen-activated protein kinase) signaling pathway has been upregulated in 88% glioblastoma patients. Moreover, that in temozolomide resistance glioblastoma cell lines, the accumulation of reactive oxygen species (ROS) leads to activation of MAPK/ERK signalling pathway and stimulation of autophagy, which ultimately leads to chemi-resistance in cancer patients.

Inhibition of C-Jun N-terminal kinase (JNK) enhances temozolomide induced cytotoxicity in human glioma cells [48]. JNK being a component of MAPK pathway, is related with cell survival, oncogenesis, growth, differentiation and cell death. After phosphorylation in signalling pathway, it activates different transcriptional factors such as JUND. From the regulatory network the interaction of lncRNA LINC-PINT and transcription factor JUND has been highlighted.

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Traditional knowledge of medicinal plants used in Dental Hygiene in Relling and Pokhriabong area of Darjeeling District, West Bengal, India

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ABSTRACT

The North Bengal Hilly regions of India are rich in multicultural diversity and are home to various ethno-medicinal traditions. The purpose of this study is to document and analyze traditional knowledge on the practice and utilization of plants in treating Dental health. It is an attempt to conserve the disappearing wealth of knowledge. The key informants were identified in the pre-survey and collected information through open-ended interviews. Collected data on age, location, the experience of the key informants, practice, and disease treatment, method of diagnosis, storage, and use of plants were collected. The identification of the plants and their information were verified through repeated guided transects in different seasons with key informants and focussed group discussions. The study delves into the rich tapestry of traditional knowledge pertaining to medicinal plants and their applications in dental hygiene within the cultural contents of Relling and Pokhriabong. A total of forty plant species have been documented for maintaining dental hygiene related ailments belonging to 29 families in the present study. The findings reveal a profound interconnection between the community and the surrounding flora, showcasing a different understanding of plant-based remedies for oral care. Local healers and community members actively participate in the preservation and transmission of this traditional knowledge, contributing to the cultural fabric of these regions. Through ethno botanical investigations and interviews with local communities a comprehensive understanding of indigenous plant-based remedies. By documenting and analysing the diverse applications of medicinal plants the study aims to contribute to the preservation of cultural heritage.

Keywords: Traditional knowledge, Medicinal plants, Dental Hygiene, Relling and Pokhriabong, Darjeeling district.

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Introduction

Globally, around 2.4 billion people suffer from caries of the permanent teeth and 486 million children suffer from caries of the primary teeth [1]. Most people don't use pharmaceutical medicine. They still use herbs for dental care.

Traditional knowledge of medicinal plants for dental hygiene has been passed down through generations, offering natural remedies for oral care. Communities worldwide have relied on plants like neem, aloe vera for their antimicrobial properties, helping to combat issues such as gum diseases and bad breath. Traditional knowledge of medicinal plants used in dental hygiene is a rich and diverse field, encompassing the wisdom passed down through generations in various cultures. Different societies have long relied on the healing properties of plants to address oral health issues. For instance, neem in Ayurveda in traditional Chinese antimicrobial properties, aiding in gum health and combating oral infections. Moreover, indigenous communities worldwide have their unique set of plant-based remedies. Dental hygiene has been a concern for humanity since ancient times, leading various cultures to explore natural remedies sourced from medicinal plants to maintain oral health. The maintenance of oral hygiene is an essential component of a person's overall health. Good oral hygiene is all about keeping our teeth and gums clean so, we don't get sick or have bad breath.

Traditional knowledge of medicinal plants used in dental hygiene has been passed down through generations, encompassing a wealth of wisdom from various cultures. Plants have been historically valued for their antimicrobial properties aiding in oral health. These remedies often involve chewing, infusions, or topical applications to address issues such as gum diseases and toothaches. The use of these medicinal plants in dental care reflects a blend of cultural practices and natural remedies that have stood the test of time. Traditional knowledge of medicinal plants used in dental hygiene in Pokhriabong and Relling involves a rich heritage of local practices. Residents often rely on plants like neem for its antimicrobial properties. Additionally, the use of cloves and guava leaves is prevalent in addressing dental issues. These practices reflect a harmonious blend of nature and cultural wisdom in oral care.

Oral health is an essential part of a person's overall health. Oral disease can significantly affect the general well-being of a person by causing considerable pain and discomfort, thus affecting quality of life. The World Health Organization (WHO), 1978 has According to one study, 80% of people in developing countries use traditional medicines, mostly herbal drugs, as their primary health care. The Healing Power of Traditional Medicinal Products and medicinal plants have been found in most of the developing

countries [2]. In India 65 % of the population relies on ethno medicine which is the only source of their primary health care needs [3]. India is considered to be one of the 12 mega biodiversity countries in the world. It is rich in vegetation with a diverse range of medicinal plants. Over 550 tribal communities are covered under 227 ethnic groups residing in about 5000 villages of India in different forests and vegetation types [4]. Oral Sanitation plays a vital role in human health and is a defining characteristic of life. The relationship between oral infection and microbial activity by many different types of microorganisms as part of the dental cavity micro flora is well-known. There are over 750 different types of bacteria that live in the tooth cavity. 50% of these bacteria are not known and many of them play a role in oral infections [5]. India has an enormous ecological diversity ranging from sea level to the highest mountains. It represents 2.4% of the world's total geographical area with about 47,513 plant species. The total number of species of Angiosperms, Bryophytes, Pteridophytes, and Gymnosperms found in India are 18043, 2523, 1267 and 74 respectively. In India, about 280 medicinal plants belonging to 79 families are used by pharmaceutical industries to prepare different formulation [6].

Materials and methodology:

Study area

The District of Darjeeling, the queen of hills, covers an area of about 2436.55 km², lies between 26° 27'05" to 27° 13'10" N latitudes and between 87° 59'30" to 88° 53'22" E longitudes [7]. The district is bordered by Sikkim in the north, Terai and Dooars in the south, Bhutan in the east and Nepal in the west. The altitudinal variation ranges from 150 m (at Sukna) to 3636m (at Sandakphu) presenting diverse topographical conditions [8-10]. The regions are significantly rich in floral and faunal diversity. The study was conducted specially in Relling and Pokhriabong village of Darjeeling district West Bengal. Total population which comprises of several communities, tribes and castes such as Lepcha, Rai, Tamang, Bhutia, Limboo, Sherpa, Gurung, Thami etc. More than half of the population is residing in rural areas, which has an easy access to traditional herbal medicine than the modern medicine facilities.

Selection of key informants

The traditional practitioners recommended by WHO [11] were considered the 'Key Informants'. As the present work is confined to dental hygiene, the traditional practitioners offering treatment for dental hygiene and related complications, who are ready to share their practicing knowledge, have been considered as 'Key Informants'.

Ethno medicinal survey

The contact of key informants in the area has been collected from various sources like local non-governmental organizations, village chiefs, crude drug vendors, school and primary health centre staff, and patients attending to traditional practices. Once the rapport with key informants has been built up, the aim and objectives of the study has been explained to them in local languages to obtain their consent. The collection of information was through semi-structured, open-ended interviews as suggested by Martin [12]. The details on age, place of practice, collecting information on practices, diseases they treat and how they diagnose, store and use plants during interviews. The identification and confirmation of the medicinal plant species used by key informants were made through specimen display method [13]. The identity was confirmed by multiple guided transact walks with the informants at different times of the year and by focus group discussions [14].

Plant identification and herbaria

Information about the local healers was gathered, and the personal interviews were conducted by taking their prior permission to share their traditional knowledge. The questionnaire was designed that included information on name, age and profession of medicine knowledge, local name of medicinal plants, parts used, dose composition, methods of preparation of dose, time taken to cure. All the data were recorded in the field note book and properly photographed for further use and for efficacy rate each patient of different areas were also interviewed with prior permission of respective healers and the patients. With few exceptions, most of the healers and patients gave their consent to share their ethnic knowledge regarding the dental hygiene treatment and also allowed us to record the data. Different formulations from different herbalists have been collected and useful plants that were spotted by the medicine men were photographed, distinguished characters were observed, carefully tagged, uses were noted in field note book and collected specimens were processed following conventional herbarium techniques [15]. The specimens were identified by referring local floras [16-18]. Identifications of processed specimens were done step one ,after another, in the Taxonomy of Angiosperms and Ecology Laboratory of the PG Department of Botany, Darjeeling Government College under North Bengal University. Identification will be also confirmed by matching specimens with the pre identified and authenticated specimens available in Lloyd Botanical Garden Herbarium, Darjeeling, West Bengal and at PG Department of Botany Darjeeling Government College Herbarium.

Findings:

Knowledge of informants

In this study, 23 out of 51 identified traditional practitioners were considered vital informants who provided treatment for dental hygiene. The low number of women in traditional medicinal practice from different regions was observed in previous studies [19-20]. The same is true in this study, as only 3 out of 23 key informants were female. The average age of the informants ranged from 40 years to 83 years. Passing knowledge down from one generation to the next was verbal, possibly in the same family or same community or to an interested outsider as a global phenomenon.

Quantitative study of the plants used

In all, 40 plant species belonging to 29 families have been documented in the present study (Tables 2). Highest number of species representation was found in families Asteraceae, Rutaceae, Zingiberaceae with four and Moraceae, Lamiaceae, Rosaceae, Solanaceae with three species of each. This deviation from the existing general trend of medicinal plants, where Asteraceae leads with more medicinal species [21-23] may be due to the easy availability of perennial trees and shrubs rather than annual, seasonal Asteraceae members for the usage. Forty genera were represented in the study, where *Ficus* were represented by two species. The habit of the species showed that 40% of the herbal drugs were obtained from herbs, followed by trees (42.5%), shrubs (15%) and climbers (2.5%). Most of the plants used were sourced from the natural environment indicating the species diversity and abundance in the study area. This also indicates the need for conservation measures, especially for those plants with high use value. The roots (22.5%) were the most commonly used plant part to prepare the medicine, followed by the leaf (20%), latex (12.5%), bark, stem, fruit, seed, and whole plants, with (7.5%) of each, rhizome (5%), and bulb (2.5%). However, in few preparations it was observed that more than one part of the plant was used for medicinal preparation.

A total of 23 traditional healers and local villager from two villages (Relling & Pokhriabong) of Darjeeling district participated in the present study. The majority were aged 40 to 83. From which 17 are males and 6 are females. More than half had secondary education, one fourth had primary education and rest of the participants had informal education. All of the participants resided in village areas. The socio-demographic characters of the participants were described in table 1.

Table 1: Socio-demographic characters of local healers:

AGES(YEARS)			
Characteristic	Male	Female	Total
40-50	5	2	7
50-60	6	1	7
60-70	3	3	6
70-80	2	0	2
80-90	1	0	1

A total of 40 plants are identified under 29 families. Certain species are used for management of gum bleeding, toothache, Bad breath. Stem, young twigs, leaves Bark, Fruit, Seeds and latex are parts of trees being exploited for oral health care. Plants "based traditional knowledge" has come to be seen as a source of value in our search, new drug sources. Over the past few decades, there's been a growing interest in researching medicinal plants and their historical uses around the world. The results were summarized in table-2 along with their scientific name, Local name, Family, Habit, Part used, Disease Treated and Mode of utilization.

Table 2: List of the plants used in dental care:

Sl. No	Useful medicinal plant (Botanical name)	Family	Habit	Local name	Useful plant parts	Mode of utilization
1.	<i>Acorus calamus</i> L.	Acoraceae	Herb	Bojo	Root (Tuber)	Tuber is boiled in water and boiled water is used for gargle twice a day for 7-10 days during toothache and bleeding gum.

2.	<i>Acmella paniculata</i> (Wall. ex DC.) R. K. Jansen	Asteraceae	Herb	Parparejhar	Flower, whole plant	Flowers are crush and keep it in teeth during toothache.
3.	<i>Aegle marmelos</i> (L.) Correa	Rutaceae	Tree	Bhel	Leaves, Fruit	Leaves and Fruit are boiled and used for gargling during toothache.
4.	<i>Azadirachta indica</i> A.Juss.	Meliaceae	Tree	Neem	Stem	Young stem is chewed and use as brush for toothache.
5.	<i>Achyranthes aspera</i> L.	Amaranthaceae	Herb	Apamarga	Stem, Roots	Roots and young stem is chewed and used as brush during toothache and pyorrhea.
6.	<i>Allium sativum</i> L.	Amaryllidaceae	Herb	Lasun (Garlic)	Bulb	Bulb is burn in low degree and little amount of salt is added and used during toothache.
7.	<i>Aloe vera</i> (L.) Burm. f.	Asphodelaceae	Herb	Aloevera	Leaves	Jel applied directly on affected tooth, rubbing.
8.	<i>Bergenia ciliata</i> (Haw.)Sternb.	Saxifragaceae	Herb	Pakhanbed	Whole plants	Stem and root are chewed or grind kept in teeth during toothache. Leaves is dried to make paste and paste is used in toothache.

9.	<i>Bombax ceiba</i> L.	Malvaceae	Tree	Simal (cotton tree)	Roots	Roots are crush and it is boiled in water adding little amount of alum is used for gargle twice a day for 8-9 days during bleeding gum and teeth break.
10.	<i>Citrus limon</i> (L.) Osbeck	Rutaceae	Tree	Nimbu	Root	Gargling with leaves and roots are useful in gingivitis and toothache.
11.	<i>Curcuma longa</i> L.	Zingiberaceae	Herb	Haldi	Rhizome	Haldi powder is mixed with salt and used as toothpaste and brush with finger instead of toothbrush during yellowness of teeth.
12.	<i>Calotropis gigantea</i> (L.) W.T.Aiton	Apocynaceae	Tree	Aak	Roots	Roots are crushed and put it on cotton need to apply during tooth ache.
13.	<i>Camellia sinensis</i> (L.) Kuntze	Theaceae	Shrub	Tea	Leaves	Dried leaves are boiled in water and boiled water is used for gargle twice a day for week helps in toothache.
14.	<i>Carica papaya</i> L.	Caricaceae	Tree	Maywa	Latex	Latex is used to cure tooth ache and mouth ulcer.
15.	<i>Datura metel</i> L.	Solanaceae	Shrub	KaloDaturu	Seed	Dried seed are burn and seed are burn and smoke is applied on toothache.
16.	<i>Euphorbia royleana</i> Boiss.	Euphorbiaceae	Shrub	Siyuri	Latex	Latex is put on cotton and those cotton are applied directly in toothache and kept it for 2-3 minutes.

17.	<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae	Herb	Elachi	Seed	Seed are chewed for 2-3 minutes and swallow during bad breath.
18.	<i>Engelhardia spicata</i> Lechen ex Blume	Juglandaceae	Tree	Mahuwa (Male)	Bark	Paste is made from dried bark. Juice is made from raw bark and used in bleeding gum and bad breath.
19.	<i>Ficus benghalensis</i> L.	Moraceae	Tree	Barh	Latex from petiole	Latex from petiole is directly used during toothache.
20.	<i>Ficus religiosa</i> L.	Moraceae	Tree	Pipal	Stem	Stem used as toothbrush during toothache.
21.	<i>Mangifera indica</i> L.	Anacardiaceae	Tree	Aam	Bark, Leaves	Gargling with decoction of bark or leaves.
22.	<i>Mentha spicata</i> L.	Lamiaceae	Herb	Pudina	Leaves	Leaves and stem are chewed for a minute and swallow in bad breath.
23.	<i>Berberis napaulensis</i> (DC.) Spreng.	Berberidaceae	shrub	Keshari	Bark	Bark is boiled and boiled water is used in gargle for 1-2 minutes for 5-6 days during toothache.
24.	<i>Mimosa pudica</i> L.	Fabaceae	Herb	Buhari jhar	Roots	Decoction of roots with water is gargled in reduce toothache.
25.	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Rubiaceae	Tree	Kadam	Latex, Stem	Young stem is used as brush in bleeding gum. Latex is used in teeth during toothache.

26.	<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Herb	Tulsi	Leaves	Leaves are chewed to induce saliva secretion, keeps mouth fresh and in toothache.
27.	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Tree	Amala	Fruit, Bark	Fruits is used as mouth freshener and for tooth decay. Bark is used in toothache.
28.	<i>Prunus persica</i> (L.) Batsch	Rosaceae	Tree	Aaru	Young leaves	Young leaves are crush and juice is applied during toothache.
29.	<i>Psidium guajava</i> L.	Myrtaceae	Tree	Ambak	Young leaves, Bark	Young leaves are boiled and used as a gargle in toothache. Bark and young leaves are chewed for 2-3 minutes during toothache.
30.	<i>Piper betle</i> L.	Piperaceae	Climber	Pan	Roots	Roots are crush and kept it in teeth during toothache.
31.	<i>Plantago major</i> L.	Plantaginaceae	Herb	Nasayjhar	Whole plant	Plant is crush and used it during toothache.
32.	<i>Rubus ellipticus</i> Sm.	Rosaceae	Shrub	Aiselu	Roots	Powder of root applied during pyorrhoea, tooth decay
33.	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Herb	Halhalay	Leaves	Gargle during teeth bleeding.
34.	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Myrtaceae	Tree	Lwang	Fruit	Fruit is directly kept in teeth during toothache.

35.	<i>Solanum anguivi</i> Lam.	Solanaceae	Shrub	Bokshikara	Seed	Seed is burn and smoke of burning seed is used during toothache.
36.	<i>Sonchus wightianus</i> DC.	Asteraceae	Herb	Mulayjhar	Latex	Latex is used during toothache.
37.	<i>Terminalia chebula</i> Retz.	Combretaceae	Tree	Harra	Fruit	Fruit is chewed and use as a chewing gum during Bad breath
38.	<i>Tagetes apetala</i> Posada-Ar.	Asteraceae	Herb	Saipatri (Marigold)	Young leaves	Young leaves are chewed and kept in teeth during toothache.
39.	<i>Zanthoxylum acanthopodium</i> DC.	Rutaceae	Tree	BokayTimbur	Root, Bark	Root and Bark are mixed together crush and apply on toothache.
40.	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Herb	Aaduwa	Rhizome	Rhizome is chewed during bad breath.

A total 29 families were identified where 16 are herbs, 6 are shrubs and 17 are trees and 1 climber. The percentage of plants habits are given in (Figure 1). In terms of utilization of ethno-medicinal plants, the young leaves used in maximum number of cases with the total of 8 plants. The roots and rhizome are used in 7 and 2 plants, bark are used in 5, stem are used in 4 species, latex is used in 4 plant species, fruit , seed and whole plants are used in 3 species each and 1 bulb is used (Figure 2). It has been recorded that the methods of utilization of plant parts and also methods of administration are different among various local communities.

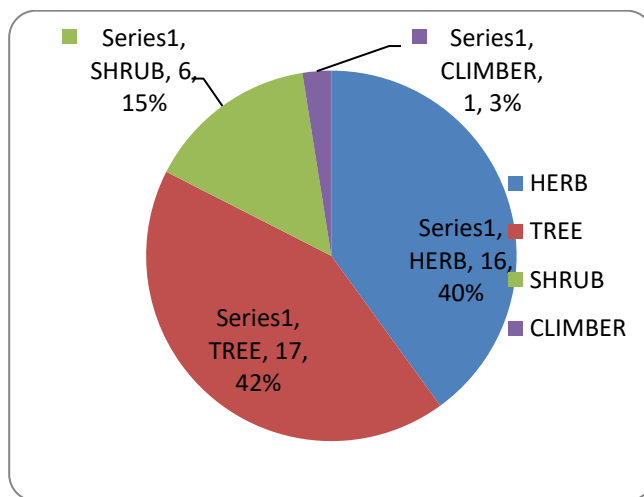


Fig 1: Habit of the plat

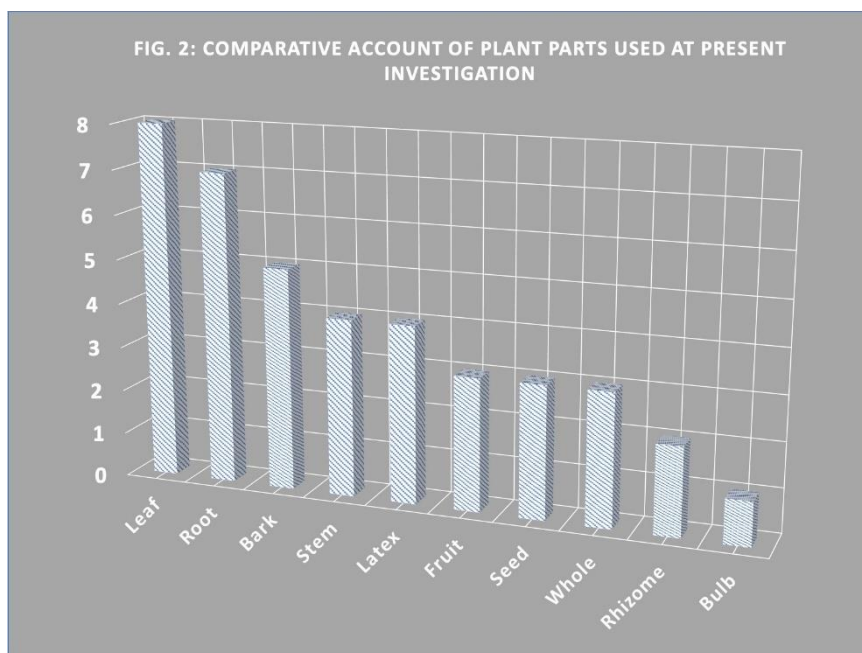


Fig 2: Plant parts used for Denta hygiene purposes



Fig 3 : Some Medicinal plants of Relling and Pokhriabong which used in various dental hygiene. A - *Euphorbia royleana* Boiss. B - *Acemella paniculata* (Wall. ex DC.) R. K. Jansen C- *Acorus calamus* L. D- *Berberis napaulensis* (DC.) Spreng. E-*Achyranthes aspera* L. F- *Solanum anguivi* Lam. G- *Bergenia ciliata* (Haw.) Sternb. and H- *Tagetes apetala* Posada-Ar.

Discussions:

The present survey revealed information on plants used in dental hygiene. This survey includes 40 plants belonging to 29 families. Among the families 3 species belongs to Asteraceae, Rutaceae and Zingiberaceae, 2 species belongs to Solanaceae, Moraceae, Lamiaceae, Rosaceae and Myrtaceae. Among various plants 16 are herbs, 17 are trees, 6 are shrubs and 1 climber. Most of the plants are used in toothache and others are used in bleeding gum, Bad breath, Tooth break and yellowness of teeth. Mostly young leaves are used for the dental care by the local peoples of Relling and Pokhriabong district of Darjeeling. Out of 40 plants species *Magnifera indica*, *Psidium guajava*, *Azadirachta indica* are reported bay various communities in india and all over the world[24-26]. *Acemella paniculate*, , *Achyranthes aspera*, *Allium sativum*, *Aloe barbadenis*, *Bergenia ciliate*, *Euphorbia royleana*, *Syzygium aromaticum*, *Solanum xanthocarpum*, *Sonchus wightianus*, *Tagetes apetala*, *Zanthoxylum acanthopodium*, *Berberis napaulensis* are mostly used by the peoples of Relling and Pokhriabong area during toothache.

Conclusion:

A survey was conducted in Relling and Pokhriabong district of Darjeeling West Bengal for identification of plants used for dental care by local peoples residing in the village. It is found that a medicinal plant used in dental hygiene in studied areas reflects a rich heritage of community-based healthcare practices. The integration of local plant resources for oral care highlights the significance of indigenous wisdom in maintaining dental health. Further research and documentation in higher level of these practices could contribute to a broader understanding of sustainable healthcare solutions and the preservation of traditional knowledge in survey areas.

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Assessment of acute toxic effects of copper sulphate on *Catla catla* fry: mortality rates, behavioral changes and opercular movement dynamics

Harinanka Chakraborty and Chandan Sarkar*

ABSTRACT

This study aimed to assess the acute toxic effects of copper sulphate on *Catla catla* fry, while monitoring changes in their behavior. The 24, 48, 72, and 96 hour LC₅₀ values of copper sulphate for *Catla catla* were determined to be 0.229, 0.162, 0.108, and 0.059 mg/l, respectively. Mortality rates of *Catla catla* exhibited significant variation ($p < 0.05$) with increasing concentrations, regardless of exposure duration. Similarly, mortality rates varied significantly ($p < 0.05$) across all exposure times (24, 48, 72, and 96 hours) at all tested doses. Observed behavioral alterations in treated *Catla catla* included excess mucous secretion, erratic movement, and air gulping, culminating in sudden death syndrome characterized by opercular flaring, convulsions, loss of equilibrium, and mortality, correlated with escalating toxicant concentrations and exposure duration. Opercular movement increased significantly ($p < 0.05$) at lower doses but decreased significantly ($p < 0.05$) at higher doses across all exposure durations. Notably, at specific concentrations, opercular movements significantly increased ($p < 0.05$) at 48 and 72 hours, yet significantly decreased at 96 hours of exposure.

Keywords: ANOVA, Bioassay, Dose, Exposure, LC₅₀

Introduction

Copper, an essential trace element found naturally in plant and animal tissues, is subject to regulation by a complex interplay of physicochemical and biological factors. Its introduction into aquatic ecosystems primarily stems from agricultural practices, alongside its utilization in a multitude of industrial sectors including textiles, tanneries, paints, batteries, laundry, photography, as well as its use in copper wire and piping for water distribution systems [1]. Elevated environmental concentrations of copper ions pose significant toxicity risks to fish across various functional levels [2]. Copper sulphate is primarily utilized for controlling cyanobacteria (blue-green algae) in pond water and is effective in managing infections

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caused by certain parasites, fungi, and external bacteria such as *Flavobacterium columnare*. Additionally, it is employed for the control of macrophytes and aquatic molluscs [3].

Fish species hold significant economic importance and are widely consumed. They serve as vital bioindicators for assessing environmental contamination, offering a comprehensive understanding of environmental conditions over extended periods, particularly with respect to metals due to their prolonged biological half-lives. Acute toxicity assessments are commonly employed to establish the concentration of a toxicant eliciting specific adverse effects within a defined timeframe. Given the ease of detection and critical nature of mortality, acute lethality tests are prevalent. The concentration causing adverse effects in 50% of the test organisms over a 96 hour period serves as a reliable and easily determined measure of toxicity. Toxicologists emphasize the importance of experimental toxicity testing, particularly concerning industrial waste, and other pollutants to anticipate potential harm to aquatic fauna in water bodies.

Some fish species are extremely sensitive to Cu and mortality is observed at extremely low concentrations, whereas other fish species are highly tolerant. Factor that may affect survival of fish exposed to Cu includes acclimation period, i.e., exposing fish to increasing concentrations of ionic copper over the course of several days until the target concentration is obtained [4]. Several studies have demonstrated that the acute toxicity of copper sulphate (CuSO_4) decreases with increased exposure time [5]. For example, the 96h LD_{50} of CuSO_4 for *Oreochromis niloticus* is 12.85 mg/l [6], and sublethal exposure to 2.0 mg/l for 10 days caused a mortality rate of only 5% [7]. However, not all species adhere to the decrease in acute toxicity concentrations of CuSO_4 with increased exposure. Hoseini and Nodeh (2012) reported the 24 and 48 h LC_{50} were both 0.42 mg/l for *Rutilus rutilus caspicus* fry [8].

Water chemical characteristics also influence the toxicity of CuSO_4 in exposed fish. Toxicity of CuSO_4 tends to increase with a smaller fish age when comparing larvae, fry, fingerlings, and juveniles of *O. niloticus* [9]. The concentration of copper ions decreases as the alkalinity of water increases and as a consequence, therapeutic concentrations of CuSO_4 used in high alkalinity water become lethal to the fish when the same treatment is carried out in low alkalinity water [10]. For *Oreochromis aureus*, the 96h LD_{50} of CuSO_4 was 43.06, 6.61, 0.69 and 0.18 mg/l in waters with total alkalinity of 225, 112, 57 and 16 mg/l CaCO_3 , respectively [11]. Concentration of copper ions in aquaculture ponds increases immediately following CuSO_4 treatment, then rapidly decreases. Hence, no contamination of effluents in culture ponds occurs with applications of CuSO_4 due to the instability of copper ions in the water column.

However, the selected fish for the study, *Catla catla* is a prime cultured species in West Bengal which occupy a prominent position in the aquatic system. Hence the toxicity evaluation of copper to this fish is chosen for the study.

Materials and methods:

The fry of *Catla catla*, a member of the Order: Cypriniformes and family Cyprinidae, with mean length 5.5 ± 1.0 cm and mean weight 4.5 ± 1.0 gm, served as the test subjects in this bioassay. Specimens were procured from the Rajendrapur fish market, Naihati, North 24 Parganas, WB and acclimated to the laboratory conditions over a 72 hour period prior to experimentation. Commercial or institutional-grade $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ was utilized as the test chemical. The acute toxicity assessment employed the static replacement bioassay method, conducted in 15 litre glass aquariums, each containing 10 litre of water, to ascertain the effects of the test chemical. Unchlorinated tap water, characterized by a temperature of 26°C , pH 7.3, free CO_2 12.0 mg/l, dissolved oxygen (DO) levels of 5.28 ± 0.39 mg/l, alkalinity of 168 ± 11.21 mg/l as CaCO_3 , and hardness of 117 mg/l as CaCO_3 , served as the diluent medium throughout the experiment [12]. Fish were subjected to a 24-hour fasting period before and during the bioassay. Each test was conducted with four replicates, each consisting of ten test organisms. Preliminary rough range-finding tests were performed to determine the dose range at which fish mortality occurred. Subsequently, the selected test concentrations were employed to determine the LC_{50} values of copper sulphate to *Catla catla* at 24, 48, 72, and 96 hours of exposure. Dead fish were promptly removed from the test water at 24-hour intervals to prevent bacterial decomposition and subsequent depletion of dissolved oxygen. Additionally, 10% of the test medium was replaced with non-chlorinated stock water every 24 hours of exposure, with the requisite quantity of test chemical added immediately to maintain a fixed concentration. Mean opercular movements of the fish (expressed as number of movements per minute per fish) were recorded at 24-hour intervals during the experiment to assess the effects of copper sulphate on respiratory rates. Behavioral changes, including excess mucous secretion, erratic movement, and gulping of air followed by sudden death syndrome (characterized by opercular flaring, convulsions, loss of equilibrium, and mortality), were meticulously documented. Mean mortality of *Catla catla* at 24, 48, 72, and 96 hours was utilized to calculate LC_{50} values (95% confidence limits) using statistical software, Probit program version 1.5 [13]. Analysis of variance (ANOVA) was applied to the results pertaining to mortality percentage and opercular movements, with two-way ANOVA conducted for comprehensive assessment. ANOVA calculations were performed using the website www.staskingdom.com.

Results:

The acute toxicity of copper sulphate to *Catla catla* was assessed, and the corresponding LC_{50} values are presented in Table 1. The LC_{50} values at 24, 48, 72, and 96 hours were found to be 0.229, 0.162, 0.108, and 0.059 mg/l, respectively. Analysis revealed a significant increase in mortality rates of *Catla catla* with rising concentrations of copper sulphate, regardless of exposure duration ($p < 0.05$). Similarly, significant variations in mortality rates were observed across all exposure times (24, 48, 72, and 96 hours) at every

tested dose (Table 2, Fig. 1). Treated *Catla catla* exhibited various irregular behaviors, including excess mucous secretion, erratic movement, and air gulping, culminating in sudden death syndrome characterized by opercular flaring, convulsions, loss of equilibrium, and mortality, in correlation with escalating concentrations of the toxicant and duration of exposure (Table 3). Opercular movement demonstrated a significant increase ($p < 0.05$) at lower doses but decreased significantly ($p < 0.05$) at higher doses across all exposure durations (Table 4, Fig. 2). Interestingly, at a specific concentration, opercular movements significantly increased ($p < 0.05$) at 48 and 72 hours; however, a significant decrease was observed at 96 hours of exposure.

Table 1: LC₅₀ values (with 95% confidence limits) of copper sulphate to the *Catla catla* at different times of exposure (24, 48, 72 and 96 h)

Test organism	Concentration (mg/l)			
	24h	48h	72h	96h
<i>Catla catla</i>	0.229 (0.147-0.357)	0.162 (0.102-0.255)	0.108 (0.068-0.168)	0.059 (0.039-0.089)

Table 2: Mean values (\pm SD) of % mortality of *Catla catla* exposed to different concentrations of copper sulphate at different times of exposure (24, 48, 72 and 96 h). Mean values within columns indicated by different superscript letters (a-h) and mean values within rows indicated by different superscript letters (m-p) are significantly different (DMRT at 5% level)

Dose (mg/l)	% mortality of fish (<i>Catla catla</i>) at different times of exposure (h)			
	24h	48h	72h	96h
00	00 ^{am} \pm 0.00	00 ^{am} \pm 0.00	00 ^{am} \pm 0.00	00 ^{am} \pm 0.00
0.02	00 ^{am} \pm 0.00	00 ^{am} \pm 0.00	10 ^{an} \pm 0.43	20 ^{ao} \pm 0.43
0.03	00 ^{am} \pm 0.00	00 ^{am} \pm 0.00	20 ^{abn} \pm 0.43	40 ^{bo} \pm 0.50
0.05	00 ^{am} \pm 0.00	10 ^{am} \pm 0.50	30 ^{bn} \pm 0.83	50 ^{bco} \pm 0.71
0.1	00 ^{am} \pm 0.00	20 ^{bn} \pm 0.71	50 ^{co} \pm 0.83	60 ^{cdo} \pm 1.12
0.2	10 ^{bm} \pm 0.00	30 ^{cn} \pm 0.50	50 ^{co} \pm 1.12	70 ^{dep} \pm 0.83
0.5	20 ^{cm} \pm 0.00	40 ^{dn} \pm 0.50	60 ^{cdo} \pm 0.83	70 ^{deo} \pm 0.43
1.0	30 ^{dm} \pm 0.00	50 ^{en} \pm 0.50	70 ^{deo} \pm 0.71	80 ^{efo} \pm 0.71
1.5	50 ^{em} \pm 0.83	70 ^{fn} \pm 0.71	80 ^{efno} \pm 0.71	90 ^{fgo} \pm 1.12
2.0	50 ^{em} \pm 0.43	70 ^{fn} \pm 0.83	90 ^{fgo} \pm 0.43	90 ^{fgo} \pm 0.43
2.5	70 ^{fm} \pm 0.43	80 ^{gn} \pm 0.71	100 ^{go} \pm 0.43	100 ^{go} \pm 0.00
3.0	80 ^{gm} \pm 0.43	90 ^{hn} \pm 0.43	100 ^{go} \pm 0.00	100 ^{go} \pm 0.00
3.5	100 ^{hm} \pm 0.00	100 ^{hm} \pm 0.00	100 ^{gm} \pm 0.00	100 ^{gm} \pm 0.00

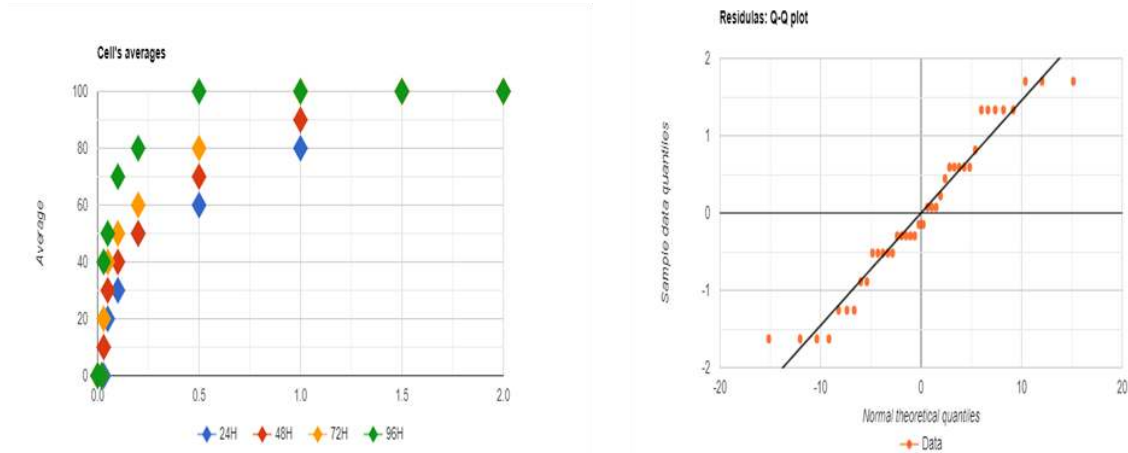


Fig. 1: Two way ANOVA was applied among the results and the p value came 0.00006 ($p < 0.05$). It means the chance of type 1 error is small and the result is significant.

Table 3: Behavioural responses of *Catla catla* (MS=Mucous Secretion, SDS=Sudden Death Syndrome, EM=Erratic Movement), -: absent, +: mild, ++: moderate, +++: high) exposed to different concentrations of copper sulphate at different times of exposure

Dose (mg/l)	Behavioural responses of fish (<i>Catla catla</i>) at different times of exposure											
	24h			48h			72h			96h		
	MS	SDS	EM	MS	SDS	EM	MS	SDS	EM	MS	SDS	EM
00	-	-	-	-	-	-	-	-	-	-	-	-
0.02	-	-	-	-	-	-	-	-	-	-	-	+
0.03	-	-	-	-	-	+	-	-	+	-	-	+
0.05	-	-	+	+	-	+	+	-	+	+	-	++
0.1	-	-	+	+	-	+	+	-	+	++	-	++
0.2	-	-	+	+	-	++	+	-	++	++	-	++
0.5	+	-	+	+	-	++	++	-	++	++	+	++
1.0	+	-	++	++	-	+++	++	-	++	++	-	++
1.5	+	+	+++	++	-	+++	++	-	+++	++	-	++
2.0	+	++	+++	++	-	+++	++	-	+++	++	-	++
2.5	+	+++	+++	++	-	+++	++	-	+++	++	-	++

Table 4: Mean values of opercular movement/minute of *Catla catla* exposed to different concentrations of copper sulphate at different times of exposure (24, 48, 72 and 96 h).

Dose (mg/l)	Opercular movement/minute of fish (<i>Catla catla</i>) at different time of exposure			
	24h	48h	72h	96h
00	118	115	113	116

0.02	121	144	146	142
0.03	121	130	148	140
0.05	105	120	150	139
0.1	95	114	119	115
0.2	93	126	117	101
0.5	89	128	117	99
1.0	81	120	131	92
1.5	73	113	95	90
2.0	74	90	83	76

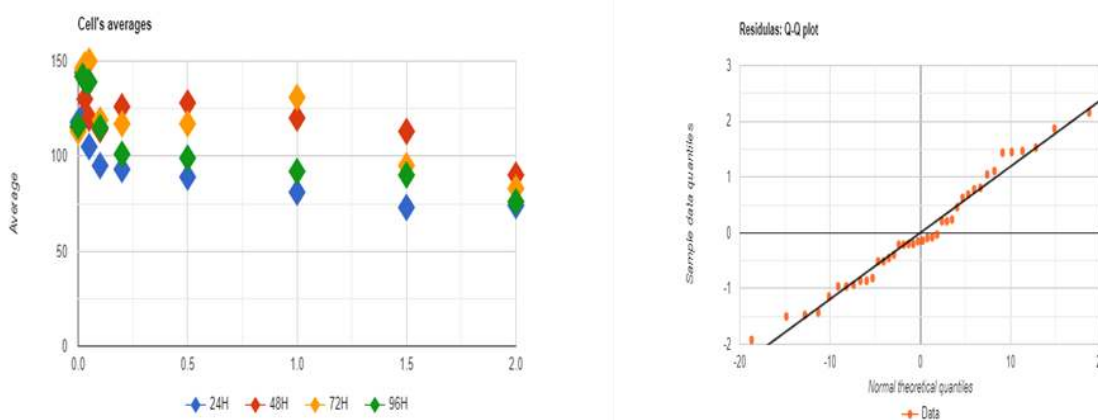


Fig. 2: Two way ANOVA was applied among the results and the p value came 0.00006 ($p < 0.05$). It means the chance of type 1 error is small and the result is significant.

Discussion:

The aberrant behaviors, such as excess mucous secretion, erratic movement, and gulping of air followed by sudden death syndrome (characterized by flaring of operculae, convulsions, loss of equilibrium, and death), observed in the current investigation may be attributed to ionic and enzymatic alterations in the blood and tissues [14]. The heightened mucous secretion in fish could potentially stem from dysfunction of the pituitary gland, induced by toxic stress on the integument [15]. It is plausible that the abnormal behaviors exhibited by the exposed fish represent a compensatory mechanism aimed at deriving energy to cope with the stress induced by the toxicity of copper sulphate [16]. The afflicted fish displayed evident signs of respiratory distress, often resorting to surface breathing and attempting to escape the toxic aquatic environment. Subsequently, they exhibited loss of equilibrium, spiraling, and upward movement in a vertical position, ultimately culminating in complete loss of equilibrium and positioning flat at the bottom [17]. These symptoms were consistent with those observed in the present experiment.

The LC₅₀ values obtained in current study indicated the toxic nature of copper sulphate to the studied fish, signifying its potential for short-term (acute) toxicity. Specifically, the 96-hour LC₅₀ value of copper sulphate for the fish was determined to be 0.059 mg/l. Notably, a significant increase in mortality was noted in *Catla catla* exposed to 1.5 mg/l of copper. While the LC₅₀ values suggest that copper sulphate may not be excessively toxic, it still poses a threat to *Catla catla*. Comparisons with literature values for other fish species revealed varying degrees of toxicity. For instance, the median lethal concentration 96-

hour LC₅₀ value for lead in *Tench tinca* was reported as 300 ppm, significantly higher than observed in our study [18]. Similarly, LC₅₀ values for Cu in other species, such as *R. sumatrana* and *P. reticulata*, were notably higher compared to our findings [19]. Conversely, studies with juvenile Brazilian indigenous fishes reported considerably lower 96-hour LC₅₀ values for copper, indicating greater susceptibility compared to *Catla catla* [20]. Additionally, previous research has reported higher total Cu LC₅₀ values for Japanese flounder and red sea bream compared to the present study (8.7–12.2 and 2.0–5.2 ppm respectively) [21]. These comparisons underscore the species-specific variations in sensitivity to copper toxicity.

Conclusion:

Copper sulphate is extensively utilized in livestock production, particularly for treating foot rot in small ruminants, and in aquaculture as both an algacide and an ectoparasiticide in hatcheries [22]. If copper sulphate is detected in any water bodies, it is advisable to refrain from discharging the water for two or three weeks. This timeframe allows sufficient time for most copper ions to form complexes with carbonates, hydroxyls, and phosphates present in the water, facilitating their settling into the bottom soil. Once deposited in the sediments, copper becomes trapped within the clay fraction of the soil, thereby freeing the water from it [23]. In this study, the acute toxicity of copper sulphate to the freshwater fish *Catla catla* was assessed through an acute toxicity test. The findings indicate a decrease in LC₅₀ values over time. Furthermore, a positive correlation was observed between mortality and concentration levels, with increased concentrations corresponding to higher mortality rates. The study revealed significant abnormal behaviors in exposed fish, including erratic movement, sudden death syndrome, excess mucous secretion, and respiratory distress. These results underscore the heightened toxicity of copper, suggesting that even lower concentrations can have deleterious effects, particularly with prolonged exposure durations.

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Analysis of Women Entrepreneurship and its association with Gender Development

Ms. Srejita Dutta and Dr. Debasree Bose*

ABSTRACT

Women are considered as the trigger to multiple developments. Entrepreneurship refers to the act of setting up a new business or reviving an existing business so as to take advantages from new opportunities. The key factor of women development is women entrepreneurship and GDI. Women entrepreneurship is spreading at a high rate in recent years. Past academic paper has investigated about the push and pull factors which influence the women entrepreneurship, obstacles of the women entrepreneurs, the factors that motivated women to establish digital startup, about the difference between the enterprises and non-enterprises on the scope of empowerment, the challenges faced by the students when they started their new enterprises, success story of entrepreneurs etc. This paper aims to know whether development of account refuels the women to take the responsibility of accompany or a startup. The raw data is collected from the World Bank database. To conduct this research, we used statistical tools like correlation, regression, two sample tests and this paper discloses a positive influence of women development on women entrepreneurship.

Introduction

The origin of the word “entrepreneurship” is from a French word “Entree”, “To enter” and “to take” and in generally applies to any person who is starting a new project or trying a new opportunity. Entrepreneurship refers to the act of setting up a new business or reviving an existing business so as to take advantages from new opportunities. (Allen, 2008) Women Gates said – ‘A woman with a voice is by definition a strong woman. But the search to find that voice can be remarkably difficult’. Entrepreneurship is significantly correlated to women empowerment. Women’s empowerment as a concept was introduced at the UN’s Third World Conference on Women in Nairobi in 1985 which defined it as a redistribution of social and economic powers and control of resources in favor of women

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(Right to Information Act 2005). In the last few decades women as a entrepreneur are emerging in developed and underdeveloped economies (Tiwari, 2017).

Female entrepreneurship and women's economic empowerment are increasingly regarded as a key driver of economic growth and sustainable development ((Allen, 2008), (Minniti, 2007),(Franzke & Froese, 2022)). The concept "sustainable development" is a term that was utilized by the Brundtland Commission in 1987, which was the World Commission on Environment and Development. This concept is focused on solving the actual issues and avoiding harm to the capacity of future generations to solve their own problems (Fernández & Patier, 2021). In 2030, Sustainable Development Goals (SDG), Gender Equality and the empowerment of women and girls (United Nations, 2018) is the fifth goal. The query about gender gap in entrepreneurship is extensive across countries. In almost all the countries there is a huge gap between entrepreneurial activities across both the genders (Global Entrepreneurship Monitor,2016) (Tiwari, 2017). This article is based on the Gender Inequality.

Currently women are breaking the shackles of traditional outlook towards gender specific roles and also going ahead in the business world. Not only are they holding high corporate positions but they are also successful women entrepreneurs who own almost half of all businesses in the United States. A study indicated that 1 out of every 11 adult women is an entrepreneur in the United States. Women business owners contribute to the overall employment of 18 million workers and generate anywhere from \$2 to \$3 trillion in U.S. economy revenues (Mohiuddin, 2016).

Women have been regarded as the nuclei of nation and builder and molder of its destiny. Time went out when Indian women are confined to four walls of their homes with their immense strength and potential. In India, early phases of women entrepreneurship was regarded as extension of their kitchen activities mainly to 3 Ps, viz. Pickles, Powder and Pappad. But with growing awareness women have started shifting from 3 Ps to 3 modern Es, viz. Engineering, Electronics and Energy. The government of India has defined women entrepreneurs as, It will take time in changing attitude, technological innovation and modern ways of thinking to reduce disparity between man and women to bring equality (Dwivedi, 2013). By the sixth economic census by the Ministry of statistics and programme Implementation, women comprise 13.76% of the total entrepreneurs in India. This is just 8.05 million out of the total 58.5 million entrepreneurs (Das, 2022).

Women entrepreneurship is the process where women take, lead and organize a business or industry and provide employment opportunities to other. Women are venturing in all kind of enterprises. Women entrepreneurs are considered to be most important economic agents for economic augmentation of the country. They are the owners, producers, co-coordinators, sellers, decision makers, risk takers, innovators

etc. They also generate employment opportunities and contribute in improving family's living standard. Today's women must supplement the family income using their potential and skills that they possess. Her skills and competencies may be sharpened and turned by way of training. Thus, women, no longer need to wait for employment outside home. They can successfully start their enterprise and earn their livelihood (Dwivedi, 2013).

Women through entrepreneurship involves access to resources and markets, actual ownership and active control, these may be the three important factors for the empowering women. In the process of empowerment, women should consider their strength, weakness, opportunities and threats and move forward to unfold their own potential to achieve their goals through self-development. In countries of huge population and problems of unemployment, women entrepreneurship happens to be one of the best instruments for women empowerment. The women entrepreneurs need not to be highly educated. It is sufficient that they possess basic knowledge of language and entrepreneurial skills. As women have to fulfill dual roles, entrepreneurship is a more suitable profession than regular employment either in public or private sector (Dwivedi, 2023).

The Ugandan women face many more challenges in entering the labour market than men and the unemployment rate is higher among women, particularly for female youths (Guloba, 2017). The unemployment rate among the female working age population (age 18-65) was 10.7 percent in 2015 and for female youth 22.2 percent, compared to 14 % for male youths (Uganda bureau of statistics (UBOS), 2017). The high rate of labour force growth is also in particular significant among women. Women in working age makes up just half of the whole female population which means that the issue of women in need of employment will become even more pressing in the future. Further, lack of education is a severe issue in the country where approximately 75 % of women in rural areas are illiterate or semi-illiterate given that they either have no formal education or never completed the primary schooling cycle. In urban areas the number is 43 % Uganda further has a high level of entrepreneurship. In a report made by the Global Entrepreneurship monitor, Uganda was ranked top entrepreneurial country in the world with 28 % of the adult population being entrepreneurs (Global Entrepreneurship Monitor, 2015). Female entrepreneurs do play a critical role in the growing of their national economy. However, they have a double burden of having to operate in an imperfect entrepreneurial environment while at the same time, they have to navigate gender roles (Guloba, 2017), (Axelsson, 2017).

This paper serves the purpose to analyse the status of women entrepreneurship by being mindful of the notion of gender equality and mainly to discuss about women entrepreneurship by taking into consideration of gender development index.

1. Literature Review

“Women-empowerment through women entrepreneurship (A study of Faizabad zone of Uttar-Pradesh)” by (Dwivedi, 2013) was about women entrepreneurs who are owning beauty parlours to examine the relationship between demographic factor and financial return in the selected sample and to develop a suitable path for beauty parlour business. The study reveals that this business best for those women’s who are having problem with coming out of the house due to culture. There is no limitation of marital status or caste or age in this particular business. A person who can read and write can easily get a degree for pursuing this business. This paper discloses that as age increases expertise and exposure increases which increases the profit and investment. Thus, this can be how this enterprise can be used as an instrument for women empowerment.

“Women entrepreneurship in India” by (Mahajan, 2013) this paper objective is to disclose the status of women entrepreneurs of India and discuss the success story of Hina Shah the most successful entrepreneurs of India in plastic packaging and founder of ICECD. Based on this analysis the writer has also given some suggestions to boost up the spirit of women entrepreneurs and encouraging them to become successful entrepreneurs in the world of creativity.

“Women entrepreneurship: An overview of Indian scenario” by (Lal, 2017) focus on the factors that lead women to take entrepreneurship – classified as PUSH and PULL factors. It also concentrates on the advantages of entrepreneurship among women – like it improve their economic position, increases self-confidence, it develops leadership qualities etc. It reveals the challenges encountered by women entrepreneurs – lack of finance, lack of training, difficulties in managing etc.

“Digital startups and women entrepreneurship: A study on status of women entrepreneurs in India” by (H, 2018) main motive is to find the factors that encouraged women to develop digital startups. It mentioned the list of successful women entrepreneurs of digital startups in India. It also critically analyzed the issues and problems faced by women in digital market. This study says that earlier it was believed that women become entrepreneurs due to push factors like poverty, husband’s death etc. But now a days people approaching in the business due to their ability to take risk, innovative thinking, and their passion for achievement. It also discussed that as environment is changing very fast, investors started investing on women leadership and their contribution in economic development is also recognized.

Challenges and opportunities for women entrepreneurs in India” by (Gaur & Chaturvedi, 2018) reveals that women entrepreneurs faces several obstacles which consist of – lack of technical knowledge, marketing, entrepreneurial skills, lack of self-confidence and low level of opportunities for education and most significantly male dominated society and socio-cultural barriers. This study discloses that - with the increase in the number of women getting opportunity for education, there is awareness among women to be self-employed. Since 21th century the women of India are approaching in the world of creativity, higher education and their proportion in the working classes are increasing over years. It also reveals that women are very good entrepreneurs and they can maintain work life balance.

“Impact of women entrepreneurship on women empowerment in Bangladesh” by (Morshed, 2015) is based on the comparison between the enterprises and non-enterprises on the scope of empowerment. The study reveals that there exists a difference between the decisions of the enterprise owned women and the housewives. It also discloses that women entrepreneurs have more control over resources, social mobility, social activities, knowledge about women’s rights etc than that of housewives. Hence womens receives a position in every sector and they gain the confidence to give decisions about their family. “The role of women entrepreneurship in women empowerment: A case study in the city of Barishal, Bangladesh” by (Khanum & Deep, 2020) concentrates on how women entrepreneurship effect on women empowerment in the society. The study tells that the perceived usefulness of awareness of women’s rights and women empowerment is a difficult factor to measure the impact on women empowerment. The findings disclose that enterprise women have more knowledge and awareness in climate change and disaster management than non- business women.

“Factors that influence women to be involved in entrepreneurship: A case study in Malaysia” by (Ismail & Rahman, 2021)) scrutinized how PUSH and PULL factors affect women’s entrepreneurship in one district in Malaysia. This study results showed that PUSH factors plays an important role in contrast to PULL factors. PUSH factors include opportunity to standard of living (family lifestyle), family background etc. PULL factors includes self-independence. These two factors plays a vital role in influencing women entrepreneurs. But women education is not considered as a put-up factor.

“Economic empowerment of women through entrepreneurial education in Pakistan: Issue and challenges” by (Maqbool & Yousuf, 2021) focus on the challenges faced by the students when they started their new enterprises. In Pakistan, women are dealing with financial issues, teasing from other genders, do not get family support, transportation issues, advertising issues etc. Entrepreneurs are ignorant to think about for association with providers, they likewise do not think going to discover the wholesalers as opposed to purchasing from neighbourhood shops.

“Entrepreneurship and women’s economic empowerment in Zimbabwe: Research themes and future research perspectives” by (Derera & Phiri, 2020) worked upon eight themes. The themes are as follows- feminism and entrepreneurship, informal sector trading, motivation for entrepreneurship, characteristics of entrepreneurs, obstacles to women entrepreneurship, socio- cultural challenges, women cross broader trading and the strategies adopted by women.

“The woman empowerment model through entrepreneurship in Depok and Bogor” by (Hasanah, 2018) attempted to create a woman empowering model through entrepreneurship in the region of Depok and Bogor. As a result, firstly it is found that home industry producers are those women’s who housewives are because they mostly have free time. Secondly, the existing capital is not enough in equipping the machines used for production. Thirdly, the technology needs to be modern, innovative it is still very ordinary, so the production is low. Fourthly, the marketing aspect should be sophisticated with the development in the information technology. Formation of women empowerment model through entrepreneurship.

Objectives

Explanation of women entrepreneurship data status across the world from the World Bank data which is considered as one of the most authentic source of information accepted worldwide.

Comparison between indicators of women entrepreneurship data –

- A women can register a business in the same way as a man (1=yes; 0=no)
- A woman can sign a contract in the same way as a man (1=yes; 0=no)
- Share of directors (% of total directors)
- Share of sole proprietors. (% of sole proprietors)
- Analysis of status of women entrepreneurship in various countries through visual method- scatter diagram.
- Testing of hypothesis keeping in mind the notion of gender equality.
- Discussion on women entrepreneurship in the light of gender development index. To analyse whether development of a country push the women to take the responsibility of a company or to start up.

The objectives are mainly grounded to explore the association between women entrepreneurship and gender development which is scarcely addressed in the literature using world level data. The study is designed to make a preliminary attempt for gauging the relationship between these two important factors of development which are not only crucial for women but for the entire country and world as well. The methodology has been chosen likewise and discussed in the next section and results obtained has been reported in latter part of the paper.

2. Data Source

World Bank Group includes five organizations- The International Bank for Reconstruction and Development (IBRD), The International Development Association (IDA), The International Finance Corporation (IFC), The Multilateral Investment Guarantee Agency (MIGA), The International Centre for Settlement of Investment Disputes (ICSID). But World Bank is the combination of IBRD and IDA. World Bank data is an important instrument to take complex decision and it provides vital statistical information for bank operational activities. This data has been published from 1978. The recent World Bank report which is known as the World Development Report 2022 was launched by the World Bank on February 15. Gender data is the information which is disaggregated by gender as well as data that affected females exclusively. In simple words, it provides knowledge about well-being of females and males across the world. In the entrepreneurship database of World Bank there are 189 countries present. The data has been collected from 1970 to 2021.

3. Methodology

Initially we are going to analyses descriptive statistics with the help of the scatter diagram and later employ statistical test for relevant hypothesis testing and regression analysis is done in the final section.

Two Sample t- Test

Two sample t- test was invented by Snedecor and Cochran in 1989. Two sample t- test with equal variances is required to test if two variables are equal or not. Generally, there are several kinds of this test. But here two- sample t- test for unpaired data has been used. It is defined as follows–

A two-sample t – test mainly use null hypothesis –

- $H_0: \mu_1 = \mu_2$ (when the means are equal of both the variable)
- The alternative hypothesis can be either two- tailed, left- tailed or right- tailed - H_1 (two-tailed): $\mu_1 \neq \mu_2$ (when the means of the two variable are not equal)
- H_1 (left-tailed): $\mu_1 < \mu_2$ (when the mean of variable 1 is less than the mean of variable 2)
- H_1 (right-tailed): $\mu_1 > \mu_2$ (when the mean of variable 1 is greater than the mean of variable 2)

If the two variables standard deviations are assumed to be equal, an “unbiased” estimator of the common variance is $S^2 = \frac{Nf S_f^2 + Nm S_m^2}{Nf + Nm - 2}$

Here, s_f^2 and s_m^2 are the sample variances. Hence, the test statistic t is given below:

$$\frac{(x_f - x_m)(\mu_f - \mu_m)}{S\sqrt{(1/Nf) + (1/Nm)}}$$

Here, x_f and x_m are the sample means for female and male counterpart respectively.

Nf and Nm are the sample sizes. The degrees of freedom $Nf + Nm - 2$.

3.1. Analysis of Association through Correlation measure

The study assess the extent of relationship shown between share of sole proprietor and share of directors with the help of Karl Pearson’s correlation. It is a statistical tool which helps to study the relationship between two variables. Let $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$ be a set of n pairs of observations on variable x and y . The correlation coefficient between x and y is denoted by r .

Correlation coefficient r is defined as-

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$$

This expression is known as Pearson’s Product formula; this is used as a measure of linear association between x and y . This correlation coefficient (r) lies between -1 and $+1$.

3.2. Regression Analysis

The regression model generally applied to measure the causal relationship between explained and explanatory variable. When there is only one independent variable in the linear regression model, the model is generally termed as a simple linear regression model. Consider a simple linear regression model:

$$Y = b_0 + b_1X + \mu$$

Here, Y = dependent variable

X = explanatory variable

b_0 and b_1 = regression coefficients where b_0 defines the intercept term and b_1 is the slope coefficient. For our analysis, X is the value for Gender Development index while Y will be the indicators for women entrepreneurship.

Share of directors

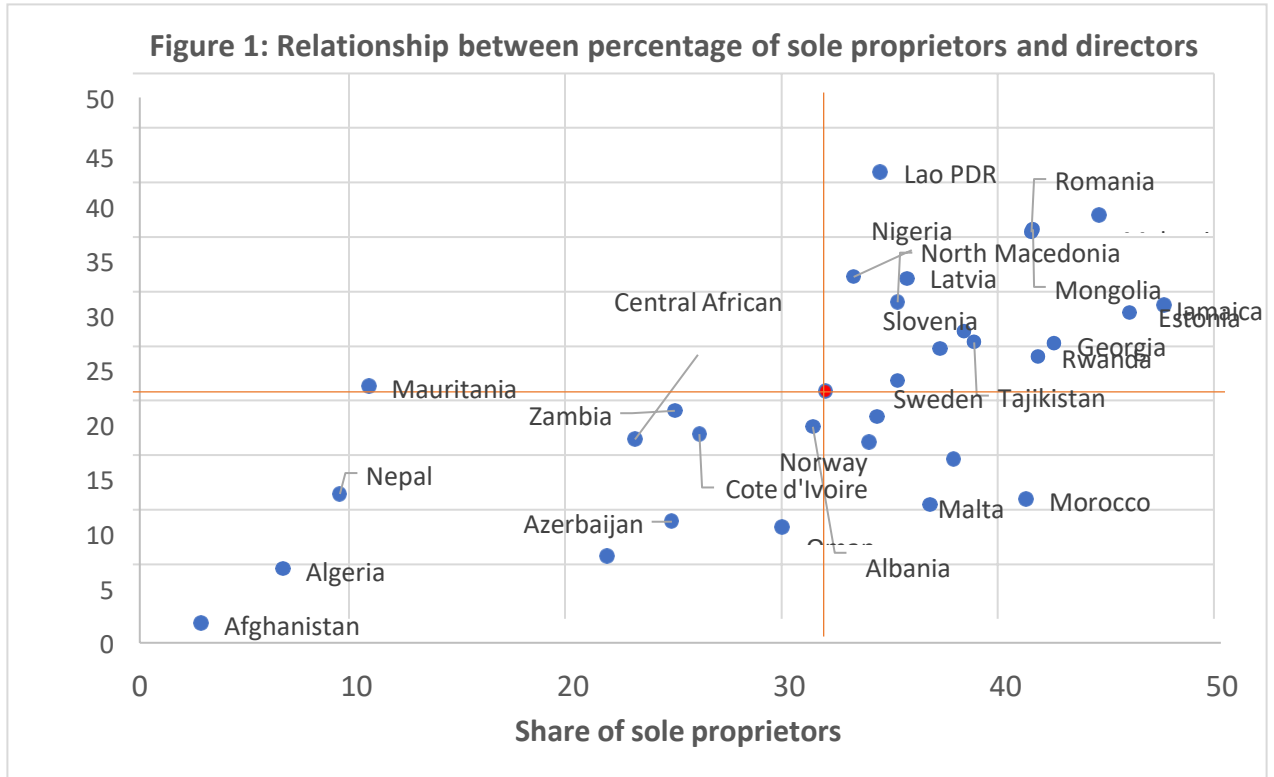


Figure 1 depicts the relationship between share of directors and share of sole proprietors measured for females. This analysis includes 31 World Bank countries assessed at the time of 2018.

4. Results

Inspection of the scatter diagram supplies a pleasant context for this study. One can see from this diagram foremost, an average marked by red dot which segregated the diagram into four sections. At the north-eastern section there are 15 countries (Lao PDR, Romania, Malaysia, Nigeria, Mongolia, Latvia, North Macedonia, Jamaica, Estonia, Slovenia, Tajikistan, Serbia, Georgia, Rwanda, Belarus) which have both share of sole proprietors and share of directors above average, which indicates 48% of these countries are having higher share of both sole proprietors and directors which is close half of the countries studied over

here. It claims relatively more women entrepreneurial activities in these countries, which says that women of these countries are moving ahead in the world of power dynamics.

At the south-eastern section there are 5 countries (Sweden, Norway, Denmark, Malta, Morocco) which have share of sole proprietors below average but there share of directors are above average, which indicates that 16% of these countries are having moderate share of both sole proprietors and directors which is less than half of the countries studied over here. It depicts that women in these countries are slightly lacking behind in the world of business and the entrepreneurial activities are curtailing in these countries.

At the south-western section there are 10 countries (Afghanistan, Algeria, Nepal, Qatar, Azerbaijan, Oman, Cote d Ivoire, Central African Republic, Zambia, Albania) which have both the share of directors and share of sole proprietors below average, which indicates 32% of these countries are having moderate share of both directors and sole proprietors. These least developed countries are lacking behind in the world of innovations. These are least developed countries where women's confidence in signing the contract are extremely low.

At the north-western part there is only 1 country (Mauritania) which have share of proprietors above average but share of directors below average. This country need immediate attention as this country is trying to catch up the average of share of directors but lagging behind in terms of share of sole proprietors. In this country most of the population lies below extreme poverty line thus it has an adverse impact on entrepreneurship also. Consequently, this country women's hang low in the field of business.

Table 2: Status of women's registration and contract signed

Year	Business registration done	Contract has not signed
1981	167	167
1991	167	166
2001	166	155
2011	155	113
2021	187	94

From the table 2, it could be seen that out of 189 World Bank countries in the year 1981, 167 countries admitted that women can register a business just like a man but women cannot sign contract in the same way as men.

In the year 1991, same number of countries agreed that women can register in the same way as man and 166 countries declared that women cannot sign contract like a man. From previous year only 1 country disagree with the statement that women cannot sign a contact like men.

Again in 2001, 166 countries claimed that women can register a business in the same way as men but 155 countries claimed that women cannot sign a contract just like a man; which means 11 countries disagreed with the previous statement; this implies that countries are investing their confidence on women so that they can become decision makers in the future world.

In 2011, 155 countries remarked that women can register a business in the similar way as men but 113 countries remarked that women cannot sign a contract just like a man; which indicates 42 countries disagreed with the initially used statement. It implies that women are shaping their careers in the world of business.

Lastly in 2021, 187 countries stated that women can register a business just like a man and 94 countries stated that women cannot sign a contract like a man; again, which pointed out that 19 countries disagreed with the statement made in the initial year. Hence year wise the countries reliance on women are increasing continuously.

Correlation coefficient between share of women sole proprietors and directors:

We will start with a series of correlation between share of sole proprietors and directors. We have used Pearson correlation coefficient, which is a technique to determine whether the two quantitative variables are correlated or not and up to which degree. The correlation coefficient between the two variables is denoted by r . In our case if r is less than 0 ($r < 0$) then there is a negative correlation which represents that share of directors and share of proprietors are not in the same direction and if r is greater than zero ($r \geq 0$) then there is positive correlation, which means that the share of directors and share of sole proprietors moves in the same direction.

Table 3: Correlation Coefficient between share of women Sole Proprietors and Directors

Correlation Coefficient	share of female directors	
	share of sole female proprietors	share of female directors
	2014	0.649965
	2015	0.659531
	2016	0.76165
	2017	0.506651
	2018	0.656388

At a first glance, illustrates that correlation between the share of female sole proprietors and share of female directors turned out to be positive. This indicates that with the increase in share of female sole proprietors share of female directors also increases the rate of women entrepreneurs also increase; as the share of female sole proprietors and female directors also moves in the same directions. In the table 3, the coefficient continuously increases from 2014 to 2016 suddenly there is a downfall in 2017 but again the coefficient started to increases slightly in 2018. As a result, from this yearly data the coefficient is strong positive correlation (Range of strong positive correlation – 0.5 to 1.0).

Two sample t-test analysis:

Table 4: Two Sample t-test Analysis

year	share of directors			share of sole proprietors		
	mean of share of female directors	mean of share of male directors	p of two tail test	mean of share of female sole proprietors	mean of share of male proprietors	p of two tail test
2014	22.25452539	77.67213392	0.00***	31.29807789	68.70192211	0.00***
2015	23.41253361	76.58746639	0.00***	31.39628404	68.60371596	0.00***
2016	23.43459932	76.56540068	0.00***	31.77063512	68.22936488	0.00***
2017	23.33450134	76.66549866	0.00***	32.0288253	67.9711747	0.00***
2018	23.71519816	76.28480184	0.00***	31.71629166	68.28370834	0.00***

Table 4, presents the two sample t-test with equal variances interrelationships between share of female directors and share of male directors. Therefore from 2014 to 2018 we reject the null

hypothesis because the p-value (0.00) is smaller than the level of significance (0.05). We also reject the null hypothesis and accept the alternative hypothesis at 0.01 level of significance from 2014 to 2018 because the p-value (0.00) is smaller than the level of significance. From 2014 to 2018 we reject the null hypothesis because p-value (0.00) is smaller than the level of significance (0.1); we accept the alternative hypothesis.

Similarly, table 4 also represents the interrelationships between share of female sole proprietors and share of male sole proprietors. Therefore from 2014 to 2018 we reject the null hypothesis because the p-value (0.00) is smaller than the level of significance (0.05). We also reject the null hypothesis and accept the alternative hypothesis at (0.01) level of significance from 2014 to 2018 because the p-value (0.00) is smaller than the level of significance. From 2014 to 2018 we reject the null hypothesis because p-value (0.00) is smaller than the level of significance (0.1); we accept the alternative hypothesis.

Regression analysis:

Model 1 result

Table 5: Regression Statistics between GDI (Gender Development Index) and share of female directors

MODEL	R square	Adjusted R Square
1	0.219539	0.199

This table of regression analysis provides information of fitting of the linear regression equation. It is analyzed that r (Karl Pearson's coefficient of correlation) comes 0.46855 which holds a positive relation between the two variables which motivates to take up the regression analysis. Positive relation takes place if there is an increase in independent variable (GDI) and the dependent variable (share of female directors) also moves in the same direction.

Table 6: Anova analysis (Analysis between GDI and Share of female directors)

MODEL	F	Significance
Regression	10.68915	0.002293

It is found that at 95% confidence level the calculated value of F is 10.68915 and the significance F (the P value of F determined from the F- distribution table) is 0.002293. As a result, here the $0.00 < 0.05$. Hence the null hypothesis is rejected, and the alternative hypothesis accepted. Hence, with 95% confidence level there is adequate confirmation to accept that, there is a noteworthy effect of independent variable on GDI.

Table 7: Regression Result of Model 1

MODEL	Coefficient	Standard error	t-stat	P- value
GDI	61.08463	18.68359	3.269427	0.002293
Intercept	-33.511	17.49575	-1.91538	0.062992

The calculated P-value is less than almost all the level of significance ($0.002293 < 0.05$, $0.002293 < 0.01$, $0.002293 < 0.1$). This indicates that GDI has influence on the share of female directors. Thus, the alternative hypothesis is accepted.

The result indicates that the countries need to increase Gender development by providing equal opportunities to women, investing in women education, keeping an eye on female gross enrolment ratio (GER) and female life expectancy, then the share of female directors will also increase; which implies that women will get motivated to work in a company. By which the countries can attain the benefit of women entrepreneurship. As half of the world population are women centric (49.58%), if they cannot invest in half of the population, they are losing half of the GDP what they could have earned from them.

Model 2 result

Table 8: Regression statistics between GDI and share of female sole proprietors

MODEL	R	Adjusted R
2	0.241601	0.225114

This table of regression analysis provides information of fitting of the linear regression equation. It is analyzed that R (Karl Pearson's coefficient of correlation) comes 0.491529 which holds a positive relation between the two variables which motivates to take up the regression analysis. Positive relation occurs

when the independent variable (GDI) increases with the increase in dependent variable (Share of female sole proprietors). There is 24% variance of share of female directors is explained by independent variable.

Table 9: Anova analysis (Analysis between GDI and Share of female sole proprietors)

MODEL	F	Significance
Regression	14.65\	0.000388

It is found that at 95% confidence level the calculated value of F is 14.65407 and the significance F (the P value of F determined from the F – distribution table) is 0.000388. As a result, here the $0.00 < 0.05$. Hence the null hypothesis is rejected, and the alternative hypothesis accepted. Hence, with 95% confidence level there is adequate confirmation to accept that, there is a noteworthy effect of independent variable on GDI.

Table 10: Regression Result of Model 2

MODEL	Coefficient	Standard error	t-stat	P-value
GDI	76.69768	20.03564	3.828063	0.039075
Intercept	-39.9796	18.82249	-2.12403	0.000388

The result indicates that the countries need to increase Gender development by providing equal opportunities to women, investing in women education, keeping an eye on female gross enrolment ratio (GER) and female life expectancy, then the share of female sole proprietors will also increase; which indicates that the women are becoming self- confident, self- employed, and supremely independent to become the decision makers and kick off with a business. By which the countries can attain the benefit of women entrepreneurship. As half of the world population is women centric (49.58%), if they cannot invest in half of the population, they are losing half of the GDP what they could have earned from them.

Conclusion: In this study firstly, we used a scatter diagram to reveal the relationship between the share of female directors and share of female sole proprietors across the world from it we found that out of 31 world bank countries in 2018, 15 countries women are moving ahead in the world of business as they have both the share of female directors and sole proprietors above average. Here only Mauritania needs urgent attention as it trying hard to move ahead but it can't due to the extreme poverty. Secondly, we compared between the first two indicators chronologically, and explore that year wise the confidence of the countries upon the women has continuously increased. Thirdly, we used the statistical tool correlation to find the correlation coefficient between share of female directors and share of female sole proprietors' year wise. Here we detect that their strong positive correlation between the

two variables. Fourthly, we used two sample t-test assuming equal variances, to determine the case of share of directors and sole proprietors, whether the difference between the mean of share of female directors and male directors is equal to zero (H_0) or the difference between mean of share of female directors and male directors is not equal to zero (H_1) and same for the case of share of sole proprietors. Here we disclosed that we reject H_0 and accept H_1 for both the cases, which indicates that we found the mean of female and male share of directors and sole proprietors are not equal. Fifthly, we used the instrument regression, to discover the relationship between GDI (independent variable) and share of female directors and sole proprietors (both are considered as dependent variable). From this we established that both the variables are positively related.

From the findings of the study conclude that across the world women are moving ahead in the world of dynamic power. Therefore, the countries should formulates policies directed towards well-being, skill enhancement so that women can become the decision maker in the progressive world. Moreover, the study explores that women are capable of registering a business like a men while the probability of signing a contract is way lesser. Therefore, government should implement policies to provide equal field of business for women as the male counterpart. Some incentives might be designed strategically to attract new women entrepreneurship. Regression analysis statistically support the notion of higher gender development invites greater opportunities for women entrepreneurship which in turn beneficial for economic growth. Hence, policies aiming towards gender development will eventually encourage women to drive into world of business.

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Descartes on the Reality of the External, Material Things

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ABSTRACT

Philosophers who have offered proofs in favour of the existence of external world or material things have also addressed the problems arising out of those proofs. A proof of the existence of the external, material world can be found in Descartes' *Meditations*. Descartes in his *Sixth Meditation* is concerned with proving that material things exist. The object of this paper is to explain and examine critically the proofs of the external world given by Descartes. The first two sections are dedicated to analyze and explain the proof of the existence of external, material, things which Descartes has offered in the earlier part of *Meditation VI*. In the third section of this paper, a critical examination of Descartes' proof of the corporeal world has been done. A concluding remark is also given.

Section I

Two arguments given by Descartes are rejected by him, en route to his proof of the external world. His first argument is that material things "may exist; in as far as they constitute the object of...pure mathematics, since regarding them in this aspect, I can conceive them clearly and distinctly."¹

He says that "there can be no doubt that God possesses the power of producing all objects I am able to distinctively to conceive, and I never considered anything impossible to him [Him], unless when I experienced a contradiction in the attempt to conceive it aright."²

He says that we must know what does it mean by 'a clear idea' of material thing. Before considering whether such objects as we conceive can exist independently without us, it is necessary to examine their ideas in so far as such ideas are to be found in our consciousness and we should also determine which of them are distinct and which of them are chaotic.

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He says that he can clearly and distinctly see that extension and motion are the two core properties that constitute the essence of material objects. A material object, which has three-dimensional magnitude, is prone to local motion, can occupy various places and have its parts differently arranged at different moments. The point of argument under consideration is this: The very existence of the sciences of geometry and kinematics demonstrates objects that are characterized by geometrical and kinematical properties, and supposed to be signified by the term ‘material things’, are possible existents. These sciences show that the idea of material objects is not self-contradictory, hence the existence of such things are logically possible. This argument indicates only that the things meant by the term ‘material’ things’ have only possible existence, therefore, Descartes has rejected it, and tried to provide another argument to determine with certainty whether material things actually exist.³

The second argument is also not a sound proof of the existence of external world. This argument depends on the power of imagination. As formulated in the second paragraph of Meditation VI, the argument is not clear. Imagination differs, Descartes says, from pure intellection or conception. There are items which can be seen clearly, but cannot be imagined except hazily although, there are items which can be both conceived clearly and imagined vividly. Thus a chiliagon is an object of clear perception in the sense that it can be rightly understood that it is a figure composed of a thousand sides and possessed of as many angles, but I cannot vividly imagine the thousand sides—neither more nor fewer than the thousand sides—of the figure in the sense of viewing them as present with the mind’s eye. But, I can both understand the figure of a triangle rightly and imagine vividly. Imagination needs a brain for the construction of physical images, and that accordingly at least one physical object, the brain exists. The power to imagine things can best be elucidated according to Descartes’ suggestion if it be held that the mind is conjoined to a body of which it makes use in order to form images.

Cottingham states:

... I ‘see’ the three lines ‘there in front of me’ as if they were actually, physically present. Now this vivid process of ‘imagining’ or ‘depicting objects could easily be accounted for, Descartes suggests, if there is a physical organ, the brain, where the three lines are actually, physically traced out, so that the mind can directly ‘contemplate’ or ‘inspect’ the resulting picture.⁴

Imagination needs a brain in order to form a physical image and consequently at least one material object must exist to imagine i.e. the brain.

This argument is not at all substantial. Cottingham argues that:-

“Indeed, to anyone even remotely familiar with the neurophysiology of the brain, the bizarre notion of images being actually, physically, traced out there will sound quite absurd.”⁵

Section II

Since the above mentioned two arguments have failed to give any certainty regarding the existence of material objects, so he persuades that it is reason but not senses that throws light on the existence of material objects. Material objects are not given as immediate objects of sense-perception. ‘Ideas’ i.e. ideas of qualities are actually given as immediate contents in sense-perception. According to him, the sensory ideas are presented to our minds, and these alone we instantly and directly perceive. The existence of material objects are actually inferred on the basis of certain considerations. The sensory ideas are the ideas of tactile qualities such as softness, cold, heat, colour, odour, sound and taste. Descartes also has talked about some special kind of sensations such as sensations of pain, pleasure etc. He says that the sensory ideas which are given directly to the mind are mostly involuntary. These ideas are produced in our minds without any endeavour and without any will.

Now, Descartes has made an intensive use of his principle of causality to determine the external substance, or substances which may be credited with the power of producing the sensory ideas. Following the principle ‘ex nihilo nihil fit’- out of nothing, nothing comes; he draws the conclusion that every idea must have a cause. He also further has concluded that cause must have as much as reality or perfection as its effect, or more, but not less. If the cause is less real than its effect then the excess in the effect must come out of nothing, and this is a sheer absurdity.

Descartes has applied the causal principle in its technical form to sensory ideas. Actually the objective reality of the sensory ideas must be contained in their cause or causes either formally or eminently⁶.

He has thought of two wide alternatives as to the external cause or causes of sensory ideas. Either God by Himself or through some divine agents is their external cause, or corporeal objects may be thought of to be such.

In the ninth paragraph of *Meditation VI*, he has stated clearly which of the aforementioned alternatives should be eliminated and which one would be accepted.

He says that God cannot be the external cause of my sensory ideas because he has given us no means of discovering that He has communicated those ideas to my mind either directly by Himself or indirectly through some divine agents. He, on the contrary, has given us a very strong feeling to believe that these ideas advance from a different source, namely corporeal objects; and if He had created those ideas either

by Himself or through some appropriate agent, He would be a deceiver, but, as he has been proved in an early part of the *Meditation VI* paragraph two, God is not a deceiver.

So, the only alternative which is left for us to accept is that sensory ideas are externally produced by corporeal objects; because we have strong propensity to believe that those ideas are so caused and we do not have any natural belief contrary to this natural belief, and we have a further guarantee arising from consideration of the divine veracity that a very strong natural belief with no natural belief contrary to it cannot be deceptive.

It follows from the above mentioned discussion that sensory ideas, according to Descartes, are caused by corporeal objects and corporeal objects can never have any causal power if they are non-existent. This is the general proof of the existence of external, corporeal, objects given by Descartes.

Section III

Descartes' proof of the external world rests on the principle of causality and on his appeal to the veracity of God. The principal of causality used by Descartes may be called after Cottingham, the Causal Adequacy Principle.⁷ According to the principal, there must be at least as much as reality in the cause as in the effect. The word 'at least' gives consent to the fact that cause may contain more reality than effect. According to Descartes, this causal principle is self-evident.⁸

However, a principle cannot properly be regarded as self-evident unless its application to any realm is found to be invalid. Descartes has used this Causal Adequacy Principle as "efficient" causes. Causal Adequacy Principle should imply that there must be at least as much reality in the 'material' cause as in the effect. It is an evident fact that an efficient cause is the productive power or agency which brings something into existence. But Gassendi has objected to Descartes' view on the ground that Descartes took it in the sense that there must be at least as much reality in the 'efficient' cause as in the effect. For example, a bridge which is very strong, derives its strength from its material ingredients, i.e., rivets, girders etc.

The causal principle, when is applied to material causes, encounters some counter examples too. Helium, for example, which is formed by fusion from Hydrogen, has some properties which are not in Hydrogen. A sponge cake has a unique characteristic, i.e., sponginess. This property is not contained by any of its material ingredients, namely, flour, butter, eggs etc. It is an emergent property coming out of the chemical changes produced by the process of mixing and baking. If it is told that the new property 'sponginess' of the sponge cake is somehow potentially contained in its material ingredients, this would certainly go

against Descartes' view because according to him, the perfections that are present in the effect must be contained actually in the cause.. In his causal argument for the existence of God, he has mentioned it distinctly that the perfectness representatively contained in the idea of God as found in the mind must be present in its cause, not just potentially but actually.¹⁰ However in one sense this argument cannot refute the Causal Adequacy Principle. The ingredients are as much real as the cause itself. Ingredients are no less real than the cause. Therefore, cause is no less real than the effect. The emergence of new property cannot nullify the reality of the cause.

Mersenne has cited the example of the emergence of life, taking the action of the Sun and rain on the Earth to be the efficient cause of the generation of the life. He claims that if by non-living forces animal life can be created, then 'it does happen that an effect may derive from its cause some reality, which is never the less not present in the cause'.¹¹ Descartes has defended himself by providing two different points at the same time.

1. Animals which are only complex machines have no properties which are not also exists in inanimate bodies.
2. As the causal principle is explicitly concerned with 'the efficient and total cause' of an effect, it is evident that if animals have properties that do not exist in the Sun, rain, etc., then these things do not compose the entire efficient cause of animal life.¹²

Cottingham has noticed that the problem with this manoeuvre is that Descartes makes his point immune from criticism by vehemently rejecting the possibility of real emergent properties. The implication of the criticism is that Descartes's position is controversial. According to him, the evolutionary biologists should be wrong in accepting the feasibility that consciousness may appear from non-conscious forces. Whether they were right or wrong was an object of debate in Descartes' time and even long before. He was quite acquainted with the Greek atomist who had given arguments for such emergence, as his comments on Democritus in the *Principles of Philosophy* (Pt. IV, 202) suggest. So it follows from the arguments that the causal principle is not self-evidently true.

Descartes' appeal to the veracity of God in proving the existence of material thing has been criticized also. In the *Replies to the Seconds Set of Objections* Descartes states that atheist 'cannot be certain that he is not being deceived on matters which seem to him very evident¹³'. It clearly follows from Descartes' point of view that one, not being deceived, is dependent on the acknowledgement that God is not a deceiver and this admission in its turn is available only to those who recognize the existence of God. According to

Robert Stoothoff it is only after proving the existence of God in *Meditation III*, Descartes presents the fact that God is not a deceiver.¹⁴

The entire liability of Descartes' view to the effect that the God is not a deceiver, i.e., of his appeal to the veracity of God collapses ultimately on his claim that God exists. This claim gets its strength from the causal proof of the existence of God in *Meditation III*. It is also repeated in *Meditation IV* which is further reinforced by another proof of God's existence, which from Kant's time is known as the ontological proof. Therefore, it is evident that if reasons are employed to cast doubts on his proofs of the existence of God, the intensity of his argument to the veracity of God will be lost, and finally his proof of the existence of external, material things will be unaccepted.

Conclusion

Descartes's proof of the external world is dubious. His causal principle and the force of the appeal to the veracity of God have been diluted by the critics. His additional arguments, intended to supplement his proof, are brilliant but by bringing in a view as to the nature of man is not satisfactory. So his proof under examination has not been successful.

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कवि भानुभक्त आचार्य र उनका काव्यकृति

अमर शर्मा*

सार (ABSTRACT)

कवि भानुभक्त आचार्य नेपाली साहित्यमा आदिकविको उपाधिले सम्मानित छन् यो सर्वविदित पक्ष हो। संस्कृत भाषा अनि साहित्यको वर्चस्व रहेको त्यस ताकका नेपाली समाजमा आफ्नो कृतिको निम्ति नेपाली भाषा चुम्नु बडो साहसको कुरो थियो। नेपाली भाषा/साहित्यलाई तुच्छ ठान्ने त्यस समयका विद्वानहरु नेपाली भाषालाई खसकुरा भन्दथे। संस्कृतका ज्ञाता भए तापनि आदिकवि भानुभक्तले नेपाली भाषामा रामायणको अनुवाद गरे, कविताको रचना पनि गरे। यस लेखमा कवि भानुभक्त आचार्यको व्यक्तित्वको संक्षिप्त चर्चा गरिएको छ। उनका कृति रामायणले नेपाली जनसाधारणमा ल्याएको उत्साह र भक्ति अवर्णनीय थियो। उनीद्वारा अनुदित रामायण र अन्य रचनाहरुको कृतिगत चर्चा गर्ने प्रयास यस लेखमा पाइन्छ।

KEYWORDS: भानुभक्त आचार्य, समाज, रामायण, भक्तिरस।

1. पृष्ठभूमि

कवितालाई 'कवेर्भावः काव्यम्, कवेः कर्म काव्यम्' भनी कविको भावाभिव्यक्ति नै कविता हो वा कविको कर्म नै कविता हो भनेर बुझाइएको पाइन्छ। अग्निपुराणमा भनिएको छ –

नरत्वं दुर्लभं लोके, विद्या तत्र सुदुर्लभा ।

कवित्वं दुर्लभं तत्र, शक्तिस्तत्र सुदुर्लभा ॥१

अतः कवि असाधारण यद्यपि बुद्धिमान, सर्वज्ञ, युगस्रष्टा, कान्तदर्शी हुन् अथवा कवि युगस्रष्टा, युगद्रष्टा वा ऋषि हुन्। यसरी विभिन्न विद्वानहरुले कवि अनि कविताको सम्बन्ध स्थापित गर्न खोजेका छन् अनि यिनीहरुको परिचय दिन खोजेका छन्। विभिन्न भाषाका साहित्यहरुको कालावधि फरक फरक भए तापनि शुरुवात भने प्रायशः कविता विधाबाट नै

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भएको पाइन्छ। नेपालीमा पनि विक्रमको 19औं शताब्दीको प्रथमाब्दतिर कवि सुवानन्द दासले कविता साहित्यको इतिहासमा प्रथम सानो टुकी बाल्ने काम गरे। यिनको 'पृथ्वीनारायण' कविता वि.सं. 1831 तिर रचना गरिएको हो भन्ने विद्वानहरूको अनुमान छ। आफ्ना कवितामा नेपाली झर्ना शब्द, अनुप्रास, उपमा, रूपक जस्ता अलङ्कारहरूको प्रयोग गरी यिनले समकालीन राजा पृथ्वीनारायण शाहको यशगान गाएका छन्।

यस कविताभन्दा केही पछि अन्य कविताहरूमा शक्तिबल्लभ अर्यालको 'तनहूँ-भकुण्डो', उदयानन्द अर्यालको 'पुरानो बातको अर्जी', 'कुलवर्णन कविता' आदि पाइन्छन्। यसपछि सुन्दरानन्द बाँडाको 'बहादुरशाह वर्णनम्' मा दुइ नेपाली श्लोकहरू पाइन्छन् जसलाई 'आशा-नदी' भन्ने शीर्षक दिइएको छ। यिनका एघारवटा नेपाली श्लोकहरू 'त्रिरत्न सौन्दर्यगाथा' मा फेला परेका छन्। यसरी नै राधावल्लभ अर्यालको 'माले साँढ्याको कवित्', रामभद्र पाध्याको 'लक्ष्मीधर्म संवाद' आदि पाइएका छन्।

यस कालका कविताहरू नेपालको एकीकरण विषयमा रचना गरिएका हुनाले यिनमा राजाको वीरताको स्तुति र गुण गाइएको पाइन्छ।

नेपाली कविता साहित्यमा वि.सं. 1873 देखि भक्तिरसको प्रभाव विशेषरूपमा परेको पाइन्छ। यता अंग्रेज-नेपाल युद्धमा नेपालको हार हुन्छ अनि सुगौली सन्धिले यो युद्धलाई अन्त गर्छ। यसअघि कविहरू राजा, सेनापति आदिलाई आलम्बन गरी कविता रच्यथे तर 'अब यस्ता महिमाशाली राष्ट्रीय चरित्र देखा नपरेकोले कविहरूले मानवीय आलम्बनलाई छाडी दैवी आलम्बनलाई श्रद्धाका पात्र बनाउन खोजे। फलतः भक्तिकाव्य आयो।'² यसबाहेक नेपाली कविता साहित्यमा भक्तिधाराको उद्भव हुनुमा त्यस समयको राजनैतिक अवस्था, सामाजिक अवस्था पनि त्यतिकै महत्वपूर्ण देखिन्छन्। यस कालमा मुख्यतः कृष्णाश्रयी, रामाश्रयी तथा निर्गुण भक्तिधाराका कविताहरूको रचना भएको पाइन्छ।

कृष्णाश्रयी भक्तिधाराका कविहरूले आफ्नो भक्तिको केन्द्र भगवान श्री कृष्णलाई बनाएका छन्। उनैको लीलाको वर्णन यस भक्तिधाराका कविहरूले गरेका छन्। यसै प्रसङ्गमा इन्दिरसको 'गोपिकास्तुति', वसन्त शर्माको 'श्री कृष्णचरित्र', हीन व्याकरणी विद्यापतिको 'गीत गोविन्द' आदि मुख्य छन्।

रामाश्रयी भक्तिधाराका कविहरूले भगवान रामको लीलाहरूको वर्णन गरी आफ्ना कविताहरू रचना गरेका छन्। यसै कालमा भानुभक्त आचार्य प्रतिनिधि कविका रूपमा देखा पर्छन्।

2) विषय-प्रवेश

2. केशवप्रसाद उपाध्याय, प्राथमिककालीन कवि र काव्यप्रवृत्ति, साझा प्रकाशन, काठमाडौं, चौथो संस्करण, वि.सं. 2060, पृ सं 75।

आदिकवि भानुभक्त आचार्य नेपाली साहित्य जगतका प्रातःस्मरणीय कवि हुन्। नेपाली वाङ्मयका नेपाली लेखक-कविहरूका आधारस्तम्भ भानुभक्तलाई देश विदेशका अध्येता, समालोचक एवं अनुसन्धाताहरूले विभिन्न दृष्टिकोणले हेरेका छन्। जे होस्, भानुभक्तलाई सर्वप्रथम नेपाली संसारमा चिनाउने श्रेय भने मोतीराम भट्टलाई जान्छ। उनले 'कवि भानुभक्ताचार्यको जीवन चरित्र' नामक लेख/जीवनी वि.सं. 1948 मा प्रकाशित गरे। यसपछि मात्र भानुभक्त विषयमा सबैले जान्ने सुयोग पाए। नेपालको तनहुँ जिल्लाको रम्घा गाँउमा जन्मेका अनि पिता श्री धनञ्जय आचार्य, पितामह श्रीकृष्ण आचार्यको देखरेखमा हुर्केका भानुभक्त संस्कृत व्याकरण, साहित्य, ज्योतिष, गणित आदिका ज्ञाता थिए।

कवि भानुभक्त आचार्यको जन्मविषय विद्वान सूर्यविक्रम ज्ञवाली भन्दछन् - 'त्यो बालकको जन्म बडो आतङ्कका समयमा भएको थियो। सिमलादेखि दार्जीलिङसम्म विस्तृत नेपाली राज्यको बढ्तीकला भारतमा अङ्ग्रेजको बल्दो प्रतापसंग जुमन पुगेको थियो। दुवै जाति अनेक निहूँ थापी परस्पर झगडा गर्न लागेका थिए। लडाईँ अवश्यम्भावी जस्तो भएको थियो। यस्ता समयमा जन्मे भानुभक्त.....'³ नेपाली साहित्यका सहज कवि मानिने भानुभक्त आचार्यको तत्कालीन नेपाली समाज र परिवेश नेपाली साहित्य रचनाको निम्ति पनि साह्रै सहायक थिएन। नेपाली भाषालाई त्यसताकका विद्वान कविहरू खसकुरा भन्दथे। संस्कृत भाषालाई देवभाषा ठान्ने विद्वानहरूले नेपाली कविहरूलाई कविका रूपमा स्वीकार्दैनथे। यही समय स्पष्टवादी अनि सत्यवक्ताका रूपमा कवि भानुभक्त आचार्य नेपाली भाषा अनि साहित्यको सेवा गर्न अग्रसित भए। आफ्ना बाजे श्रीकृष्ण आचार्यबाट संस्कृतको धेरै ज्ञान लिए तापनि संस्कृत भाषामा नभई नेपाली भाषामा साहित्यको सेवा गर्ने उनले अठोट गरे। उनले कुनै प्रसंसाका निम्ति लेखेनन्। उनले लोकका हितका निम्ति कृतिहरू रचना गरेको पाइन्छ।

'भानुभक्त सर्वसाधारण सांसारिक पुरुष थिए। उनी न संसारदेखि विरक्त भएर चिन्तनमा डुबिरहने मानिस थिए, न रातदिन रामनाम जपेर बस्ने मानिस थिए। उनले जीवनमा धर्म, अर्थ, काम, मोक्ष, सबैको साधना गरे, गृहस्थाश्रमका सम्पूर्ण व्यापारमा उनलाई पूर्ण रुचि थियो। तर उनको चरित्र पूर्ण आदर्श चाहिँ थिएन। किनभने रागद्वेषमा उनी मुद्धिएका थिए।'⁴ उनमा क्रोध अनि लोभ बडीमात्रामा थियो। विशेषतः क्रोधले गर्दा त उनी बदनाम नै थिए। गजाधर सोतीकी घरबुढीलाई यिनी 'अलच्छिनकि' भन्दछन् भने गिरधारी भाटसंग मुद्दा पर्दा उनको आफ्नै जित भए तापनि 'भाट' शब्दसंग नै घृणा गरी आफ्नो घरको छानाबाट भाटाहरू झिक्दछन्। जे होस्, सांसारिक पुरुष भएपछि व्यक्ति षडरिपु (काम, क्रोध, लोभ, मोह, मद, मात्सर्य) को अधि नतमस्तक बन्दछ, भानु पनि बने, यो साधारण विषय हो।

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3. सूर्यविक्रम ज्ञवाली, 'भानुभक्त', गोपीचन्द्र प्रधान (सम्पा), भानुभक्त स्मारक ग्रन्थ, नेपाली साहित्य सम्मेलन, दार्जीलिङ, पृ सं 105।
 4. केशवप्रसाद उपाध्याय, ऐंजन, पृ सं 172।

- भानुभक्तका काव्यकृतिहरू

क) रामायण :

रामायणको रचना नेपाली साहित्य जगतको एक युगान्तकारी घटना हो। भानुभक्तले संस्कृत अध्यात्म रामायणको अनुवाद गरेर नेपाली समाजलाई एउटा ठूलो सम्पत्ति जोडिदिए। भक्तिधारा अन्तर्गत रामभक्तिधाराका प्रतिनिधि कवि भानुभक्त आचार्य संस्कृतका छन्दोबद्ध कविताहरूको पारायण वा वाचनबाट प्रभावित बनेका थिए। त्यसैले संस्कृत रामायणलाई अनुवाद गरी नेपाली भाषामा छन्दोबद्ध काव्यको रूपमा बडो सरल र गेयात्मक बनाइदिए। लोकोबद्ध छन्द र सरल सहज भाषामा लेखिएको हुनाले यो सर्वसाधारणको अतिप्रिय बन्यो। अलिकति साउँअक्षर चिनेकाहरूले पनि रामायण कण्ठस्थ गर्नथाले। उठ्दा-बस्दा, हिड्दा-डुल्दा, मेलोपात गर्दा मानिसहरूले भानुभक्तीय रामायणका श्लोकहरू गाउन थाले। रामायणमा आध्यात्मिकजनले रामजस्ता देवता पाए भने सामाजिक जनले रामजस्ता सर्वगुण सम्पन्न आदर्शवादी व्यक्ति पाए।

रामायण भानुभक्तको मुख्य कृति हो। वाल्मीकीको रामायण संस्कृत भाषामा त्यति सरल छैन, तुलसीदासको रामायण पनि पुरानो हिन्दीमा त्यति सरल छैन तर भानुभक्तले पवित्र रामकथालाई सरल नेपाली भाषामा महाकाव्यका रूपमा तयार पारेका हुनाले नै उनलाई नेपाली कविहरूको श्रेणीमा पहिलो वा आदिकविको रूपमा चिनिन्छ।

सातकाण्ड रामायणको अनुवाद भानुभक्तले वि.सं. 1868 मा थालेर वि.सं. 1910 मा पूरा गरे। उनले वि.सं. 1868 मा स्वैच्छावस बालकाण्ड अनुवाद गरे। यसपछि वि.सं. 1909 मा 6 महिनाको निमित्त कुमारीचौकमा थुनिँदा अयोध्याकाण्ड, अरण्यकाण्ड, किष्किन्धाकाण्ड र सुन्दरकाण्डको अनुवाद गर्ने समय पाए। पछि गएर काठमाडौँमा पं. धर्मदत्त तथा मित्रहरूको प्रेरणाको फलस्वरूप वि.सं. 1910 मा युद्धकाण्ड र उत्तरकाण्डको अनुवाद भयो। रामगीता चाहिँ वि.सं. 1925 तिर मृत्युशैय्यामा हुँदा मुक्तिको भावनाले प्रेरित भई छोरा रमानाथलाई श्रुतिलेखनस्वरूप उनले लेखाएका हुन्।

भानुभक्तले आफ्नो रामायणमा शार्दूलविक्रीडित, वसन्ततिलका, स्रग्धरा, मालिनी, इन्द्रवज्रा, शिखरिणी, स्वागता र द्रुतविलम्बित जस्ता आठवटा छन्दहरूको प्रयोग गरेका छन्। भानुभक्तीय रामायणको 1319 श्लोकहरूमध्ये सबैभन्दा धेरै 1039 श्लोकहरूमा शार्दूलविक्रीडित छन्दको प्रयोग भएको छ। यसपछि 138 श्लोकहरूमा वसन्ततिलका, 41 श्लोकहरूमा स्रग्धरा, 37 श्लोकहरूमा मालिनी, 33 श्लोकहरूमा इन्द्रवज्रा, 29 श्लोकहरूमा शिखरिणी अनि 1-1 वटा श्लोकमा स्वागता तथा द्रुतविलम्बित छन्दको प्रयोग उनले गरे। केही उदाहरणहरू –

शार्दूलविक्रीडित :

तर्लु क्षार समुद्र आज सहजै भन्या इरादा धरी ।

श्री रामका चरणारविन्द मनले अत्यन्तै चिन्तन गरी ॥ (सुन्दरकाण्ड)

वसन्ततिलका :

यो इन्द्रजित गइ यसै विचमा मलाई ।

बाँधेर ल्याइकन आज दियो तलाई ॥ (सुन्दरकाण्ड)

अद्वैतवादी दर्शनमा आधारित 'लोकको गरुँ हित' भनेर रचना गरिएको 'भानुभक्तिय रामायण' को प्रमुख उद्देश्य तत्कालीन नेपाली समाजमा रामकथाको प्रचार-प्रसार गर्नु थियो।⁵ यद्यपि यसका सामाजिक एवं आध्यात्मिक उद्देश्यलाई पनि नकार्न सकिन्न। सामाजिक उद्देश्यमा जीवन दुःख र सुखको मेल हो, रामजस्तो देवताले पनि दुःख झेलनुपर्छ भन्ने कुरो बताइएको छ। जस्तोसुकै स्थितिमा पनि रावणजस्तो दुष्ट नभई रामजस्तो सदाचारी रहने शिक्षा यहाँ प्रदान गरेका छन् भानुभक्तले। अन्तमा 'सत्यमेव जयते' को मर्यादा राख्दै रावणजस्तो दुष्ट अत्याचारीको वध मर्यादापुरुषोत्तम रामद्वारा गराइएको छ। संसार माया हो, मानव जीवन क्षणभङ्गुर छ, तसर्थ मानवले परब्रह्म स्वरूप रामको स्तुति गर्नुपर्छ तबमात्र भवसागर पार गर्न सकिन्छ भन्ने आध्यात्मिक सन्देश पनि कविले रामायण मार्फत हामीलाई दिएका छन्।

तसर्थ समग्रमा भन्नुपर्दा भानुभक्तले नेपाली समाजमा सरल, सहज, गेयात्मक रामायण मात्र दिएनन् तर नेपाली साहित्येतिहासमा नयाँ कोशे ढुङ्गो थपे।

ख. कविताहरु :

भानुभक्तका लामा कविताहरुमा प्रश्नोत्तरमाला एउटा मुख्य कविता हो। रामायणमा झैं यसमा पनि कविले धेरथोर आध्यात्मिक दर्शन सम्बन्धमा चर्चा गरेका छन्। विशेषतः आध्यात्मिक मार्ग अन्तर्गत ज्ञान अनि भक्ति मार्गलाई सरल तरिका चर्चा गर्न यस कविताको रचना गरेका छन् कविले। भक्तिमार्ग अन्तर्गत हरिनामको महिमा गाउँदै पहिलो श्लोकमा नै कवि भन्छन् :

अपार संसार समुद्रमाहाँ ।

डुब्याँ शरण कुन छ मलाई जाहाँ?

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5. डा. कविता लामा, कवि भानुभक्त आचार्यको जीवनी तथा कृतिपरिचय, पुण्यप्रसाद शर्मा (सम्पा), केही समालोचना आदिकवि भानुभक्त आचार्य, जनपक्ष प्रकाशन, गान्तोक, सन् 2010, पृ सं 240।

चाँडो कृपाले अहिले बताउ

श्री कृष्णको पाउ छ मुख्य नाउ ॥1॥

ज्ञानमार्गको अनुशरण गरी ज्ञानले नै मोक्ष प्रदान गर्दछ भन्दै कवि भन्छन् :

कुन हो सहज मोक्ष गराइदिन्या ?

ज्ञान हो अरुको किन नाम लिन्या ॥4॥

कवितामा नारीहरुप्रति कविको भावना त्यति उचित देखिँदैन। कविताको 5, 10, 14, 22, 24, 28, 32, 42 आदि श्लोकहरुमा उनले नारीहरुको निन्दा गरेका छन्।

कुन हो ठुलो सर्व विवेक गर्न्या ?

स्त्री सब् पिशाच हुन भनि दूर गर्न्या ॥22॥

समग्रमा प्रश्नोत्तरमाला भानुभक्तको सर्वोत्कृष्ट अनुवादकला मानिन्छ। ज्ञान अनि भक्ति जस्ता कठिन आध्यात्मिक मार्गहरुलाई उनले कवितामा सरल-सहज ढङ्गमा बुझाएका छन्। यसबाहेक यस रचनामा कविले तृष्णा, मृत्यु, वैराग्य, आत्मा, ब्रह्म, मुक्ति आदि जस्ता कुराहरुलाई पनि बुझाउने प्रयास गरेका छन्।

भक्तमाला भानुभक्तको मौलिक कृति हो। यसको रचना वि.सं. 1910 तिर भएको मानिन्छ। मूलतः यसमा 22 श्लोक भए तापनि यसको रचना भने खण्डमा भएको पाइन्छ। पहिलेको 15 श्लोक भानुभक्तले पाल्पामा खरदार भएको समय रचना गरे भने पछिल्लो 7 श्लोक काठमाडौँ हुँदा रचना गरे। मोतीराम भट्टले 22 श्लोक भक्तमाला प्रकाशित गरे तापनि कहिँ कतै 15 श्लोक अनि 41 श्लोक भक्तमालाको चर्चा भएको पाइन्छ। भक्तमाला मूलतः भक्तिरसप्रधान कृति हो। जन्मनु अघि नै सीतारामको कीर्तन गर्ने प्रण यमसित गरेको उनी प्रथम श्लोकमा नै भन्दछन् :

प्रतिज्ञा मैले यो यमसित गर्न्याँ जन्मि अब ता ।

सिताराम् भज्या छु विषयहरुमा छाडि ममता ॥

तर जन्मिएपछि संसारको मोहपाशमा बाँधिएर यो प्रण भुलनगएको कुरा उनी पछिल्लो पंक्तिमा भन्दछन् :

प्रतिज्ञा सो बिर्सीकिन जन धनै खोजि डुलियो ।

सिताराम् भज्या हो शिव शिव उसै आज भुलियो ॥

संसारको क्षणभङ्गुरतालाई बुझ्दै जीवनको मूल उद्देश्य नै हरिकीर्तन गर्नु हो भनेर कवि भन्छन्। आफ्नो बाल्यकाल, यौवनावस्था, प्रौढावस्थामा पनि मोह मायामा परी ईश्वर आराधना भुल्ल गएकोमा कविलाई यहाँ पश्चताप भएको छ। शङ्कराचार्यको 'ब्रह्मसत्यम् जगत्मिथ्या' लाई अनुशरण गर्दै मायाले युक्त संसारको सम्पूर्ण चीजहरू असत्य, नश्वर, अनित्य हुन् केवल ब्रह्म मात्रै सत्य हो भन्ने ज्ञान कवि यहाँ दिँदछन्। हरि नामबाट संसारबाट मुक्ति पाइने कुरो कवि यहाँ गर्छन् :

मनुष्यै योनीमा यदि हरि भज्यो ता जन तन्यो ।

अवश्यै फन्दामा हरिकन नभज्या पछि पन्यो ॥

जगतमा यो चाला बुझिकन विचार गर्नु जनले ।

निरन्तर ठाकुरको चरणकमलै धर्नु मनले ॥

तसर्थ यहाँ यो भन्न सकिन्छ कि शिखरिणी छन्दमा रचित भानुभक्तको भक्तमाला हरिसंग भक्तहरूको योग हुने ज्ञानरत्न हो।

भानुभक्तको अर्को मौलिक कृति हो वधुशिक्षा। यसको रचना वि.सं. 1919 तिर भएको मानिन्छ। यसको रचनाको पछि पनि आफ्नै एउटा कथा छ। एकदिन भानुभक्त काठमाडौँबाट तनहूँ जाँदा बाटामा आफ्ना मित्र तारापतिको घरमा बास बस्न पुग्छन्। तर बेलुकी त्यहाँ सासु-बुहारीमा भनाभन चल्छ। भानुभक्तलाई यो कुरो मन पर्दैन अनि उनले 'वधु-शिक्षा' अर्थात् बुहारीहरूको निम्ति उपदेश कवितामार्फत कोरिराखे। यसमा जम्मा 36 वटा श्लोकहरू छन् जसलाई 3 वटा श्लोकहरू 'प्रस्तावना' अनि 33 वटा श्लोकहरू 'उपदेश' गरी भाग गरिएको छ। यसमा शार्दूलविक्रीडित, मालिनी, वसन्ततिलका आदि छन्दहरूको प्रयोग गरिएको छ।

भानुभक्तको 'वधुशिक्षा' मूलतः उपदेशात्मक कृति हो। यसमा बिहानदेखि बेलुकीसम्म बुहारीहरूले के कसो गर्नुपर्ने सो कुराको जानकारी दिइएको छ।

शुरुमा नै तारापतिको घरको स्थिति कवि यसरी बखान्छन् :

एक्थोक् भन्छु नमान्नु दुःख मनमा हे मित्र तारापति ।

तिम्रा ई जति छन् जहानहरू ता जुझ्या रह्याछन् अति ॥

सून्याँ दन्तबँझान आज घरको कर्कर गन्याको जसै ।

भर्नात् जाग्रन झैँ भयो मकन ता लागेन आँखा कसै ॥

यस कृतिद्वारा कविले एकजना आदर्श बुहारीको कल्पना गरेका छन्। बुहारीले सधैं पतिव्रता धर्मको पालन गर्नुपर्ने, सासु-ससुरा सेवा गर्नुपर्ने, घरको नोकर चाकरलाई खटाउनुपर्ने, चोर पापी आदिसंग पनि बाँच्नुपर्ने कुरा कविले यहाँ गरेका छन्। बुहारीहरूले अल्छी नगरी घरको साफ-सफाई गर्नुपर्ने तथा घरमा भएको पशु-पक्षीहरूको ध्यान राख्नुपर्ने कुरा कवि कवितामा गर्छन्। तसर्थ यस कृतिमार्फत कविले आफ्नो प्रगतीशील विचारधाराको स्थापना गर्न खोजेका छन्।

प्रश्नोत्तरमालामा जस्तै यस कृतिमा पनि नारीहरूप्रति कविको भावना नकारात्मक रहेको देखिन्छ :

हाँसुछैन कदापि नारिहरूले वेश्या हुन्या हास्तछन् ।

वेश्या लौ नहउन् तथापि घरको काम् ती सबै नास्तछन् ॥19॥

सौताको रिस गर्नु पाप छ बहुत एकै दुवैका पति ।

मर्दामा पनि जानु पर्छ जसले मीलेर संगै सति ॥13॥

भनेर कविले यहाँ नारीहरूले हाँसुसम्म नहुने, पति स्वर्ग भए सती जानुपर्ने कुरा भन्दछन्। बहुविवाहको समर्थन पनि कविले यहाँ गरेको पाइन्छ। नारीहरूको हक र अधिकारको पर्वाह नगरी कृति रचना गरेकाले कविले यहाँ धेरै आलोचना झेलनुपरेको छ।

जे होस्, तत्कालीन नेपाली समाजमा नारीहरूको स्थिति र शोषणको चित्रण यस कृतिमा भएको छ।

ग. फुटकर कविता_:

आदिकवि भानुभक्त आचार्यको फुटकर रचनाहरू पनि अन्य कृतिहरू सरह प्रसिद्ध छन्। भानुभक्त आशुकवि थिए। साधारण बोलचाल गर्दा, कसैलाई केही भन्दा उनी पद्यात्मक ढंगमा भन्दथे। यी पद्यहरू छन्दोबद्ध रहेका छन्। कसैले एक ठाँउ उनलाई परिचय सोधे र उनले आफ्नो परिचय यसरी दिए :

पहाडको अति बेस देश तनहूँमा श्रीकृष्ण ब्राह्मण थिया ।

खुप् उच्चाकुल आर्यवंशि हुन गै सत्कर्ममा मन दिया ॥

विद्यामा पनि जो धुरन्धर भई शिक्षा मलाई दिया ।

इन्को नाति म भानुभक्त भनि हूँ यो जानि चीन्ही लिया ॥

भानुभक्तका फुटकर कविताहरु कोही लामा त कोही धेरै छोट्टा चार पंक्तिका रहेका छन्। कति समालोचकहरुले यस्ता साना कविताहरुलाई मुक्तक भनेर पनि भनेका छन्। यी कविताहरुको रचनाको पछि सा-साना घटना वा कथा रहेका छन्। जस्तै : कोही समय भानुभक्त घुम्दै जाँदा एकजना घाँसीसंग भेट हुन्छ। त्यहाँ साधारण घाँसीले पनि भानुभक्तको मनभित्र 'परोपकारम् इदम् शरीरम्' को भावना जागृत गराएको छ। परोपकार गरे मात्र आफ्नो यश, कीर्ति फैलिने कुरा घाँसीसँगको भेटमा कविले बुझे अनि एउटा कविताको रचना गरे :

भर् जन्म घाँसतिर मन् दिइ धन कमायो ।

नाम् क्यै रहोस् पछि भनेर कुवा खनायो ॥

घाँसी दरिद्र घरको तर बुद्धि कस्तो ।

मो भानुभक्त धनि भैकन आज यस्तो ॥

भानुभक्त बडो रिसाहा थिए। एकपल्ट मित्र गजाधर सोतीको घरमा बास बस्न पुग्दा गजाधर घरमा थिएनन्। गजाधरकी स्वास्नीले परिचय नभएको व्यक्तिलाई वास दिँदैनन्। भानुभक्त अलि पर गएर रात बिताउँछन्। भोलिपल्ट बिहान गजाधरको नाममा उसकै सानो छोराको हातमा कवि बेलुकीको गुनासो गर्दै कविता लेखिपठाउँछन् :

गजाधर् सोतीकी घरबुढि अलक्षिनकि रहिछन् ।

नरक जानालाई सब सित बिदा बादि भइछन् ॥

पुग्यौं साँझमा तिनका घर पिठिमाहाँ बास गरियो ।

निकालिन् साँझैमा अलिक पर गुल्जार गरियो ॥

भानुभक्तले अभिधालाई पर सारेर आफ्ना कविताहरुमा लक्षणा अनि व्यञ्जनाको बेजोड प्रयोग गरेका छन्। आफ्ना व्यथा अड्डाका एकजना ठूला बाबुलाई यिनी यसरी पोच्छन्:

रोज् रोज् दर्शन पाउँछ्छ चरणको ताप् छैन मनमा कछ्छ ।

रात् भर् नाच पनि हेर्छ्छ खर्च नगरी ठूला चयनमा म छ्छ ॥

लाङ्खुट्टया उपियाँ उडुस इ सँगि छन् इन्कै लहडमा बसी ।

लाङ्खुट्टयाहरु गाउँछन् ति उपिजा नाच्छन् म हेर्छ्छ बसी ॥

भानुभक्तले आफ्नो जीवनमा धेरैपल्ट अड्डा अदालतको चक्कर लगाउनु परेको थियो। यसै सन्दर्भमा डिट्टा विचारीहरूको दीन अवस्था अनि अड्डा अदालततिर वा सरकारी कार्यलयतिर भइरहेको भोलीवादी प्रथाको चित्रण गर्दै कवि भन्छन् :

विन्ती डिट्टा विचारीसित म कति गरुँ चुप रहन्छन् नबोली,

बोल्छन् ता ख्याल गन्या झैं अनि पछि दिन्दिन् भन्दछन् भोलीभोली।

की ता सक्तिन भन्नु कि तब छिनिदिनु कयान भन्छन् इ भोली,

भोली भोली हुँदैमा सब घर वितिगो बक्सियोस् आज झोली।।

एकपल्ट एकजना पाल्पाली सुब्बाले पछिल्लो विवाह गरेपछि ज्योतिषी धर्मदत्तलाई आफ्नो आयु सोधिपठाए। भानुभक्त अनि धर्मदत्त दुवै ती सुब्बाका मित्र थिए। कवि धर्मदत्त मार्फत यसरी जवाब पठाउँछन् :

पैले दाङ् गइ एक विवाह गरियो भन्त्या पनी लेखियो।

फेर तेसै चिठिमा म मर्छु कहिले भन्त्या पनी देखियो।।

आयूको त विचार विवाह नगरी पैल्हे उचित् हो लिन्या।

उल्लू हौ तिमि उल्लुलाई अहिले कुन् उत्तरै हो दिन्या।।

बालाजीको सौन्दर्यको वर्णन कवि यसरी गर्छन् :

यतिदिनपछि मैले आज भालाजि देख्यौं।

पृथिवितल भरीमा स्वर्ग हो जानि लेख्यौं।।

काठमाडौं आएर यस शहरको वर्णन खुबै सुन्दर ढङ्गमा कविले गरेका छन्:

चपला अबलाहरु एक् सुरमा।

गुनकेसरिको फुल ली सिरमा।।

हिडन्या सखि ली कन ओरिपरि।

अमरावति कान्तिपुरी नगरी।।

कविका यस्ता धेरै फुटकर रचना पाइन्छन् ती मध्ये कही यहाँ प्रस्तुत छन्:

क) विद्वान जन्ले लोहलाई बेच्नु छैन।
भक्त्या सुन्थ्याँ यो कुरो हो कि ह्वैन।।

लोहा बेची मोल क्या लीनु होला।

योग्यै जानी यो उसै दीनु होला।।

ख) असल् मुङ्गे केरा कि त महि हवस् वेस अमिलो।

कि ता सेता मूला कि त बरु हवस् साग उसको।।

असल् हुन्थ्यो धूपमा नतर कसरी खानु यसरी।

भुटी ल्यायौ थाल्मा मकइ तिमिले क्यान यसरी।।

ख) आजार्थ्याँ मनका कुरा चरणमा झीजो गरौं क्यै भनी।

दर्शन पाइन फर्कि जान्छु अहिले हाजिर् जनाई पनी।।

हीडयाँ घरतिर आज ता घर पुगी फर्केर आई अब।

गन्थन् ई मनका कुरा चरणमा बिन्ती गरौंला सब।।

कविको सरल सहज भाषा अनि व्यङ्ग्यात्मक शैलीका कारण यी कविताहरू पठनीय एवम् सुन्दर भएको छ।

3. निष्कर्ष :

कवि भानुभक्त आचार्य नेपाली साहित्यका एक प्रखर विद्वान कवि हुन्। नेपाली साहित्य-समाजले मोतीराम भट्टमार्फत यदि भानुभक्तलाई नचिनेको भए धेरै कुरा गुमाउनुपर्ने थियो। रामायणको रचनाद्वारा कविले नेपाली समाजलाई रामकथा बुझ्ने मौका दिए। रामको आदर्श, सीताको सतीत्व, लक्ष्मण आदि जस्ता भाइहरूको भातृप्रेम, राजा दशरथ अनि रानी कौशल्याको पुत्रप्रेम आदि यस रामायणमा खुबै सुन्दर ढङ्गमा चित्रण गरिएको छ। त्यहीमाथि झर्ना शब्द अनि सरल सहज भाषाशैलीका कारण यो अझ सुन्दर बनेको छ। कतिपय आलोचनाको शिकार भए तापनि भानुभक्तका कविताहरू आजको सन्दर्भमा पनि सान्दार्भिक ठहर्दछन्। वधुशिक्षा, प्रश्नोत्तरमाला, भक्तमाला जस्ता कविताहरूमा हाम्रो जीवनको उद्देश्य र सामाजिक कल्याणका कुराहरू गरिएका छन्। उनका फुटकर रचनाहरू पनि धेरै सुन्दर छन्। झट्टै कविता लेख्ने शक्तिले कविले यस्ता कविताहरू रचेका छन्। आफ्नो व्यङ्ग्यात्मक शैली र सरल सहज भाषा भएका यी कविताहरू बडो रोचक बनेका छन्। यही शक्तिका कारण कवि भानुभक्त नेपाली साहित्यका आदिकवि बने। यद्यपि धेरै समालोचक विद्वानहरूले कविका यी रचनाहरू अनि आदिकवित्व विषय धेरै प्रश्नचिन्ह खडा गरेका छन्, यता यो एउटा शोधको विषय हो। तथापि अहिलेसम्म कवि भानुभक्त आचार्य नेपाली साहित्यका महान कवि हुन्, आदिकवि हुन्। उनका रचनाहरू नेपाली साहित्यमा अमर अनि कवि अविस्मरणीय बनेका छन्।

सन्दर्भ ग्रन्थ सूची :

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Structural Changes in Employment in India in the Post Liberalization Period with Emphasis on COVID 19 Effects

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Abstract

Contribution of labour-market has a crucial role in the development process of any country. Despite of different reforms, growth of employment in India becomes a matter of serious concern. Our recent growth experience shows that there is shift towards the use of more capital-intensive technology. Aggregate employment in absolute terms is continuously declining over the periods 2011-2012 to 2018-2019. Our government has implemented different employment stimulating programme to solve the problem. This article examines the profound changes in India's employment landscape from 1991-2022 through the lens of economic liberalization and structural shifts. Drawing on extensive data, it chronicles the gradual transition from an agrarian to a service driven economy and the implications of labour markets. Particular attention is devoted to analysing sectoral trends, increasing importance of unorganized sector and the impact of recent disruptions like COVID 19. This is a qualitative analysis based on PLFS, NSS data. The major findings of the study reflect that structural changes such as increasing importance of secondary and service sector were noticed in Indian economy during the post liberalization period. Unorganized sector's importance is continuously increasing. Change in occupational structure is also important in the context of Covid 19 faced by Indian economy.

Keywords: Structural shift, rate of growth of employment, organized sectors, self-employed labour, COVID 19.

Introduction

The world economy including Indian economy became stagnant due to the outbreak of COVID 19. The Government of India announced complete lockdown in between March 2020 to May 2020 for maintaining social distance among its residents. And this becomes a challenge for the Indian labour market to function on its own way because the unorganized sector and in some cases organized sector faced the challenge to earn a living. On 3rd May Government partially opened the economic activities and a New Normal life started which was difficult for the unorganized sector to face and to participate. So, the struggle of the unorganized sector continued. Gita Gopinath, chief economist of the International Monetary Fund (IMF), in a blog (dated 14th April,2020) suggested that the corona virus – led slowdown across the world is likely

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to be bigger than the financial crisis of 2007-08 and the Great Depression with more geographic outreach.⁶

According to ILO, more than 25million jobs were at risk due to COVID 19 pandemic and approximately 81% workers were severely affected by this lockdown in various countries. ILO mentioned in its report as ‘the worst global crisis since World War II’⁷. According to the ILO report more than 40 crore informal workers may get pushed into deeper poverty due to COVID 19 pandemic⁸.

The three nations which were mostly affected the virus, were USA and Brazil and the India. The unplanned lockdown announced by the Government of India led to an unmanageable crisis among the resident of India as there were no planning of how to earn a living. A large section of workers particularly from unorganized sectors did not have enough resources to face the three weeks of lockdown. At a glance hunger, poverty and unimaginable sufferings were the primary result of the lockdown. Facing the challenge imposed by the lockdown of different phases, our Government of India has taken an initiative on 12th May, 2020 namely ‘Atmanirbhar Bharat’ for reducing dependency. One of the important things to be Atmanirbhar of the country, is the requirement of a well-developed labour market. But the labour market in India is characterized by huge rate of unemployment which is an impediment for India to be atmanirbhar.

It is important to remember that the Indian economy was not in good position even before the pandemic. There is evidence that aggregate employment was declining in absolute terms in between 2011-12 and 2017-18. Open unemployment was around 2%-2.5% and it reached to the highest level of 6.1% in 2017-18 (highest in 45 years) and 5.8% in 2018-19.⁹ And then came COVID 19 with its effect of complete disruption of labour market activities. Data from PLFS (Periodic Labour Force Survey) shows acute crisis in the job market. Within a period of three months unemployment raised a lot.

The 1991 reform policy was designed to achieve high rate of growth through the implementation of the programme of LPG (liberalization, privatization, and globalization). Importance was given to free market competition. According to a considerable number of studies, this reform policy was to some extent successful for the Indian economy to overcome its crisis and to achieve the objective of high growth rate.

¹<https://blogs.imf.org/2020/04/14/the-great-lockdown-worst-economic-downturn-since-the-great-depression/>

⁷ <https://www.ilo.org> press release 7th April 2020

⁸ <https://m.economictimes.com/news/politics-and-nation/covid-19-crisis-can-push-40-crore-informal-sector-workers-in-india-deeper-into-poverty-ilo/articleshow/75032778.cms>

⁹ PLFS Data 2017-18 and 2018-19.

The budget of 2000-01 implied the 'second generation reform' which comprised of good governance and fiscal adjustment and structural reform. A number of studies showed that the impact of the reform was not pleasant in case of employment. (Himansu,2008). The Indian economy passes through the stages of financial crisis of 2007-08, demonetization of 2016, introduction of GST in 2017 and at last the most dangerous crisis of lockdown in 2020.

The last three decades have been a period of far-reaching transformation for the Indian economy. Starting with the pivotal reforms of 1991 that opened India to market forces, the country has emerged as a globally integrated economic powerhouse. However, this growth story has been inextricably intertwined with profound changes in employment structure. This article seeks to document and analyse these tectonic shifts to better understand the evolving world of work in India.

This article consists of nine sections. Section two is the literature review, three is the objectives, section four is methodology, section five describes structural change in employment, section six describes the growing importance of unorganized sector, section seven analyses the changes in occupation, section eight is the analysis and findings and the last section is conclusion.

Literature Review

Lee and Vivarelli (2006), Dasgupta and Singh (2007) expected that during the implementation of the reform in 1991, the lifting of industrial controls and trade restrictions may result in higher output growth, leading to a creation of new employment opportunities and a visible fall in poverty and inequality.

Santosh Mehrotra, Jajati Parinda, Sharmistha Sinha and Ankita Gandhi (2014) observed that in the Indian Economy, a structural transformation was happened and it was happened with an absolute fall in agricultural employment and a rise in non-agricultural employment, increasing participation in education, decline in child labour, mechanization of agriculture and rising living standards in rural areas due to growth in real wages which led to a decline in workforce , most of which was of women leaving the workforce. They also observed that a fall in demand for manufacturing exports and increasing capital intensity also resulted in a decline in manufacturing employment during 2004-05 to 2009-10.

Indraneel Dasgupta and Saibal Kar (2018) found that since 1991 per capita output has increased significantly while the overall unemployment rate has remained low. They also observed that labour force participation rates have fallen sharply, especially for women and in addition youth unemployment remained stubbornly high. An overwhelming proportion of the labour force continued to work in the

informal sector and there was a little evidence of a sustained rise in wages for either unskilled rural or factory workers.

Parveen Jha and Manish Kumer (2020) concluded that world of work has been hit very much, unleashing unprecedented vulnerability and insecurity for millions of workers in the context of the pandemic, particularly due to the ill-conceived lockdown and overall policy framework to deal with it.

Sonalde Desai, Neerad Deshmukh and Santanu Pramanik's (2021) findings revealed that there was a gendered change in employment during India's pandemic lockdown. There was a substantial decline in employment for men and women during the lockdown. They also concluded that comparing only wage workers, employment decline was far greater for women than for men.

Objectives

The objectives of this article are:

1. To analyse the profound changes in the employment structure in India in the post liberalization period.
2. To analyse the effect of COVID 19 on the employment structure of India.

Methodology

This article is basically qualitative in nature. The analysis is based on nationally representative datasets like different rounds of NSS (43th, 50th, 55th, 61th, 68th rounds), Periodic Labour Force Survey etc. Supplementary data sources covering unorganized sectors and different secondary sources like journals, research papers, published books, daily newspaper, internet etc are also utilized.

Structural change in employment

We start our analysis from the year 1991 as it was the most significant year in Indian economic history. The policy of LPG opened our economy to the World economy and gave importance to the free market competition with the aim to achieve a higher growth rate. Though the policy was to some extent successful to pull the economy from the deep crisis but the employment condition was deteriorated. The unemployment rate declined from 8.3% to 5.99% from 1983 to 1994 and then it increased to 6.68% by 2004-05. In the post reform period employment growth was accelerated in the secondary sector and service sector but it decreased in the primary which is shown in the following table¹⁰.

Table-1

Sectoral Contribution in employment

¹⁰ 43th, 50th, 61th & 68th rounds of NSS Data on Employment & Unemployment

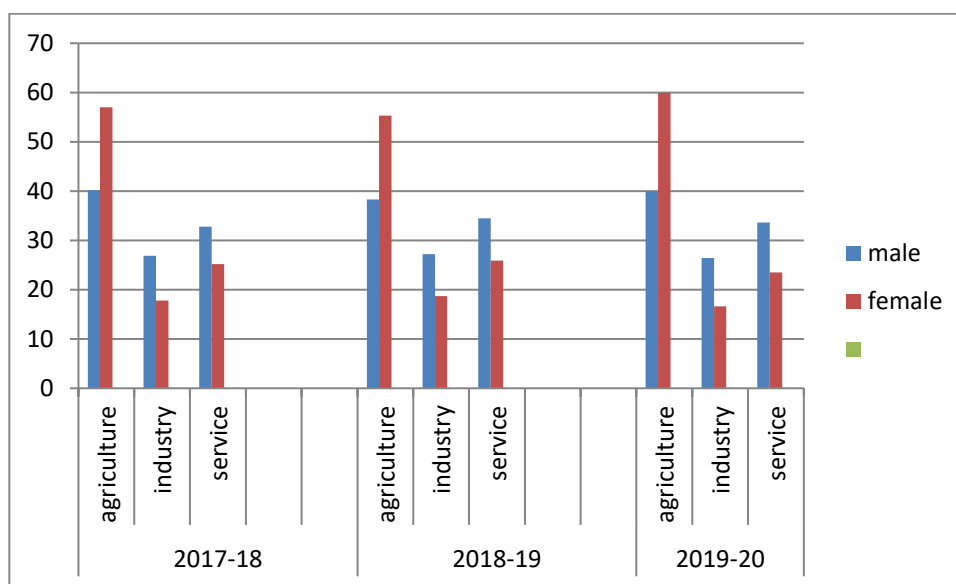
sectors	1994-95	2011-12	2015-16	2019-20
Agriculture	60%	52.9%	46.1%	45.6%
Industry	16%	19.3%	21.8%	23.7%
Service sector	24%	27.8%	32%	30.8%

Source: Employment Unemployment survey, PLFS

In the post-reform period, though the agriculture sector was the main source of employment but still the contribution of agriculture was decreasing and that of industry and service sector's contribution were continuously increasing. Another important fact is that service sector gets much more importance than the industry in terms of employment contribution. Following the PLFS data we see that the absolute number of workers and the share of the workforce employed in agriculture decreased during the period between 2017-18 to 2018-19. But something reverse was happened just after that. Indian economy witnessed a sharp increase in the share of employment in the agricultural sector. The share of industry and service sector was also declining though there was an increase in the job creation of both industry and service sector during 2019-20 which include a quarter effect of COVID 19 on the activities of the economy. CMIE data from consumer pyramid household survey revealed that the share of the agricultural sector in total employment increased from 35.3% in 2017-18 to 38% in 2019-20.

The declining trend in agricultural sector in the post reform period can be attributed to the fact that the labour productivity of the two non-agricultural sectors is much higher than the agricultural sector. But the reason behind the reverse thing that happened during 2019-20 can be explained by the fact that due to COVID 19 pandemic non-agricultural sector experienced a decline of 26% in its output growth whereas the agricultural sector experienced a decent growth of 3.45% in its output.

Another interesting fact is that along with the increase in the share of agriculture in employment, the year 2019-20 also experienced the increase in the share of women in the agricultural sector. This is clear from the following figure:-



Source: based on NSO-PLFS data,2017-18 to 2019-20

Figure 1: contribution of male and female in different sectors

Increasing importance of unorganized sector:

Based on different rules, regulation and conditions of work, economic activities are classified into unorganized and organized sectors. The activities which are well organized by the Government are known as organized sector. The organized sectors are well organized in terms of employment. On the other hand, the unorganized sector has no such well-defined structure. This sector does not follow any Government regulations. The examples of unorganized sectors are domestic workers, farming, construction companies etc. The National Commission for Enterprise in the unorganized Sector (NCEUS) reports that the share of unorganized sector is significantly large. In the post-reform period, the share of unorganized workers increased significantly while that of organized sector showed a decline. In 2011-12 almost 83% of workers were engaged in the unorganized sector and 17% in the organized sector. In 2017-18 the unorganized sector contributed 86.8% and the organized sector contributed 13.2%. According to the economic survey of 2021-22, about 91% additional workers were engaged in the unorganized sector.

Changing trends in occupation

Workers are divided into three categories of occupational status namely self-employed labour, casual-labour and regular wage/ salaried labour. A self-employed labour is one who earns his income by working for himself/ herself rather than for a specific employer. Businessman, lawyer etc are examples of self-employed person. Casual labours are those who do not earn regular wages and do not have regular employment throughout the year. Workers working at a construction site are examples of casual labours.

They are generally unskilled workers. Regular wage/salaried workers are those who work on a permanent basis and get regular salaries/ wages for their work. Data on employment and unemployment indicates that in the post reform period the occupational structure also changed in a significant way as reported in table 2. During this period the shares of casual and self-employed workers increased considerably (Bhalla 2004). The proportion of regular wage/salaried workers among female showed an increasing trend (6.5% in 1993-94 to 9% in 2011-12) but for male it was a declining trend(18.95 % in 1993-94 to 11.81% in 2011-12). Women are more often in the category of casual labour, though the share of this category has been increasing in case of men, while it has been some decline in case of female labour. To find out the effect of COVID 19 on the occupation of workers we consider the three consecutive years as COVID hits the economy on 2020.

Table-2: Percentage Distribution of workers by their employment status in usual status (ps+ss)

Year	Category of workers	Category of employment		
		Self-employed	Regular wage/salaried	Casual
1993-94	Male	50.75	18.95	30.29
	Female	56.65	6.44	36.9
	Total	54.7	13.53	31.77
1999-00	Male	51.28	16.86	31.8
	Female	55.53	7.54	36.9
	Total	52.61	14.65	32.75
2004-05	male	52.98	13.34	33.68
	female	60.99	9.10	29.91
	total	56.38	15.35	28.27
2011-12	male	52.57	11.81	35.62
	female	52.95	8.97	38.08
	total	56.58	8.63	32.79
2017-18	male	52.3	23.4	24.3
	female	51.9	21.0	27.0
	total	52.2	22.8	24.9
2019-20	male	52.4	24	23.6
	female	56.3	20	23.7
	total	53.5	22.9	23.6
2020-21	male	53.9	22.7	23.3
	female	59.4	17.4	23.2

	total	55.6	21.1	23.3
2021-22	male	53.2	23.6	23.2
	female	62.1	16.5	21.4
	total	55.8	21.5	22.7

Source: 43th, 50th, 61th, 68th rounds of NSS, PLFS 2019-20,2021-22.

What is clear from the table is that the category of self-employment gets too much importance during the pandemic period. COVID 19 hits our economy on 2020 and from then the proportion of self-employed in both male and female workers increased considerably. The likelihood of a woman worker being self-employed was much more than the male workers. We find that proportion of self-employed among female rose from 56.3% in 2019-20 to 62.1% in 2021-22 though the same for male also increased in the period mentioned. The proportion of regular wage/salaried labours both for male and female indicates a declining trend. The proportions of the category of casual labours remained more-or-less the same.

Analysis and findings

The structure of employment in India underwent significant changes from 1991 to 2022 due to economic reforms and other factors. In the early 1990s the Indian economy gave heavy focus on agriculture but as India opened to globalization and privatization there was a gradual shift towards the service and manufacturing sectors. The growth of the IT industry can be accounted for the remarkable rise of the service sector. But from 2017-18 the increase in the share of agriculture in total employment (from 35% in 2017-18 to 36.1% in 2018-19 and then 38% in 2019-2020) is an implication of poor condition of the labour market because the non-agricultural sector was not able to provide sufficient employment and as a result labours were forced to migrate to the agricultural sector for livelihood. According to CMIE large part of labour from the relatively unorganized construction sector and the the unorganized manufacturing sector moved to agriculture. Nearly 60% of employment in unorganized manufacturing industries migrated into agriculture at the times of distress.

Another important fact to notice is that despite COVID 19 shock agriculture sector performed well. Good monsoon, various government measures for increasing credit availability, infrastructural development, increased provision of quality inputs to the agricultural sector etc can be accounted for this sector's well performance. Livestock and fisheries experienced buoyant growth and had helped the agriculture sector to perform well during this period.

Increasing share of unorganized sector is another important fact to notice. The implication of this rise in the labour market is that there has been an increase in social security measures of the Government for the labours of the unorganized sector. E-Shram portal is for the registration of the unorganized workers and

to support them. Approximately over 28.62 crore unorganized workers have registered on this e-Shram portal in March, 2023.

In the post-reform period, the share of casual and self-employed workers in total workforce has increased. But the female labour force depended much on salaried service compared to male. But during the COVID period somewhat different picture is noticed. Proportion of self-employed labour (both male and female) continued to increase during this period. Due to the lockdown imposed by the Government of India, most of the salaried / regular wage labours lost their jobs. For casual labour, most of them were forced to stay at the nearby workplace for their livelihood. Those among the casual labours who were unable to join the work during the lockdown were failed to earn a livelihood. Self-employment was the best option in that period. Those who were able to run online business were hampered little less by the lockdown. After lockdown due to job loss most of the labour force joined in the labour market as the self-employed.

Conclusion

The findings of this article reveal that though the economic reform of 1991 that was undergoing in the Indian economy was helpful in terms of the growth of the economy but it affected the structure of employment in the economy which can also affect the social welfare. The Indian employment kaleidoscope has been in a constant state of flux over last 30 year. The period 1991-2000 can be mentioned as the agrarian root as the India's workforce remained firmly entrenched in agriculture. The next period 2000-2010 can be mentioned as service surge as the new millennium dawned, the service sector rapidly emerged as the pre-eminent employer, catalyzed by IT/ITES, finance, trade etc. But contrasting the services boom was manufacturing's sluggish employment trajectory. And at last the period 2010-2022 can be mentioned as the recent disruptions as the post – 2010 period witnessed a general employment crisis across sectors that worsened with COVID-19.

COVID 19 threatened the Indian economy. During this period drop in the labour force participation rate was a sign of slowdown. Work from home concept was not applicable for all types of labour. As a result what was inevitable was poverty and inequality. Both sectoral and income inequality increased a lot during that period. To balance the lives and livelihood, some steps were undertaken by the Government to support the affected one such as free food distribution, providing welfare pensions etc.

Hence what we can conclude is that sustainability of the Indian economy requires an access to quality work. Work from home is a great boost for the labour market especially for female labour market. Online teaching, Writing, communications, marketing, online sales etc could be preferred professions for labours to join in the labour market. In addition, self-employment opportunities including manufacturing at home, creative projects etc can be proposed professions on MSME levels in both rural and urban areas.

The structural change in the Indian economy from 1991 to 2022 have been transformative, marked by liberalization, privatization and globalization. These reforms spurred significant growth diversification and integration into global economy. However, challenges such as income inequality, regional disparities and environmental sustainability persist. As India continues on its developmental trajectory, it must prioritize inclusive growth, sustainable development and innovation to ensure a prosperous future for all its citizens.

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ICT enabled online learning: effectivity and challenges during pandemic

Koustav Kundu* and Anirban Pandey

ABSTRACT

Academic institutions (schools, colleges, and universities) across the world rely solely on traditional methods of teaching, i.e., face-to-face lectures in a classroom. Despite the fact that many educational units have begun to use online teaching during the period of pandemic. The unexpected emergence of Covid-19, a devastating disease caused by the Corona Virus (SARS-CoV-2) startled the entire world. In this pandemic condition, the success of this online mode of teaching-learning depends on the social and physical learning settings of students, especially in underdeveloped nations. The research claims that learning space disparity is caused by a lack of digital infrastructure paired with familial and societal dynamics. In this paper it has been discussed how academic institutions can reinvent content delivery, assessment, and student aid to alleviate learning space inequalities.

Keywords: COVID-19, digital divide, learning space inequality, online learning, ICT

1. Introduction:

Corona Virus, also known as COVID-19, is a dangerous infectious disease that has had a significant impact on the world economy. This catastrophe has shaken the education system, and this dread is likely to spread throughout the world's education field. Many schools and institutions were forced to shut down momentarily due of the COVID-19 pandemic. Various places are affected globally, and there is concern that the education system may collapse. As lockdown prevents access to open schools or universities, internet education is the sole remaining alternative for further education (Rielry 2020).

However, this internet-based and technology-based education system has a number of drawbacks. Students in wealthy households and metropolitan locations can readily buy educational digital equipment. Students from rural locations and poor families face the opposite predicament. Generally, smartphones are held by family members who generate money, and as students have restricted or no access to smartphones,

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they are having a hard time attending online classes. At this point digital division arises and students become more vulnerable to be dropping out (Carey 2020).

2. Online Teaching is Not Optional, it's a Need of Time:

Due to the alarming onset of this worldwide pandemic, a large portion of the planet is under quarantine. Several cities have become ghost cities as a result of Covid-19, and its impacts may also be seen through schools, colleges, and institutions. The Corona Virus has forced educational institutions to shift from an offline to an online form of interaction. The institutions that were previously averse to change will be forced to accept modern technologies as a result of this crisis. This disaster will demonstrate the financial benefits of online teaching and learning. We can reach to a huge number of pupils at any time and from anywhere in the world using online teaching options. All institutions must juggle various online pedagogical techniques and endeavour to make better use of technology. Numerous institutions all across the globe have totally digitalized their activities, recognising the critical need in this scenario. As a result, improving the effectiveness of online teaching–learning is critical at this point (Dhawan 2020).

3. Modes of Online Teaching:

3.1. Uses of Application:

For online education, a variety of digital platforms like Google meet, Webex, Zoom etc are currently available. These platforms make it easier for students and teachers to communicate with one another, and have enabled teachers and educators to take online classes effectively. These platforms are also utilised for administrative meetings and online academic seminars.

3.2. Platforms for Online Education:

Online education can be done on a variety of platforms like Impartus, Swayam, e-pg pathshala etc. Online lessons can be taken, videos can be posted, and recorded videos can be sent via these services. As a result, these platforms are beneficial to both students and teachers (Dhawan 2020).

3.3. Use of Different e-content :

There are no time or location constraints when it comes to learning with online education. Anyone, at any time and from any location, can learn as long as the internet facility is available. As a result, everyone can pursue a variety of educational opportunities. For students, several e-contents have been produced. These are beneficial to them in terms of expanding their understanding.

4. Scope and Application of ICT:

The application of information and communication technology (ICT) in education is done to assist, improve, and accelerate the transmission of information. In many studies' ICT has been found very effective around the world to enhance student learning and teaching approaches. Because of the rapid advancement of ICT, the world wide web (WWW) is constantly updating information warehouses for learners, educators, and scientists. Each day, a person from village can access the most up-to-date information and research. Open universities and distant education via ICT are new avenues for working individuals to get information while studying at home. Television is one of the most effective communication mediums for informing students, farmers, and athletes about current events through video snippets. It is possible to see the expensive and challenging research, sophisticated surgery for medical students, and so on (Oliver 2002; Raja & Nagasubramani 2018).

On the Internet, curriculum material such as textbooks, reference books and references are found. Even a foreign university course can be completed using the Internet, which is incredibly cost effective. The online credential is administered by the computer industry's behemoths, Microsoft and Oracle Corporation, in prometric centres all around the world. Audiocassettes, videotapes, audio and video CDs, and video multimedia interactive CDs are all available in the market for students ranging from kindergarten to graduate school. Computers can even be used by teachers to create content CDs. LCD/DLP projectors can be utilised instead of overhead projectors to provide effective learning for a large group of pupils (Raja & Nagasubramani 2018).

Table 1: ICT Tools Used in Education

ICT Tools	
Desktop and laptops, Projector Digital cameras Digital cameras, Printer Photocopier	Pen Drive Ipods, Ipads Webboards Scanners Microphones, interactive white board DVDs and CDs Flash discs

5. Opportunities of Online Learning and ICT:

Although there are many options for online learning in general, most educational institutions have moved to this approach during this time of crisis, which will enable online learning to flourish. During the onset of the Corona Virus pandemic, e-learning, working from home, and e-collaborations exploded. Educational institutions can now take advantage of this opportunity by requiring their teachers to teach and students to study via online methods. People have always been comfortable with class room learning and have never experimented with different learning methods. This crisis will usher in a new era for

online learning, allowing individuals to consider the positive aspects of e-learning. This is a moment when startling inventions and digital advancements have a lot of potential. Teachers may put technology to use and create a variety of customizable programmes to help kids learn more. Both the educator and the students will be put to the test if online learning is used. It will help pupils improve their problem-solving talents, critical thinking, and adaptability. Users of any age can utilize online tools in this critical moment, and they can take advantage of the time and place adaptability that comes with online learning. In this frantic circumstance, teachers can come up with new instructional ideas.

5.1. ICT as a Useful Tool for a Teacher:

It is beneficial to teachers' professional growth. With the use of ICT, a teacher can master a variety of linguistic skills. One can enroll in a variety of certification programmes offered by prestigious educational institutions. These programmes assist him in improving his ability to teach his topic information in a simple, cost-effective, and understandable manner. With the use of e-journals, e-magazines, and e-libraries, a teacher can expand his sphere of knowledge, which is only possible via the libraries, a teacher can expand his sphere of knowledge, which is only possible via the use of ICT.

He can also use audio and video conferencing to participate in conversations and conferences with subject-matter experts to enhance his knowledge and abilities (Oliver 2002; Raja & Nagasubramani, 2018).

ICT aids a teacher's ability to learn new teaching approaches. He has the ability to collaborate with pupils on a wide range of projects and assignments. It also aids him in the delivery of instructional materials, such as homework (Raja & Nagasubramani, 2018).

With the help of ICT, he/ she can engage in a variety of in-service training programmes and workshops that are vital to his professional development. ICT enables a teacher to inform his students about learning resources available on the internet, such as e-books, e-journals, and e-magazines, as well as social media sites such as LinkedIn, which aid in the better understanding of topic skills (Raja & Nagasubramani, 2018).

ICT also aids in the development of subject curricula. He can research curriculums from various countries to learn about their advantages and disadvantages, obstacles, and sociological and psychological issues affecting students. All of this aids him in developing a curriculum that leads to the achievement of the subject's goals and objectives (Raja & Nagasubramani, 2018).

5.2. ICT as a Useful Tool for a Student:

Online materials are available to students for study. Students can use a variety of materials to better grasp the topic. Students can learn whenever and wherever they want. Students can communicate with teachers

via the internet and obtain the necessary information. There are no time or location restrictions for students (Oliver, 2002).

6. Challenges and Digital Divisions:

Learner concerns, educator issues, and material issues are just a few of the challenges that online learning faces. Institutions face a difficult task in engaging students and getting them to participate in the teaching–learning process. Teachers face difficulties in transitioning from offline to online mode, adjusting their teaching approaches, and managing their time. It's difficult to create content that not only meets the curriculum's requirements but also engages students (Dhawan, 2020).

Teaching learning is a two-way interaction in which a student can ask the teacher questions in order to solve problems and gain a better understanding of the subject. After receiving feedback from students, teachers might adjust their teaching methods. As e-learning is more or less teacher-centric, pupils were unable to provide immediate feedback (Indira & Sakshi, 2018).

There is no clear guidelines by the government in their educational policies about online learning programs. There is a lack of standards for quality, quality control, development of e-resources, and e - content delivery. This problem needs to be sort out immediately so that everyone can take the benefits of online education (Dhawan, 2020).

To deliver education via the internet, an effective and efficient educational system must be built. Getting the devices and equipment, maintaining the equipment, training the teachers and students, generating the online content all take a lot of time and money (Indira & Sakshi, 2018; Dhawan, 2020).

Ensuring digital equity is crucial in this tough situation. Unavailability of digital tools, no internet connections, or Wi-Fi connections can cause a lot of trouble. Efforts should be taken by institutions to ensure that every student and faculty is having access to the required resources. They must also ensure that all educational apps work on mobile phones as well. Therefore steps must be taken to ensure the minimal digital divide (Indira & Sakshi, 2018; Dhawan, 2020).

Practice makes a man perfect is a well-known proverb. Students and teachers across various institutions have never really been familiar with e-learning. Most of them are associated with traditional methods of teaching and learning. We can learn a lot from this hectic situation. A lot of tools are available, teachers are required to choose the best from it and implement it to encourage their students. A step-by-step guide might be prepared by academic institutions that can guide the teachers and students on how to access and use various online learning tools and how to cover most of curriculum content via these tools and thus reducing the digital illiteracy. Teachers can present the curriculum in various formats, videos, audios, and

texts. It is beneficial if teachers gave their lectures with video chats, virtual meetings, and so on to take immediate feedback from the students (Dhawan, 2020).

In laboratory-based subject, laboratory experiments are extremely significant. It's difficult to offer practical lessons through the internet. Laboratory work provides students with hands-on experience in order to better comprehend the subject. Most institutes are closed during lockdown, laboratory work is suspended, and students lose interest in the subject.

7. Conclusion:

Students can learn while coping with the pandemic by utilising ICT for teaching and learning. In order to deliver uninterrupted services during and after the crisis, each institute requires a solid digital infrastructure. We can't forget about the pupils who don't have access to all of the internet resources. We need to be well-prepared so that we can adjust swiftly to changes. Institutions may develop contingency plans in the event of pandemics or natural disasters. Even in times of crisis, e-learning may aid in the provision of inclusive education. Such methods must be implemented in educational institutions to ensure that no student is denied an education because of their location, socioeconomic status, ethnicity, or other factors. It is critical to conduct in-depth research and due diligence on the technology.

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Education: In the Context of Sustainable Development

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Abstract:

Education is not limited to textbook knowledge. Connecting that knowledge to the real world is also a major objective. Students will know the information and make responsible decisions by making themselves a trusted citizen of the country and will play a role in the society, changing the climate, improving the economic conditions, achieving the desired quality of life. Philosopher Plato believed that education is essential for the economic development of a society. According to him "education is indispensable for the economic health of a good society". Adam Smith considered education as capital in economic terms while evaluating education. Others believe that education is a means of inculcating good habits, a desire for self-improvement, moral commitment and a sense of personal responsibility. It is clear from their words that there is no substitute for education in development. That is also true for developing countries like ours. Every aspect of life is constantly changing. Education can play an important role in meeting this challenge by raising the level of understanding of all people, because information is not only to be known or heard, but also to be understood. Learning helps to analyze data and arrive at an effective decision. Undoubtedly, education is a tool for sustainable development.

There is no substitute for education when it comes to development. Synonymous with the word development is improvement, progress and change. According to some - development means industrialization, to some independence, to others political, social and economic independence. Some want skyscrapers, migration from villages to cities. One wants instant worldwide communication and jet plane travel. Each nation chooses its desired goal in the light of its existing conditions. However, despite the differences in goals, all nations are sure to agree in favor of development. Education among others can also make an effective contribution in this regard. The question is, can education contribute to sustainable development? At the same time, does the current trend of our education system speak in favor of sustainable development? That is the subject of this article.

Key-Words: Sustainable development, Education, Environment, Human resource, Equality, Creativity

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Introduction

Education is termed as the main regulator of human life and development. The application of the knowledge gained over the ages is behind the amazing civilization that the once cave-dwelling primitives have developed today. The growth and prosperity of civilization, is rooted in the wide-ranging influence of education. Behind all the development of the world is the contribution of education. Education is the key to all development and the tool of development. Only education can provide permanent solutions to national and social problems. Education broadens the horizon of human knowledge. Education is the best and long-term investment through which the country and nation can be improved. The more educated the nation is, the better the nation is. Only education can make the country free from poverty. Education is power, knowledge is light and education is the backbone of the nation.

Education is the knowledge, skills, values and qualities that people acquire since coming to earth to meet their needs. Different thinkers have defined education from different perspectives. According to sociologists, the process of acquiring knowledge about material and social norms, their interrelationships, resources, linkages is called education. While physical prowess was once the pride of a nation, in the present age of the astonishing progress of science, there is no substitute for education in the national life. If education is given importance, the country will progress. As long as people are deprived of the light of education, the misery of the nation will continue to increase, people will live inhumane lives, along with this, obstacles will be created in the way of progress of the nation. A nation that is more advanced in education, knowledge, science, bravery and influence-prestige are greater of that nation. The ancient Greeks are remembered for their learning and knowledge. Uneducated people turn the nation into a dull, pride less, lack luster, stooping state. In fact, the expansion of education can make a nation dynamic, able to face problems, give courage to hope and dream. Hence the importance of education in individual and national life is essential.

The main objectives of education are three- the first of which is to improve the physical and mental skills of man, the second is to develop human qualities in the individual and the third is to provide universal and eternal motivation to man. The biggest driver of long-term economic growth is human resource development. Education is a medium through which human resource development takes place. Education influences people's knowledge, habits, behavior and values. Education, on the one hand, enriches the store of human knowledge, and on the other, plays a leading role in avoiding economic poverty.

Human resource is the biggest capital in the economic development of any country. Educated and skilled manpower is called human capital. If we can make the people skilled through technical education, it will be the biggest capital. Education plays an important role in development. Rabindranath Tagore felt that it would be impossible to accelerate the growth of the country if the masses could not be freed from the darkness of illiteracy. But he did not want to see people as mere capital. He wanted economic development through humanity. Development of any country is not possible in this complex economic era without skilled manpower and technological development. Along with material capital formation, human capital formation is also required, which will accelerate technological and sustainable development.

Objectives:

The objectives of this essay are as follows: -

- To develop the concept of sustainable development.
- To gain knowledge about the goals of sustainable development and their crisis.
- To understand the relationship of education with sustainable development.
- To understand the impact of various aspects of education on sustainable development.
- To develop the understanding of what should be done in the education sector to ensure the sustainable development.

Sustainable Development:

In the 21st century, the buzzword is sustainable development. One of the topics in any discussion on environment and development is sustainable development. The literal meaning of the word sustainable is to give or maintain the ability or strength. And the word development means upliftment or growth. So, sustainable development means that development is sustainable or can be sustained, which in one word can be called stable development or growth. The term sustainable development was first used by Eva Belfour, the founder of the International Institute for Environment and Development.

The main goal of every country in the world today is stable development. Economists and theoretical leaders in government policy makers in various countries have become particularly aware of the issue of sustainable development. In India too, various directive principles of the Constitution, even during the various Five Year Plans, have laid emphasis on formulating appropriate policies for sustainable development.

The concept of sustainable development was elaborated in two international documents published in the 1990s. One of these is "Carrying for the Earth: A strategy for sustainable living (1991)". And the other is the report of the 1992 United Nations initiative Bashundhara Summit held in Rio de Janeiro, Brazil. It is an important document on environment and development. The conference was attended by ministers, top leaders and environmentalists from 178 countries. This conference discusses the world's environmental problems and their solutions. The outline of environment and development specified in the conference can be called sustainable development approach or principles. The popular title of the 1992 conference report is the 21-point program or Agenda 21. The United Nations Commission on Sustainable Development in 1993 and the United Nations Environment Program in 2000 published the Global Environment Outlook emphasizing sustainable development.

Sustainable development is a modern concept of balancing environment and resources. Sustainable development can be done in various ways from the perspective of various branches of science like economics, social policy, ecology, geography etc.

Earnest Simonis Udo (1990) says that- Sustainable development refers to development projects that maximize economic benefits while maintaining natural quality and function over the long term.

According to Allen (1980), Sustainable development is the provision of quality of human life and permanent satisfaction of human needs.

Mayhew, S. & Penny, A. (1992) stated that- Sustainable development is a form of development based on prudent management of resources, resulting in lasting success.

According to Brundtland commission (1987), meeting the needs of the present generation, while maintaining the ability of future generations to meet their own needs is called sustainable development.

Allaby, M. (1993) says that- Sustainable development is economic development that reconsiders the environmental determinants of economic activity and is based on the use of resources that are replaceable and renewable.

According to the report 'Carrying for the Earth: A strategy for sustainable living (1991)'- Sustainable development is the improvement of human living standards within the limits of the natural environment within the carrying capacity of ecosystems.

Repetto, R.C. & Repetto, R. (1985) stated that Sustainable development is the national development approach that frees future citizens from the burden of foreign debt, enhances the skills and human qualities of future generations, and prevents environmental degradation and resource depletion.

Analyzing the above statements, it can be said that sustainable development is the development project through which maximum economic benefits can be realized while maintaining the quality and function of natural resources over a long period of time. Sustainable development is a long-term human development system in harmony with the environment. Through this development, the well-being of the country and the decade is achieved without destroying the balance of the natural environment. Development activities consider not only the needs of the present generation but also the future generations and the protection of the quality of the environment.

Goals of sustainable development:

In 2015, the United Nations General Assembly set 17 global goals or global targets for the implementation of sustainable development concepts and a better future. Thereby ending poverty and inequality in society and mitigating climate change. The time frame for achieving all these targets was 2030. The 17 objectives adopted are:

- No poverty
- Zero hunger
- Good health and well being
- Quality education
- Gender equality
- Clean water and sanitation
- Affordable and clean energy
- Decent work and economic growth
- Industry, innovation and infrastructure
- Reduced inequalities

- Sustainable cities and communities
- Responsible consumption and production
- Climate action
- Life below water
- Life on land
- Peace, justice and strong institutions
- Partnerships for goals

Crisis of sustainable development:

The primary goal of the concept of sustainable development is to create a pollution-free environment and equitable distribution of resources. For this purpose, the target of implementation of the concept of sustainability has been specified, but at present the increasing needs of the human society have put the target of this concept in front of a crisis. As a result of which the policies adopted too sustainably and sustainably in environmental, economic, social etc. fields have been affected in various ways. A number of factors can be attributed to the crisis in the implementation of sustainable development. It is discussed below-

- **More use of natural resources** - The demand of human society is increasing in the present time. To continue supplying this demand, various natural resources, such as unregulated mineral resource extraction, forest resource extraction, tree cutting, etc. are being done in large quantities, which are disrupting the natural balance and disrupting the path to sustainable development goals.
- **Unplanned production system-** Agriculture, industry etc. have to be expanded massively to keep supply in line with population growth and the demand of that population. As a result, the amount of forest land is decreasing; the level of pollution is increasing; which is damaging the environment and creating problems in implementing the principles of sustainable development.
- **Population Growth-** Since the Industrial Revolution, the world's population has been increasing. Even South and Southeast Asian countries are witnessing population explosion. As a result, forests are being destroyed to meet the basic needs of this large number of people. Besides, the

environment is constantly being damaged due to the unprecedented progress of urbanization, globalization, and transportation.

- **Political instability** – At the international level, conflicts between different countries and states can be observed from time to time. For example: - India-Pakistan, India-China, North Korea-South Korea, political instability can be observed in various countries of the Middle East which disrupts social life locally and hinders development. Even different states within a country, political instability are becoming an obstacle to stable development.
- **Concentration of resources-** There is a great inequality or concentration in the distribution of natural resources and human resources in the world. In this case, on the one hand, some regions have more population and less technological development; On the other hand, some regions have enough resources but less population. Also in the socio-economic condition of our country, a class of people has become market controllers and they are getting rich. On the other hand, poverty is increasing among common people.
- **Lack of awareness-** Presenting a pollution-free and resource-rich environment to the human community is the goal of sustainable development, but lack of awareness and lack of planning by people damages the entire environment, which creates a crisis in the path of sustainable development policies.

Quality education and sustainable development:

Education is considered as a tool for development of human universal qualities and human resource development. The developed countries are achieving rapid success in all fields including literature, arts, agriculture, industry and trade along with the development of science and technology by developing a standard and balanced education system. Quality education, human resource development and modernization of education are widely discussed in recent times. Ensuring quality education, not quantity, is the need of the hour. Universal education is now transcending the borders of countries and nations especially due to the advent of computers and information technology. Education not only gives people knowledge about production techniques but also creates a supportive outlook for development. Encouraging the people to live a better life, awakens the sense of life, imparts moral and spiritual knowledge to the people, which acts as a supporting element of balanced development.

Quality education is an important topic of discussion in the current context. It continues to attract the attention of academics in the developed world as well as in the developing world. The United Nations

Educational, Scientific and Cultural Organization UNESCO have highlighted the concept and importance of quality education in the context of sustainable development. Considering the 10-year period from 2005 to 2014 as the 'United Nations Decade of Education', UNESCO defined the goals, objectives, components and action plan for quality education. The organization considers quality education as a prerequisite for education in sustainable development. Emphasis was laid on simultaneous quantitative and qualitative development of education.

One of the many essential prerequisites for quality education is greater investment. Despite the fact that our country is a developing country, the allocation of money in the education sector is insufficient. Undeniably, the funds allocated for the development of various sectors are often not spent fairly and efficiently; which is unintended and unwanted. The actual investment in the education sector in the country is insufficient compared to the demand. Developing countries should follow the recommendations made by the Delors' Commission report for spending on education sector. If the recommendations in this regard are implemented, the qualitative and quantitative aspects of education will be balanced and integrated.

Along with this, there is no alternative to increase the budget allocation in the education sector to ensure the desired quality of education, modern and up-to-date curriculum, diversification of subjects, opening new horizons of knowledge in the field of science and technology and ensuring world-class research programs in higher education institutions and universities. To this end, the university grant commission and the government can jointly take multi-dimensional effective initiatives to ensure the quality of education and research by gradually increasing the budget allocation in the higher education sector in the national budget to consolidate the position of the country's universities in the regional and global rankings. Only then will the Sustainable Development Goals (SDGs) be achieved.

Quality education cannot be expected to depend on any one subject. It requires coordinated and effective management and action of many elements. The elements that need to be properly coordinated for quality education are modern and up-to-date curriculum, sufficient number of qualified and trained teachers, necessary teaching materials and physical infrastructure, proper teaching-learning methods, appropriate evaluation methods, continuous monitoring etc.

Sustainable development in learning and teaching:

Education creates knowledge, skills, attitudes and values in people, which can contribute to future development. However, in terms of sustainable development, there is a need to bring about a change in the current education system. There is a need to improve the quality of education with a focus on

understanding the contours of the future, decision making and critical thinking which will lead to sustainable development in the future. Education for sustainable development refers to the inclusion of development issues in learning and teaching such as climate change, disaster response, poverty alleviation, sustainable consumption, biodiversity, disparity between rich and poor, human rights, globalization, awareness of better lives, etc. A report by WWF's Living Planet shows that mankind's ecological footprint (a measure of human demand on the Earth's ecosystem) is steadily increasing. This increase is greater in developed countries than in developing countries. A developing country like ours should have this sense of growth. Because if we don't start thinking about where we are, we lose our way on the way forward. If such concepts are included in the textbooks of students especially in environmental science, they will undoubtedly gain a real understanding of the bio capacity of the earth. But not only the inclusion of content in the curriculum, but also the need to follow participatory teaching and learning methods in the classrooms that encourage students to take action towards behavioral change and sustainable development. The practice of modern concepts in formulating and implementing a standardized and up-to-date curriculum ensures achievement of goals.

The concept of sustainable development in education and learning has spread throughout the world. Learning in sustainable development can be seen from two perspectives. One is - what will we learn and how? If we talk about environmental problems, scientific knowledge can play a role in solving these problems. And such learning can be achieved by students through their teachers. Therefore, education is one of the ways to understand the problems around us and gain knowledge about their solutions. The role of the school and its teachers in achieving that education is unique. Again, for this development we want to adopt participatory teaching-learning approach which helps students to change their behavior and empower them. This result in higher thinking skills based on mutual cooperation, drawing meaningful blueprints for the future, decision making etc. becomes easier. So how can a teacher teach students about sustainable development? One of the main ways to do this is to create group discussions. When a student presents their own opinions on a given topic with the help of a teacher, their understanding of the topic is clarified. In this regard problem based learning can play a clear and practical role. It develops decision making ability in students. However, in this case, the main goal should be to create the ability to take action in the field of sustainable development among students. So both the subject matter and the method of learning are important. Sustainable development will be coordinated; everyone and everything will come into it. Researchers have coined a concept called the 'chair of sustainability' for the facility. This chair has four legs and in policy-making and management these four legs must be coordinated equally. If you put too much weight on one of the legs, the chair will lose balance.

Creative education in sustainable development:

Sustainable development is largely dependent on a protected and balanced ecosystem and refers to the quality of life and security of the people, thereby enabling a sound economic status. However, it is not possible to define sustainable development by relying on a few developmental factors. With this guarantee, it is possible to say that the great contribution of education in sustaining development is truly undeniable. Education ensures people's well-being and increases their opportunities to become responsible and productive citizens of society. Quality and creative education is key to sustainable development. Therefore, a revolution in the education sector can be brought about by bringing changes in the education system, providing training to teachers, bringing skills in curriculum development and other aspects under the plan, which will ensure the education needs of the 21st century. In the same vein, constant learning should be given importance to the students in terms of development. However, an important question in the case of institutions is - will they follow the current trend of development or will they discover a new trend in the field of development, think something new? Because one thing is clear, the trend of development is changing. In keeping with the times, new trends of development have to be followed and therefore creativity plays a very important role in teaching. Therefore, creativity has to be given priority in the case of students. Learning to live with the times therefore strengthens the foundations of sustainable development. Creativity education is therefore essential for sustainable development.

Equality and sustainable development in education:

The distribution of wealth is disproportionate to the growing population. This is a major obstacle to sustainable development. Women's education can play a major role in overcoming this barrier. Women's education enables proper utilization and distribution of resources while keeping the fertility rate under control. Sustainable development is not possible if the educational attainment of both men and women is not equalized. It is generally seen that highly educated people accumulate more wealth than uneducated or less educated people. This is also a major issue in terms of sustainable development. Bridging the gap between these two groups of people is also a big task. Also people from all strata of society irrespective of rich and poor should have equal opportunity of education. Education should be spread among people of all communities. If you think about it, what is clear is that if you want development, you need education. Education can accelerate and sustain this development only when education is ensured for both men and women, while at the same time the gap between highly educated and less educated people is reduced, education is equally accessible to all irrespective of caste-religion-gender. However, there should be a change in the way of obtaining and providing education. Textbook learning should be aligned with real life.

This is the basic philosophy of the development we aspire to as a nation - to move forward with equal consideration for all. And the most important path for this progress is a non-discriminatory rights-based education system. A system in which every citizen of the country will have the right to develop with equal opportunities and will be motivated to lead the welfare of the country. All the nations that have succeeded in the world today have invested the most in education. Therefore, there is a proverb about development in the modern world - invest in education first. Even after 75 years of independence, we have not been completely successful in providing equality of education. Although investment in education is increasing, participation rates are increasing. We are already getting positive results. But we still have a long way to go to reach the real development scale. To introduce a rights based and non-discriminatory education system, we need to make radical changes in our current education system and approach.

Education to ensure sustainable development:

Education should move forward keeping in mind the goals of this century keeping in harmony with the society. It is important to keep in mind that globalization is not only about economics; Also involved in other matters. People of one country are going to another country. Mixing of cultures is happening. Information is being exchanged. Eating habits are changing. The whole world is united today. In such a situation, it is difficult to keep pace with the whole world. The contribution of education in making a country so prosperous is undeniable. Therefore, sustainable development must be ensured by taking proper, application-oriented and life-oriented education. To ensure sustainable development through education, therefore, the following points must be seriously considered-

- Taking into account the strategies of developed countries in the formulation of curriculum, taking into account the own society, culture, educational philosophy, psychological condition of students;
- Giving attention to the needs of the 21st century in teaching and learning;
- Verifying the student's knowledge, age and aptitude in determining content;
- Prioritize cutting edge technology in equipment selection;
- Ensuring the participation of all students by varying the way lessons are presented;
- Providing training to management committee members including teachers in building an ideal learning environment;

- Considering 21st century education;
- Giving teachers a clear understanding of the digital classroom;
- Enhancing students' real-life engagement with lesson content through practical application-based knowledge practice;
- Enhancing students' direct engagement with lessons through hands-on learning;
- Giving importance to mainstream education along with alternative education;
- Emphasis on women's education;
- Ensuring 100% attendance of students in schools with emphasis on vocational education.
- To inspire students with the spirit of patriotism;
- To make the student aware of his/her rights, duties and responsibilities for effective participation in the democratic process/institution as a good citizen/to train him/her to perform the responsibilities;
- Helping students to know and understand their own environment;
- To gain knowledge and insight into national traditions and culture and inculcate respect for them;
- To understand the importance of science and technology in improving the quality of life and to be interested in its application;
- Helping the child acquire mathematical concepts and skills and basic skills in English as a foreign language and use this language;
- Assisting the student in acquiring the necessary knowledge and skills to develop into a complete person and worthy citizen according to the student's ability, inclination and interest and making him suitable for the next level of education;
- To help develop a positive attitude towards manual labor and respect for working people;
- To support the physical development of the child through exercise and sports and to help develop healthy living habits; and

- To make the student aware of his rights, duties and responsibilities for active participation in family and social life.

Conclusion:

Sustainable development is not a goal, it is a long-term process and a standard by which people's behavior and actions can be judged. An educated citizenry is essential for implementing sustainable development. The level of education a country's citizens are attaining may enable or limit the implementation of a country's sustainable development plan. A nation that has a high literacy rate but lacks skills has little chance of progress. In most cases these nations have to buy energy and commodities from the international market at high prices. To collect this high price they have to resort to international business. It involves exploitation of natural resources or conservation of land from subsistence family-based farms to agriculture. Therefore, it can be said that limiting the speed of economic growth or following the traditional pattern of growth is not sustainable development, but introducing new development models suitable for this concept. In this model, all kinds of investments will be made based on the welfare of people. Social, economic and environmental development requires good societal decision-making and depends on an educated population. Education for sustainable development helps us to face present and future globalization challenges constructively and creatively and build sustainable societies.

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Differentiating AI from Non-AI in Education and Teaching

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ABSTRACT

AI (Artificial Intelligence) and its acceptability among students and teachers may be impacted by several factors. One of the major factor is the understanding of differences between AI and non-AI technologies may lie in the methods used to automatize and to adapt tasks. AI includes machine learning, natural language processing, or various kinds of algorithms. Teaching community has fear of replacement or ethical concerns with AI. The purpose of the current study is to investigate the understanding of concepts of educational tools with or without AI. The main premise is that technologies with AI would be more negatively judged than technologies without AI, and thus intention to use would be weaker for technologies with AI. Discussions show that when students and teachers seem to accurately perceive and understand the potential benefit of AI technologies with clear cut distinction from Non AI technologies, they have better acceptance. So the purpose is to develop better understanding of AI and Non AI for educational practices, and increase acceptability from all stakeholders in the Education fraternity.

Keywords: Artificial Intelligence, AI, Non-AI, Education, Teaching

Introduction

Education technology as reached such a level that computer enabled platforms can take decisions or act accordingly without human intervention. Artificial intelligence (AI) is one of the latest additions in this arena. So, the teaching fraternity today has a lot of advantage using AI while teaching. At present times, many priorities for improvements to teaching and learning are being explored. Teachers and Educators seek technology-enhanced approaches addressing these priorities that would be nontoxic, more effective, and accessible. Teachers practice AI-powered tools and services in their everyday class, such as voice assistants in their class; tools that can correct grammar, complete sentences, and write essays; and automated trip planning on their phones for field study. As a result, teachers see opportunities to use AI-powered tools like speech recognition to increase the help and support available to students with disabilities, multilingual learners, and others who could benefit from greater adaptively and

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personalization in digital tools for learning. They are advancing and exploring how AI can enable writing improving lessons, as well as their process for finding, choosing, and adapting material for use in their class lessons. So, everyone in education field has a responsibility to harness the good effects to serve educational priorities while also protecting against the dangers of AI being integrated in education.

Key Understandings of AI in Education

From the time when Alan Turing first pronounced the hopeful dream of “thinking machines” in 1950 Skinner (1958) , artificial intelligence (AI) research has been advanced in many different fields and generated an increasing body of knowledge. As early as 1991, Garito has stressed that AI is changing the traditional role of a teacher (Garito, 1991). Lately, further many other scholars point out that AI empowers educators with better ways to teaching and learning in the following ways -

- ***AI enables new forms of interaction.*** Students and teachers can speak, gesture, sketch, and use other natural human modes of communication to interact with a computational resource and each other. AI can generate human-like responses, as well. These new forms of action may provide supports to students with disabilities.
- ***AI can help educators address variability in student learning.*** With AI, designers can anticipate and address the long tail of variations in how students can successfully learn— whereas traditional curricular resources were designed to teach to the middle or most common learning pathways. For example, AI-enabled educational technology may be deployed to adapt to each student’s English language abilities with greater support for the range of skills and needs among English learners.
- ***AI supports powerful forms of adaptivity.*** Conventional technologies adapt based upon the correctness of student answers. AI enables adapting to a student’s learning process as it unfolds step-by-step, not simply providing feedback on right or wrong answers. Specific adaptations may enable students to continue strong progress in a curriculum by working with their strengths and working around obstacles.
- ***AI can enhance feedback loops.*** AI can increase the quality and quantity of feedback provided to students and teachers, as well as suggesting resources to advance their teaching and learning.
- ***AI can support educators.*** Educators can be involved in designing AI-enabled tools to make their jobs better and to enable them to better engage and support their students

Distinguishing AI from Non-AI

To construct a logical argument, giving reasons and evidence to support whether an example is AI or not. For example, you might think out loud: “I believe that a car or a bicycle are NOT AI because they just follow their driver’s instruction without getting better over time. The car behaves the same way no matter what road you are on.” This argument has a claim, reason, and evidence. In order for students to be able to fully grasp the following work in this course about artificial intelligence, it is important that they have a strong understanding of Artificial Intelligence, and how it differs from traditional computer programming, or other “automated” technology such as automatic doors etc.

One of the most effective ways to think about this distinction is to ask the question “where does the intelligence, or thinking, take place?” For artificially intelligent programs, the program itself is making the decisions (for example, Google Maps and Navigation, and a smartphone decides whether to stop or not). In non-examples of artificial intelligence, it is the human programmers that tell the computer how to respond to certain commands (a human must click a calculator to perform the operations; a television must be controlled by a human, etc.). Examples of Non- AI is Television Analog watch, Cycle, Calculator. Examples of AI are Robotic dog, Smart watch Google Map

Prediction based on dataset and algorithm is the key in AI. Algorithm is a set of steps or rules to follow in order to solve a problem or accomplish a specific goal. Teachers can project to the students the three main parts of an algorithm: *the input*, the steps to change the input, and then the output. It can be explained that an algorithm is a lot like a recipe. The ingredients are *the input*, the steps that you take to cook the something are the steps to change the input, and the *output is* a hopefully a yummy treat. Think of an example of an “algorithm” for making *masala tea*. What are the inputs? (Tea kettle, water, milk, tea leaves, sugar, ginger, cardamom, cloves, black pepper) What are the steps to prepare tea? . Switch on the stove. . Pour 2 cups of water into a teapot and place it on the burning stove. . Let the water come to a boil. . Add milk, tea leaves, and sugar to the water. . Add crushed ginger, cardamom, cloves, black pepper to the mixture and stir for 2minutes. . The tea is ready to be sieved and served. What’s the *output*? Masala Tea. So we can think of some examples of other algorithms, such as math algorithms, other recipes, or maybe processes used in the classroom for specific purposes (e.g., the “start the day” algorithm might include putting belongings away, getting breakfast, or the algorithm to cook Rice or Daal step by step). Now how computers use algorithms programmed by computer scientists to complete tasks and achieve goals. It is important to know that computers are very systematic. The algorithms that computer scientists write have to be very specific because the computer will follow exactly what they say Renz (2020). AI processes the importance of datasets and algorithms in making predictions. The datasets that machines learn from as well as the algorithms the machine uses

create the machines' perspective. When algorithms continue with biases that already exist, they make problems like racism, sexism, classism to carry on with. This is even more dangerous since it is challenging to see exactly how algorithms work, so we might not be exactly sure how they are working in negative ways. Looking more carefully at the algorithm itself and not accepting its results blindly. Making sure that the data set is more equitable. Testing out algorithms to make sure they do not contain bias.

Discussion

From this discourse it can be noted that use of AI tools particularly in the field of education and teaching has its major benefits in terms of personalisation of learning, administrative efficiency, continuous assessment and ubiquitous access. AI mainly helps learners in personalising their learning but at the same time teachers also benefit from it to design their tailor-made lesson design that ultimately innovates the pedagogy. In case of LMS based teaching AI is found to be very effective in managing the educational administrative tasks also. As of now it is an established fact that continuous assessment is more effective over periodic assessment. AI in this regard helps in collecting significant attainments of the students in the form of e-portfolio from a data set of continuous assessment records. But teachers are also aware of new risks. Useful, powerful functionality can also be accompanied with new data privacy and security risks. Educators recognize that AI can automatically produce output that is inappropriate or wrong. They are wary that the associations or automations created by AI may amplify unwanted biases. They have noted new ways in which students may represent others' work as their own. They are well-aware of "teachable moments" and pedagogical strategies that a human teacher can address but are undetected or misunderstood by AI models. They worry whether recommendations suggested by an algorithm would be fair. Educators' concerns are manifold. As the we get more familiar with the concept and definition of AI, with the help of a *game*, they can apply that definition to several examples to see if the examples are relevant or not. 2. If it is possible, bring a physical example of a machine with AI (i.e. a smartphone, or a smart watch or other virtual assistance device) and a machine without AI (i.e., a normal watch or calculator). When going through these examples, remind the key questions that help to distinguish AI from Not AI: Does the machine perceive/understand its environment? There is a difference between perceiving/understanding the environment and just sensing it. A camera senses light and colors but does not know what objects they represent Sharkey (2016). Does the machine continue to learn? There is a difference between learning and using a knowledge bank. In Board games, such as Ludo and Chess, students can win every time they play. However, they are not learning to beat their opponent; instead, they are following exact mathematical instructions for the game. Online games (chess, Ludo) require a computer to react to their opponent's strategy. Does the machine make plans or decisions on its own?

There is a difference between making a plan and following a plan. For instance, Google map app makes a plan. ➤ Does the machine interact with its environment? There is a difference between interacting with an environment and following a script. Automated phone tellers, like those in voicemail, can talk with you but they follow a pretty rigid script. Modern voice assistants can respond to almost any question, no matter how you phrase it. Who is doing the thinking - “where is the intelligence” - with the humans who programmed it or with the device/program? If a system does one of the four intelligent things above, think about how it works. Is it making intelligent actions on its own or did all of the intelligence come from the humans who programmed it.

Conclusion

To conclude we can say that AI tools are trained with datasets and algorithm. Whereas Non-AI tools like Smart machines which are not AI, do not require training data, they work on algorithms only and do not decide of its own. AI machines learn from mistakes and experience. They try to improvise on their next iterations. Non-AI Smart machines work on fixed algorithms (set of rules)and they always work with the same level of efficiency, which is programmed into them. AI technologies can analyses the situation and can take decisions accordingly. Apparatuses which are not AI cannot take decisions on their own. AI based drones capture the real-time data during the flight, processes it in real-time, and makes a human in dependent decision based on the processed data. An automatic door in a shopping mall, seems to be AI-enabled, but it is built with only sensor technology. An AI enabled instrument should not only recognize, but should also do something with its gathered information. Artificial intelligence” must mean a human-made interface with the power to reason and integrate knowledge. AI must demonstrate at least some of the following behaviors associated with human intelligence: planning, learning, reasoning, problem solving, knowledge representation, perception, motion, manipulation and, to a lesser extent, social intelligence, and creativity.

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উন্নততর নাট্যরূপের সন্ধান উৎপল দত্ত

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সংক্ষিপ্তসার:

উৎপল দত্ত (১৯২৯-১৯৯৩) সমাজকে বিশ্লেষণ করতেন বিপ্লবী দৃষ্টিভঙ্গি দিয়ে। তিনি নিজেকে শুধু নাট্যকার মনে করতেন না। প্রয়োজনের তাগিদে তিনি নাটক লিখতেন। বাংলা নাট্যসাহিত্যের এক স্বতন্ত্র অধ্যায় উৎপল দত্ত। তাঁর মননশীল উদ্ভাবনী শক্তি ভারতীয় নাট্যসাহিত্যে স্মরণীয়। শুধু নাটক নয়, যাত্রাপালা কিংবা পথনাটিকাতেও তিনি ছিলেন শ্রেষ্ঠ। একটি সার্থক নাটক উপস্থাপন করতে হলে প্রতিটি নাট্যকর্মীকে শিক্ষিত হওয়া প্রয়োজন তা উৎপল দত্ত গভীরভাবেই অনুভব করেছেন। থিয়েটারের শিক্ষায় শিক্ষিত হতে হলে সমাজ, ঐতিহ্য, দেশের সংস্কৃতি, বিশ্ব রাজনৈতিক পরিস্থিতি এসব যে ভালো করে জানা দরকার, সে বিষয়ে তিনি সমস্ত নাট্যকর্মীকে সচেতন করে দিয়েছেন। চিন্তা ও মননের স্তরে যে সূক্ষ্ম অনুভূতিগুলো থাকে সেগুলোকে যতক্ষণ মঞ্চে রূপায়িত করা না হচ্ছে ততক্ষণ থিয়েটারে তার কোনো মূল্য নেই। নাটক যেহেতু সামাজিক প্রক্রিয়া এবং এই বিষয়গুলিকে কেন্দ্র করেই সামাজিক প্রক্রিয়াগুলি চলতে থাকে, সেহেতু এগুলিকে অবহেলা করে কোনো নাট্যকর্মী তাঁর নাট্যদায় পালন করতে পারেন না। নাটকের প্রতি দায়বদ্ধতা তাঁর কাছে পণ্য নয় বলেই তাকে সার্থকভাবে বাঁচিয়ে রাখার জন্য প্রাণরস সহকারে আমাদের সামনে তিনি এসেছিলেন নবদূতরূপে। উৎপল দত্তের সমগ্র জীবনের নাট্যচর্চার গুরুত্বপূর্ণ বিষয় ছিল মুখ্যত সমাজ, রাজনীতি, যুক্তিবাদ, নাস্তিকতা, ঈশ্বর বিরোধিতাসহ নানাবিধ প্রগতিশীল চিন্তাভাবনা। তিনি বিশ্বাস করতেন থিয়েটারে আগত অভিনেতা মাত্রই বুদ্ধিজীবী। ইতিহাস, দর্শন, সমাজবিজ্ঞান, রাষ্ট্রবিজ্ঞান, চিত্রকলা, সংগীত, সাহিত্য সম্পর্কে মানুষের সর্বগ্রামী চিন্তাধারার প্রতি তার সক্রিয় উৎসাহ থাকবে— নচেৎ অভিনয়ে চরিত্রের গভীরে প্রবেশ সম্ভব হবে না অধিকাংশ ক্ষেত্রেই।

সূত্রশব্দ: দ্বন্দ্বমূলক চিন্তা, মননশীল দর্শক, Agit-prop, শিল্পীসত্তা, ঐতিহ্যের শিকড়

থিয়েটারে অভিনয় সম্বন্ধে উৎপল দত্তের দৃষ্টিভঙ্গি ছিল সম্পূর্ণ দ্বন্দ্বমূলক চিন্তাভিত্তিক। তাঁর মতে সুস্থ, সুঠাম স্বাস্থ্য, সুন্দর কণ্ঠস্বর ও বাচনভঙ্গি থাকলেই হবে না, ভালো অভিনয় করতে গেলে দ্বন্দ্বমূলক চিন্তা অপরিহার্য। পৃথিবীর শ্রেষ্ঠ অভিনেতারা নিজেদের অভিনয়ে অজ্ঞাতসারেই দ্বন্দ্বমূলক পদ্ধতি প্রয়োগ করেছেন। অনুভবের মধ্য দিয়ে শিল্পী তাঁর ভিতরের মানুষটাই প্রকাশ করেন। উৎপল দত্ত ভারতীয় থিয়েটারের সন্ধান করতে গিয়ে উঁকি দিয়েছেন পূর্বসূরীদের নাট্যগৃহে। ইতিহাস, দর্শন, সমাজবিজ্ঞান, রাষ্ট্রবিজ্ঞান, চিত্রকলা, সংগীত, সাহিত্য – মানুষের সর্বগ্রামী চিন্তাধারার প্রতি তার সক্রিয় উৎসাহ থাকবে— তা না হলে অভিনয়ে চরিত্রের গভীরে প্রবেশ সম্ভব হবে না অধিকাংশ ক্ষেত্রেই। চ্যাপলিন হাসির মধ্যে কান্না খুঁজে বেড়ান, স্তানিস্লাভস্কি বলেন অভিনেতাকে একই সঙ্গে সজাগ ও বিহ্বল হতে হবে।^১ দ্বন্দ্বমূলক চিন্তা বলে অভিনয়ে চরিত্রটিকে ভালো-মন্দ, সৎ বা অসৎ বলে এড়িয়ে যাওয়া উচিত নয়। গোটা চরিত্র এক অখণ্ড, আন্ত মানুষ। চরিত্রের জটিলতার ব্যাখ্যা দিতে পারে একটি অভিনেতা-অভিনেত্রীর মূল কথা। প্রতি ক্ষেত্রে দুই বৈপরীত্যের দ্বন্দ্ব, উলটো এবং সোজা, সাদা এবং কালো। নাটকে কোনো চরিত্র বুঝতে গিয়ে অভিনেতা দ্বন্দ্বমূলক চিন্তার দ্বারা প্রভাবিত হন। এই দ্বন্দ্ব হল চরিত্রের রূপায়ণ বনাম চরিত্রের ব্যাখ্যা। অভিনেতা চরিত্রটি ব্যাখ্যা করবেন, না, তিনি নিজে চরিত্র হয়ে ওঠার চেষ্টা করবেন। এই দুইয়ের মধ্যে পারস্পরিক ক্রিয়া-প্রতিক্রিয়া ঘটে এবং তৃতীয় উপাদান দর্শক এসে হাজির হয়। উৎপল দত্ত অভিনেতার নানা দ্বন্দ্বমূলক পরিস্থিতির উল্লেখ করতে গিয়ে বললেন, তাঁর কাজ সত্য হওয়া, বাস্তব হওয়া, অথচ তার সামনে বসে থাকে দর্শক যা ভুলে যাওয়া অভিনেতার পক্ষে সম্ভব নয়, কারণ ওই দর্শকের জন্যই তাঁকে গল্প বলতে হয়, যে গল্পটি আগে ঘটে গিয়েছে; সেই মুহূর্তে দর্শকের কাছে গল্পটি অবাস্তব, অসত্য। তাই অভিনেতা গুরুত্বপূর্ণ দ্বন্দ্বের মুখোমুখি হন। অভিনেতা পাট মুখস্থ করে মঞ্চে উঠে অভিনয় করেন, অথচ বাইরে দেখান যেন কত শান্ত, ধীর। এখানে দ্বন্দ্ব উত্তেজনা বনাম প্রশান্তি। অভিনেতা চরিত্রের গভীরে প্রবেশ করে দর্শকের কাছে চরিত্রটি আকৃষ্ট করে তুলবেন এবং দ্বন্দ্বমূলক চিন্তার দ্বারা দর্শককে সাময়িক ভুলে গিয়ে অভিনেতা দর্শকের কাছে আসবেন।

থিয়েটারে এমন বিষয় আনতে হবে যা দর্শকের মনকে স্পর্শ করে। নাটকের বাঁধুনি, গতি এবং চমক যেমন থাকবে তেমন যুক্তিবাদী সময়োপযোগী বিষয় চিন্তা এবং ভাবনাকে স্থান দিতে হবে। অর্থাৎ নাট্যকার নাটকের আঙ্গিক ও বিষয়বস্তু নির্বাচনের ক্ষেত্রে যত্নবান হবেন। এমন বিষয় ও আঙ্গিক দর্শকের সামনে আসে যা দর্শকের বোধগম্য হয়। উৎপল দত্ত নাটক নির্দেশনার ক্ষেত্রে দুর্বোধ্য রূপ নীতি ত্যাগ করার পরামর্শ দিয়েছিলেন। তাঁর মতে, “ফর্ম-এর পরীক্ষা কখনো দর্শককে বাদ দিয়ে হতে পারে না, দর্শকের জ্ঞানবুদ্ধিতে বিস্মৃত হয়ে পরীক্ষা চালালে শুধু নিজের বৈদগ্ধ্য প্রকাশ পাবে, দর্শককে সঙ্গে নিয়ে এগোবার পথ রুদ্ধ হয়েই থাকবে। আমি কেমন বুদ্ধিমান তা দেখাবার জন্য তো আর থিয়েটার খুলিনি...! খুলেছি দর্শককে উন্নততর নাট্যরূপের সন্ধান দিতে। সেটা ক্রমে ক্রমে হয়।”^২ ভালো নাটক সবসময়ই দর্শককে সঙ্গে নিয়ে চলে। ভালো নাটক মাত্রই একাধারে মঞ্চ এবং সাহিত্য সচেতন। মঞ্চসফল নাটকের ব্যাখ্যা দিতে গিয়ে তিনি গুরুত্বপূর্ণ একটি দিকের কথা বলেন। একটি মঞ্চসফল নাটকের মধ্যে কাব্যছন্দ থাকবে, যা নিয়ে নাট্যকার এবং পরিচালক খেলা করবেন আর এই কাব্যছন্দের মধ্যেই নাটকের প্রাণ লুকিয়ে আছে। ফলে নাটক জনপ্রিয় হয়ে ওঠে। নাটকের অন্তর্গত লজিকে ঘটনাটা সত্য বলে মনে হবে। এলিয়টের মতে

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নাট্যকৌশলের মজাই এই – “It may allow characters to behave inconsistently but only with to a deeper consistency”^৩ উৎপল দত্তের রচনার দিকে তাকালে একটি বক্তব্য পরিষ্কার হয়ে যায় যে, তিনি সব সময়ই যুক্তিতর্কের মধ্য দিয়ে তাঁর নাটকগুলিকে মঞ্চে উপস্থাপিত করার কথা বলেছেন।

তাঁর নাট্যচিন্তার মূলে রয়েছে তাঁর বিপ্লবী থিয়েটার ভাবনা। তিনি নিজেকে অভিহিত করেছেন ‘প্রোপাগান্ডিস্ট’ নামে। বিপ্লবী থিয়েটার আসলে বামপন্থী চেতনাসমৃদ্ধ থিয়েটার^৪ উৎপল দত্ত এই থিয়েটারের প্রেরণা পান জার্মান নাট্য প্রযোজক আরউইন পিস্কাটারের নাট্যভাবনা থেকে। পিস্কাটার বলেছিলেন যে, সমাজ পরিবর্তনের হাতিয়ার হচ্ছে থিয়েটার। একমাত্র বিপ্লবী থিয়েটার রাজনৈতিক ঘটনার বিশ্লেষণ করতে পারে। উৎপল দত্ত লিটল থিয়েটার গ্রুপ প্রতিষ্ঠার পরই যোগ দেন গণনাট্য মঞ্চে। তাঁর বিপ্লবী থিয়েটারের প্রেরণা পানু পালের কাছ থেকে। বিপ্লবী থিয়েটারের ভিত্তি আছে এজিটপ্রপের (Agit-prop) প্রতি অনুগত্য। Agitation ও Propaganda— দুটি ইংরেজি শব্দ। এই দুটি শব্দের মিশ্রণে তৈরি হয়েছে ‘এজিট-প্রপ’ (Agit-prop)^৫ উৎপল দত্তের নাটকে লক্ষ করা যাবে, একই সঙ্গে এজিটেশন ও প্রোপাগান্ডা। প্রচলিত সমাজব্যবস্থার ভিত কাঁপিয়ে দেওয়া ছিল তাঁর নাটকের বিষয়। তাঁর নাট্যকর্মের প্রধান উদ্দেশ্য ছিল দর্শক সাধারণকে সমাজ পরিবর্তনের চিন্তায় উদ্বুদ্ধ করে তোলা। তিনি চিরাচরিত ধারায় নাটক লিখতে চান নি। তিনি তাঁর নাট্যজীবনের আদিপর্ব থেকেই নাট্যকর্মকে একটি বিশেষ উদ্দেশ্যের দিকে এগিয়ে নিয়ে যাওয়ার চেষ্টা করেছেন। সাম্যবাদী চেতনাসমৃদ্ধ সমাজতাত্ত্বিকতাই ছিল তাঁর দৃষ্টিভঙ্গি আর এই বিপ্লবী ভাবনা এসেছিল এজিট-প্রপের সংস্পর্শে। বুর্জোয়া সমাজব্যবস্থা সম্পর্কে মানুষের মন থেকে বিশ্বাসের ভিত ভেঙে দেওয়াই ছিল এজিট-প্রপের উদ্দেশ্য। অবিশ্বাস জাগাতে পারলে মনে সৃষ্টি হবে ক্রোধ। সেই ক্রোধ পরিণত হবে ঘৃণায়। ঘৃণার প্রকাশ পাবে প্রোপাগান্ডায়। আর এজিটেশন হল ক্রোধ।

উৎপল দত্ত জনতেন এই এজিট-প্রপের গুরুত্ব কতখানি। সেই জন্যই তাঁকে রাজনৈতিক নাট্যকার আখ্যা দেওয়া হয়। তিনি তাঁর বিপ্লবী ভাবনা প্রতিষ্ঠা দেওয়ার জন্য ইতিহাসকে জেনেছেন। উৎপল দত্ত ছিলেন পিস্কাটারের মতো একজন মার্কসবাদী নাট্যকার। উৎপল দত্ত তাঁর Towards a Revolutionary Theatre-গ্রন্থে নিজের থিয়েটার ভাবনা সম্পর্কে বলেছেন— “I am ratisam, not nutral, and I believe in politisized struggle. This day I cease to participate in political struggle. I shall be dead as an artist too.”^৬ উৎপল দত্তের এই বিপ্লবী থিয়েটারি ভাবনার সত্যতা সংক্ষেপে দেখবার চেষ্টা করব।

‘কল্লোল’, ‘লেনিন কোথায়?’, ‘মানুষের অধিকারে’, ‘দুঃস্বপ্নের নগরী’— এই নাটকগুলির সংক্ষিপ্ত বিশ্লেষণের মধ্য দিয়ে উৎপল দত্তের থিয়েটারের বিপ্লবী ভাবনা একরকমভাবে দেখা যেতে পারে। অবশ্য এ নিয়ে অনেকের অনেক তর্ক থাকতেই পারে। ‘মানুষের অধিকারে’ (১৯৬৮) লেখা হয়েছে আমেরিকার বর্ণবিদ্বেষের পটভূমিকায়। নাটকটি প্রথম অভিনীত হয় মিনার্ডা থিয়েটারে ১৪-ই জুলাই ১৯৬৮-তে। বাংলা নাটকের ইতিহাসে এ ছিল এক আশ্চর্য সৃষ্টি। আমাদের মনে রাখতে হবে, বোম্বে থেকে ফিরে আসার পরেই উৎপল দত্ত লিখছেন ‘মানুষের অধিকারে’। তবে এই নাটক তেমনভাবে জনপ্রিয় হয়নি এই কারণে নাটকটি দীর্ঘ বলে। ‘দেশব্রতী’ পত্রিকায় সত্য ঘোষ ও নরেন্দ্র সেনের দুটি দীর্ঘ প্রবন্ধ বেরোল নাটকটিকে প্রতিবিপ্লবী বলে চিহ্নিত করে^৭। আত্মপক্ষ সমর্থন করে প্রত্যুত্তরে উৎপল দত্ত লিখলেন একটি অসামান্য প্রবন্ধ ‘মানুষের অধিকারের স্বপক্ষে’। রচনার দৈর্ঘ্য বেশি এই অজুহাতে ‘দেশব্রতী’ তা ছাপতে অস্বীকার করায় এল.টি.জি ছাপার খরচ পর্যন্ত দিতে চাইল, কিন্তু তা প্রকাশিত হল না। তখন তাপস সেন এল.টি.জি.-র সাধারণ সম্পাদক রূপে লেখাটি পুস্তিকারূপে প্রকাশ করেন। তবে লেখক হিসাবে ব্যক্তিগত কোনো নাম ছিল না। ‘মানুষের অধিকারে’ নাটকটি ১৯৩১ সালের আমেরিকার কুখ্যাত স্কটস্বেরা মামলা অবলম্বনে রচিত। ১৯৬৭ সালের ঘটনার সূত্র ধরে নাটক চলে যায় ১৯৩১ সালের অ্যালবামার তুলো খেতের পাশে পেটরক স্টেশনে। স্টিভ বলে, ‘...স্কটস্বেরায় সেই কচি কচি ছেলেগুলো ধরো তোমরাই, ধর তোমরাই সেখানে উপস্থিত। পার্থক্য শুধু একটি— ওখানে তোমাদের হাতে ছিল না অস্ত্র’। প্রথম দৃশ্যে স্টিভ এই সংলাপের মধ্য দিয়ে সাম্রাজ্যবাদী শক্তির প্রতিভূ শ্বেতাঙ্গ মার্কিনরা কীভাবে নিগ্রোদের উপর অত্যাচার করে তা স্পষ্ট— “...সেই ১৯৩১ সালে— স্কটস্বেরা মামলা। শত শত মামলার একটি। মার্কিন স্বাধীনতা দেবীর পদতলে মাথা কুটেছি ব্র্যান— মার্কিন সংবিধান আর আইনের দোহায় পেড়েছি— সংবিধানগত নিয়মতান্ত্রিক সেই জোড় হস্তে মিনতি— ফলে শুধু শ্বেতপাদুকার ভার শতগুণে তীব্র হয়ে কাদায় চেপে ধরেছে কালো মাথা! তারিখ ছিল ২৫-শে মার্চ, ১৯৩১— স্থান পেটরক স্টেশন— এলাবামা রাজ্য— মার্কিন যুক্তরাষ্ট্র।” এই সম্ভাবনা দৃশ্যের পরই নাটক চলে আসে ১৯৩১ সালে। বিষয়বস্তু এবং নিহিত বিশ্বাসের জোরে এই নাটক হয়ে ওঠে সর্বকালীন নিপীড়িত মানুষের নাটক।

‘মানুষের অধিকারে’ নাটকের সবচেয়ে গুরুত্বপূর্ণ দৃশ্য ডেকাটুর শহরের আদালতের দৃশ্য। বিচারের প্রহসনের মাধ্যমে রাষ্ট্রবিরোধী তাজা মানুষের হত্যা করা সেদিন শুধু ডেট্রয়েট বা অ্যালাবামায় নয়, পৃথিবীর অনেক দেশেই হয়েছে— ভারতেও। এই নাটকে প্রধান প্রধান চরিত্রের কথা বলেছে কাব্যের ভাষায়, কেননা চরিত্রগুলি আদর্শের প্রতিনিধি— আইওয়ার প্রতিনিধি^৮ শুধুমাত্র ‘মানুষের অধিকারে’ নয়, ‘কল্লোল’ বা অন্যান্য নাটকের দিকে তাকালে স্পষ্ট যে নাটকের প্রধান চরিত্রেরা হয়ে ওঠে সমাজের এক একটি গোষ্ঠীর প্রতিনিধি। ‘লেনিন কোথায়?’, ‘দুঃস্বপ্নের নগরী’র দিকে তাকালেও আমাদের কাছে সেই ছবি ধরা পড়বে। ‘কল্লোল’ (১৯৬৫) ২৯শে মার্চ ১৯৬৭ সালে মিনার্ডা থিয়েটারে অভিনীত হয়। উৎপল দত্তের রাজনৈতিক অবস্থানের জন্য সর্বাধিক প্রচারিত বাংলা সংবাদপত্রটি ‘কল্লোল’-এর বিজ্ঞাপন ছাপা বন্ধ করে। কিন্তু মিডিয়া এই বয়কট এবং শাসকদলের গুণ্ডাদের হামলা সবকিছুকে উপেক্ষা করে ‘কল্লোল’ রমরমিয়ে চলতে থাকে। ইতিমধ্যে উৎপল দত্ত নিজেও গ্রেপ্তার হন। ফলে তিনি এবং ‘কল্লোল’ বামপন্থী জনতার আবেগের উৎস হয়ে ওঠে এবং মিনার্ডা থিয়েটারকে কেন্দ্র করে বাম কমিউনিস্ট পার্টি শহরাঞ্চলে শক্তি সংহত করতে থাকে। ‘কল্লোল’ নাটকে নৌবিদ্রোহের তথ্য সমাবেশের সত্যসত্য নিয়ে তর্কের অবকাশে বা শাদুল সিং-এর আপোসহীন বিপ্লবী ভূমিকার চমকপ্রদ উপস্থিতির পাশাপাশি নাট্যকার নারীর স্থানের প্রশংসা তাঁর বিপ্লব প্রকল্পের সঙ্গে অবিচ্ছেদ্যভাবে যুক্ত করে দিয়েছেন। ‘কল্লোল’-এ বিপ্লবী শাদুল সিং-এর বিপ্লব প্রকল্পে নারীর সতীত্বের সংস্কার বা স্বামীর কাছে স্ত্রীর প্রশংসিত আত্মসমর্পণের অন্যান্য বিধি অটল থাকে। শমীক বন্দ্যোপাধ্যায় ‘উৎপল দত্ত – নাটক সমগ্র, পঞ্চম খণ্ড’-এ লেখেন, “কৃষ্ণাবাদ-এর ভূমিকাভিনেত্রী শোভা সেন এই অংশটি উদ্ধৃত করে তাঁর স্মৃতিকথায় লেখেন: ‘এমন চরিত্রের তুলনা কোথায়? এই সংগ্রামী মেয়েরা গতানুগতিক সতীপনার পরাকাষ্ঠা নয়, এরা বেঁচে থাকার লড়াই

চালিয়ে গেছে আত্মসম্মান বজায় রেখে। মা একাধারে বিপ্লবী চেতনায় উদুদ্ধ ও পূত্রস্নেহে বিচলিত। তার সেই বিপ্লবী চেতনা তাকে সঠিক পথে চালিত করে। সে ছেলেকে বোঝাতে চেষ্টা করে, বৌকে সমর্থন করে, তাকে ভালোবাসে নিজের মেয়ের মতোই। এ চরিত্রে অভিনয় করে আমি ধন্য হয়েছি।” সমাজের অমর্যাদা ও অধিকারের মধ্যে দাঁড়িয়ে দুই প্রজন্মের নারীর মধ্যে এই পরস্পর নির্ভরতা ও সহমর্মিতাবোধ বা প্রতিরোধী সৌহার্দ্যই উৎপলবাবুর নাটকে নারীসমাবেশে এক বিশেষ মতাদর্শের দ্যোতক হয়ে ওঠে।”

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উৎপল দত্ত নাটকের মধ্য দিয়ে জীবনকে তুলে ধরেন সমাজ-দুন্দ্বের প্রতিরূপ হিসেবে। ইতিহাসের তথ্য তাঁর কাছে বড় নয়। মাটির তলায় জ্বলতে থাকা আগুন, বহু সহস্র ক্ষুদ্র ক্রোশ ক্রমশ এক হয়ে এক বিশাল আকাশ ছোঁয়া বিস্ফোভ সৃষ্টি করে থিয়েটার সম্পর্কে উৎপল দত্তের এটাই মূল চিন্তাভাবনা। স্বাধীনতা পরবর্তী ভারতবর্ষ বিশেষ করে পশ্চিমবঙ্গের রাজনৈতিক দ্বন্দ্ব সংগ্রামের বিশেষ মুহূর্ত, রাষ্ট্রশক্তির অত্যাচার নিপীড়ন, সাম্প্রদায়িক হানাহানি প্রমুখ এমন অনেক বিষয়কে তিনি তাঁর নাটকে স্থান দিয়েছেন। ‘দুঃস্বপ্নের নগরী’ সমকালের সাড়া জাগানো নাটক। ১৯৭৪ সালে রচিত এই নাটকের কেন্দ্রে রয়েছে কলকাতার সেই সময়কার চিত্র। রাজনৈতিক সন্ত্রাসের চূড়ান্ত পরিস্থিতিতে প্রশাসন, শাসকদল, বিত্তবান শ্রেণি, লুস্পেন যুবক ও ভাড়াটে খুনি সবাই মিলে এই রাজ্যকে এক নৈরাজ্যের অবাধ ক্ষেত্র তৈরি করেছিল। নাটকের শুরু ও শেষ হয় স্বপ্নের গান দিয়ে। বলা বাহুল্য, কলকাতা শহর যাকে কেন্দ্রীয় রাষ্ট্রনেতারা নাম দিয়েছিলেন কখনও ‘মিছিল নগরী’, কখনও ‘দুঃস্বপ্নের নগরী’ কারণ এই শহরের নাগরিকরাই শাসকদের ঘুম কেড়ে নিয়েছিল। এই নাটকের মধ্য দিয়ে লেখক সমকালীন শাসকদের চরিত্র তুলে ধরেছেন ব্যঙ্গ, বিদ্রূপ এবং কবিতার মধ্য দিয়ে,

“এক বুক ঘৃণা নিয়ে উষার প্রতীক্ষা তার,
অত্যাচারীর শেষ ঘন্টা বাজবে ঢং ঢং।”

অর্থাৎ নাট্যকার উৎপল দত্ত নাটকে অসামান্য দক্ষতায় বিভিন্ন চরিত্রের মুখ ও মুখোশ উন্মোচন করে ফ্যাসিবাদী শাসকগোষ্ঠীর স্বরূপ উদ্ঘাটন করেছিলেন। তাঁর নাটকে বিষয়ের নানাবিধ বৈচিত্র্য রয়েছে। যেমন ‘লেনিন কোথায়’-এর নাট্যবিষয় ইতিহাসাশ্রয়ী। কিন্তু লেনিন, স্তালিন, ট্রটস্কি, ক্রুপকায়্যা ইতিহাসের এই সব চেনা মুখ নাট্যকারের নাট্য উপাদান বিস্তারে, দ্বন্দ্ব সৃষ্টিতে, তীক্ষ্ণ রাজনৈতিক ও সরস সংলাপে, কল্পনার শিল্পময় মিশ্রণে জীবন্ত হয়ে যাত্রার গ্রামীণ আসরে বিশ্বাসযোগ্য হয়ে গিয়েছে। নাটকের শেষে লেনিনের ঘোষণা— ‘কমরেডস্, যে শ্রমিক কৃষক বিপ্লবের কথা আমরা বলেছিলাম তা সম্পন্ন হয়েছে, এবার আমরা রাশিয়ার সর্বহারার সমাজতান্ত্রিক রাষ্ট্রগঠনের কাজ আরম্ভ করবো। বিশ্ব সমাজতান্ত্রিক বিপ্লব দীর্ঘজীবী হোক।”

প্রোপাগ্যান্ডিস্ট উৎপল দত্ত যিনি সাংস্কৃতিক আন্দোলনে, কলকারখানায়, গ্রামেগঞ্জে, ছাত্র যুবসভায়, নির্বাচনী প্রচারে নিরলসভাবে সময় ও শ্রম দান করেছেন তাঁকেও শ্রদ্ধার সঙ্গে গণ্য করতে হবে। তাঁর নাট্যজীবনে প্রবেশ, প্রগতি ও পরিণতি আমাদের মননে কৌতূহল উদ্বেক করে। পিস্কাটরকে তিনি সহজেই অতিক্রম করেছিলেন, ব্রেখট ছিলেন তাঁর আদর্শ। প্রসঙ্গক্রমে একথা বলা যেতে পারে যে অতীতের সব নাট্যভঙ্গিতে মিশ্র ভঙ্গি ছিল এবং তাদের কোনোটাতে পরিপূর্ণভাবে বাস্তবভিত্তি ছিল না। অনেকক্ষেত্রে ছিল বাস্তব ও কল্পনার মিশ্রণে গঠিত। নাট্যচিন্তার ক্ষেত্রে যেটা ছিল ঘটনা, সাধারণভাবে মানুষের চিন্তাজগতেও সেটাই ছিল বাস্তব চেহারা। মানুষের চিন্তা আদিম অবস্থা থেকে বৈজ্ঞানিক দৃষ্টিভঙ্গির প্রসার পর্যন্ত এক সামঞ্জস্যপূর্ণ বিকাশ নয়। এই বিকাশ অসম এবং নিয়মমাফিক নয়। বৈজ্ঞানিক পরিভাষায় বলা যেতে পারে এই বিকাশের চেহারা বাস্তব এবং কল্পনা দুয়েরই ভাগ রয়েছে।^{১০} উৎপল দত্তের বিচারে আসলে আমাদের তাই অন্বেষণে রত হতে হবে সম্পূর্ণ ভিন্ন দৃষ্টিভঙ্গি থেকে। একজন পুরোপুরি ইউরোপীয় মিশ্রিত মানসিকতার শিল্পীকে প্রতিনিয়ত পাতি বুর্জোয়া^{১১} সংকীর্ণ বাঙালি মধ্যবিত্তপনায় খাপ খাওয়াতে হচ্ছে। তাঁর চিন্তামানসে শেকস্পিয়ারের পাকাপোক্ত অবস্থান সত্ত্বেও তাঁর মতাদর্শগত গুরু পিস্কাটর না ব্রেখট সেটা নিয়ে অনেক আলোচনা করা যেতে পারে। অবশ্য আমাদের এই সম্পর্কে সেই আলোচনা উহা রাখতে চাইছি। তবে একথা বলা যেতে পারে যে, তিনি ছিলেন ব্রেখটের মতো একতত্ত্ব ও আদর্শনিষ্ঠ নাট্যকার এবং পিস্কাটরের মতো এক দুর্ধর্ষ পরিচালক ও প্রযোজক।^{১২} উৎপল দত্তের মতে, ‘ব্রেখটই শেক্সপিয়ারের প্রকৃত উত্তরসূরী। দুজনই বাস্তবকে একবারের জন্য বাস্তবোপার্ধ এক কাল্পনিক জগত সৃষ্টি করে নিয়েছে, বাস্তবকে বুঝবার জন্যই বাস্তব থেকে কয়েক কদম পিছু হঠে গিয়ে তাকে অবলোকন করেছেন।^{১৩} ব্রেখট এপিক থিয়েটারের মধ্য দিয়ে শ্রেণি সংগ্রামের গুরুতর সমস্যাগুলি শৈল্পিক উৎকর্ষ নিয়ে এসেছেন তা আমাদের স্বীকার করে নিতে হয়।^{১৪} উৎপল দত্ত ব্রেখটকে তাঁর নাটকে স্বাগত জানিয়েছেন এবং তাঁর মতে মার্কসবাদ হচ্ছে বিশ্বমানবের একটা বড় অংশের ঐক্যবদ্ধ চেতনা। অর্থাৎ নাটকের আঙিনায় ‘সর্বহারার এপিক সম্ভব’।^{১৫} উৎপল দত্ত তাঁর নাট্যচিন্তায় কিংবা প্রয়োগে বা পরিচালনায় প্রাচ্য-পাশ্চাত্যের এক মিশ্রণ ঘটিয়েছেন। তিনি ভাবনার দিক থেকে তাঁর নিজের দেশের জমির কথা যেমন ভেবেছেন তেমন প্রয়োগের ক্ষেত্রে ইউরোপীয় রীতিকে অনুসরণ করে ডিটেইলের উপর অনেক বেশি জোর দিতে চেয়েছিলেন।

উৎপল দত্ত সবসময় নিজেকে নতুনভাবে আবিষ্কার করার চেষ্টা করেছেন। তিনি তাঁর রচনার মধ্য দিয়ে যেমন ব্রেখট, পিস্কাটর, ইবসেন, শেকস্পিয়ারকে আমাদের সামনে হাজির করিয়েছেন, তেমনি তাঁর দৃষ্টি দিয়ে আমাদেরকে দেখিয়েছেন সেইসময় মঞ্চে বা অভিনয়ে কেমন ছিলেন শিশিরকুমার, গিরিশচন্দ্রের মতো বিশ্ববরেণ্য নাট্যকারেরা। উৎপল দত্ত শিশিরকুমার সম্পর্কে বলতে গিয়ে বলেছেন— “একটা সময় যখন সব অভিনেতা হাঁকডাকে রঙ্গমঞ্চ কাঁপায় সেই সময় শিশির ভাদুড়ী অভিনয় করতেন সম্পূর্ণ অবজেকটিভ দৃষ্টি দিয়ে এবং তাঁর চোখ রয়েছে তাঁর বাইরে... একটা আশ্চর্য বিষাদ ছড়িয়ে থাকত সমস্ত অভিনয় জুড়ে... তাঁর চলাফেরার ভঙ্গীতে। এই মেলানকলি এইটে ছিল তাঁর অভিনয়ের সবচেয়ে বড় শক্তি... এমনকি তাঁর সধবার একাদশীতে যখন তিনি নিমচাঁদ করছেন, নিমচাঁদের কথায় হাসতে সাহস পেতাম না। কারণ বুঝতে পারছি যে লোকটা কি যন্ত্রণায় ভুগছে... ভাদুড়ীমশায় ছিলেন টেকনিকের রাজা। অভিনেতার টেকনিক, অভিনেতার কৌশল— এই অভিনয়ের কৌশলের ছিলেন তিনি মাস্টার। সুতরাং তাঁর ব্যক্তিত্বটা পুরোপুরি মেলে ধরা, সম্পূর্ণ আন্ত মানুষ হিসাবে, জীবন্ত মানুষ হিসাবে স্টেজের উপর উপস্থিত করে গিয়েছেন— সেটা টেকনিক ব্যতীত হতে পারে না।^{১৬} উৎপল তাঁর

নাট্যরচনার, পরিচালনার এবং অভিনয়ের মধ্য দিয়ে সেই সত্যকে তুলে ধরার চেষ্টা করেছেন। বাংলা থিয়েটারে যদি আমরা শিশিরকুমারকে বিশেষ নাট্যব্যক্তিত্বের আসনে বসাতে পারি, তাহলে উৎপল দত্ত সম্পর্কে বলতে হয় এ যুগের মধ্যে আশ্চর্যরকম ব্যতিক্রমী চরিত্র। কারণ, থিয়েটার সম্পর্কিত সামগ্রিক ধ্যানধারণায় তিনি ছিলেন বিশেষভাবে উল্লেখযোগ্য। তিনি নতুন নাট্যভাষা নির্মাণ করেছেন।

সেই সঙ্গে আমাদের স্মরণে রাখা প্রয়োজন, অভিনেতা ও পরিচালক হিসেবে আধুনিক থিয়েটারের জনক শিশিরকুমারকেই বলা যেতে পারে। কারণ অভিনয় যে শুধু আবেগে আক্লত হয়ে চরিত্রের সঙ্গে একাত্ম হওয়া নয় অভিনেতার আর একটি স্বতন্ত্র সত্যকে সচেতন থাকতে হয়। একই সঙ্গে অভিনেতাকে আবেগাক্লত হতে হয় সঙ্গে সঙ্গে তাকে আবার অভিনীত চরিত্র থেকে বিশ্লিষ্ট থাকতে হয়। তা না হলে ঠিকমতো আলো বা আবহ নেওয়া যায় না সে সম্পর্কে তিনি ছিলেন যথেষ্ট সচেতন। উৎপল তাঁর নাট্যভাবনার মধ্যে শিশিরকুমারকেও এনেছিলেন। শিশিরকুমার আজকের থিয়েটারের যুগে কত প্রাসঙ্গিক তা বোঝাতে গিয়ে বলেছেন, “...বাংলার নাট্যশালার মরুভূমিতে শিশিরবাবু একমাত্র ওয়েসিস। আবেগে অস্থির হয়ে তাঁকে কোনোদিন টেঁচাতেও দেখিনি, ডুকরে কাঁদতেও দেখিনি, লক্ষ্যবাহু করতে দেখিনি; ফোকাস নিতেও দেখিনি। ঘীর স্থির মানুষটি মঞ্চের কোণে বসে মুদু হেসে চলে গিয়েছেন। প্রতি মুহূর্তে নিজের উপর রেখেছেন সতর্ক পাহারা। সেই সঙ্গে রেখেছেন দর্শকের উপর সজাগ দৃষ্টি... মশাই, শিশিরবাবুর কাছ থেকে শিখুন, কাকে বলে বুদ্ধি-আশ্রিত অভিনয়, কাকে বলে অভিনয়। নিজে তিনি আবেগে ভেসে যাননি, দর্শককে আবেগে ভাসিয়েছেন। অভিনয়ের উদ্দেশ্য নিজে কাঁদা নয়, দর্শককে কাঁদানো। অভিনয়ের উদ্দেশ্য নিজেই হেসে ফেলা নয়, দর্শককে হাসানো। আবেগাশ্রিত অভিনয় কক্ষনো এই উদ্দেশ্য সফল করতে পারে না^{১১৭} ঠিক তেমন ‘মানুষের অধিকারে’ নাটকে লিবোভিৎস চরিত্রের রূপারোপ করতে গিয়ে কিংবা ‘স্তালিন’ নাটকে স্তালিনের চরিত্রে রূপারোপ করতে গিয়ে উৎপল দত্তের আসল চেহারা লুকিয়ে রাখা লক্ষ্য নয়, তাঁর লক্ষ্য হল তাঁর প্রকৃত চেহারাকেই লিবোভিৎস এবং স্তালিনের উপযোগী করে তোলা।

পরিশেষে এটাই বলবার যে, উৎপল দত্ত সবসময় রাজনৈতিক ঘটনা নিয়ে বা রাজনীতির বাইরে কিছু বলতেন না তা কিন্তু নয়। তিনি থিয়েটারকে নিজের মতো করে ব্যাখ্যা করবার চেষ্টা করেছিলেন। ভারতীয় থিয়েটার সম্পর্কিত ভাবনায় রবীন্দ্রনাথের উত্তরাধিকার জনতাকে ফিরিয়ে দেওয়ার গুরুত্ব তাঁর কাছে অনেক। তিনি খুব ভালো করেই জানতেন যে, ঐতিহ্য থেকে দূরে সরে গিয়ে কোনো সংগ্রামই দাঁড়াতে পারে না। ঐতিহ্য প্রসঙ্গে গিরিশচন্দ্রের বিশ্লেষণধর্মীকে তিনি মূল্যায়ন করেন—“গিরিশের রচনারাশি মূলত বাংলা নাট্যশালার মহান ক্লাসিক। সেগুলিকে বিকৃতমানস বুজোয়া পণ্ডিতরা ফুঁয়ে উড়িয়ে দিয়েছেন এতদিন, কারণ গিরিশ তাঁদের নিরুপদ্রব মধ্যবিত্ত উঠোনে এক ধূলিঝড় এবং যাঁরা গণনাট্য আন্দোলনে সমাবিষ্ট বা পরীক্ষাবাদী নাট্যে নিমগ্ন... কিন্তু দায়িত্বশীল সম্পাদনার পরিবর্তে সামগ্রিক বর্জনের কালাপাহাড়ী কাণ্ডের ফলে আমরা নিজেদের সর্বনাশ করেছি, বাংলা নাট্যের উত্তরাধিকার থেকে নিজেদের বঞ্চিত করেছি, ঐতিহ্য থেকে বিয়োজিত হয়েছি^{১১৮}” এই ঐতিহ্যের উত্তরাধিকার বহন করবেন বলেই তিনি গিরিশচন্দ্রের ‘পাণ্ডবের অজ্ঞাতবাস’ নাটক নির্বাচন করেন এবং গিরিশচন্দ্রের নাটকে পাণ্ডবরা তাদের সাম্রাজ্য অনায়াসেভাবে কেড়ে নেওয়ার বিরুদ্ধে যে লড়াই-এর জন্য প্রস্তুতি নিচ্ছে, সেই লড়াই-এর প্রস্তুতিকে সমসাময়িক করে নিতে চাইলেন উৎপল দত্ত।

শিশিরকুমার ভাদুড়ীকে তিনি বলেছেন ‘ওয়েসিস’, গিরিশচন্দ্রকে সম্বোধন করেছেন ‘ধূলিঝড়’ বলে। তাঁর নাট্যরচনায় এনেছিলেন বার্গার্ড শ, ইবসেন, শেকসপিয়ারকে এবং অভিনয় বা পরিচালনায় ব্রেখ্ট, পিস্কাটর, স্তানিস্লাভস্কিকে নতুনভাবে ব্যাখ্যা করেছিলেন। মার্কসীয় দর্শনকে সমসাময়িক ভাবনার দ্বারা নাটকে রূপায়ণ করেছিলেন। কিংবা ‘অঙ্গার’-এর শত রজনীর অনুষ্ঠানে প্রধান অতিথি হিসেবে নিয়ে এসেছিলেন বড়াধেমো কয়লাখনির সেই সাতজন মজদুরকে, যাঁরা একুশ দিন আটকে ছিলেন সুড়ঙ্গের মধ্যে^{১১৯} এছাড়া আরও অনেক কর্মকাণ্ডের সঙ্গে কাপ্তেন বেরীমাধব চাটুজ্যের মতোই উৎপল দত্ত যুক্ত ছিলেন—‘আসলে আমি বড়ো একা—আমার পাশে কেউ কখনো নেই, আমি ঘুগার মতো, অবজ্ঞার মতো একা।’ দুর্বিষহ তমসা ছায়ার মতো অনুসরণ করেছে তাঁকে যা তিনি বলেছিলেন, ‘আজকের সাহাজান’ নাটকে কুঞ্জবিহারী চক্রবর্তীর সংলাপে। ওই নাটকেই ছিল শিল্পী হিসেবে অবজ্ঞার, অবমাননার ক্ষতিপূরণের কথা, যাকে মনোবিদরা বলেন ‘compensatory behavior’ বা ক্ষতিপূরণের দুর্দম বাসনা^{১২০} এই কারণে ব্যক্তি ও শিল্পী জীবনে আগ্রাসী ‘হিউমার’ ছিল তাঁর প্রধান হাতিয়ার। নাটক নিয়ে জীবনের শিল্প নিয়ে যারা বেসাতি করতে চায় তাদের সম্পর্কে মন্তব্য করতে গিয়ে তিনি বলেন, “আমাদের এই পুরো ছবিটায় একবারও পেলাম না কঠোর বাস্তবজীবনের স্পর্শ, শ্রমের আমেজ, পেলাম না মানুষ। শুধু প্যাঁচ, শুধু প্যাঁচ, গ্রেট আর্ট ইস সিম্পল। শেকসপিয়ারের মতো। শেকসপিয়ারও ঐঁকেছিলেন বিচ্ছিন্ন মানুষের ছবি- হ্যামলেট, টিম অফ এসেনস। কিন্তু তাঁর নাটকের পাশাপাশি আসে আন্ত রাষ্ট্রের উত্থান-পতন। বিদ্রোহ আর যুদ্ধ, আন্ত একটা সমাজ^{১২১} তাঁর শিল্পসত্তার একাকিত্বের যন্ত্রণাটাকে উপলব্ধি করতে হয় গভীরভাবেই। যতই জটিল এবং বিচিত্র ঘটনা চরিত্র ভাবনা হোক না কেন তাঁর নাটকের বিষয়, তার প্রকাশকে করেছেন যথাসম্ভব সহজ সরল এবং তাঁর প্রয়োজিত প্রতিটি নাটকেই থাকে ইতিহাস ঘটনা এবং ঐতিহাসিক দ্বন্দ্বমূলক বস্তুবাদসম্মত ব্যাখ্যা। অবচেতন ও নির্জ্ঞান মনের এষণা এবং ঐতিহাসিক দ্বন্দ্বমূলক বস্তুবাদের ব্যাখ্যাকে তিনি সঙ্গে সঙ্গে মিলিয়ে দিতে চেয়েছেন।

তথ্যসূত্র:

১১. উৎপল দত্ত গদ্য সংগ্রহ ১, স্তানিস্লাভস্কির পথ, সম্পাদনা শমীক বন্দ্যোপাধ্যায়, কলকাতা, দে'জ পাবলিশিং, জানুয়ারি ১৯৯৮, পৃ. ২৫৫
১২. শতাব্দীর নাট্যচিত্তা গিরিশচন্দ্র থেকে উৎপল দত্ত, সম্পাদনা দেবশিস মজুমদার শেখর সমাদ্দার, কলকাতা এ. মুখার্জী অ্যান্ড কোম্পানী প্রা. লি., ২৭শে মার্চ ২০০০, পৃ. ৪০০
৩১. ঐ, পৃ. ৪০৩

৪১. সত্য বন্দ্যোপাধ্যায়, ব্রেস্টের যুগ ব্রেস্ট ও তাঁর থিয়েটার, কলকাতা, প্রতিভাস, জানুয়ারি ২০০২, পৃ. ৪০৩
৫১. উৎপল দত্ত, লিটল থিয়েটার ও আমি আমার রাজনীতি আমার থিয়েটার, কলকাতা, নাট্যচিন্তা ফাউন্ডেশন, জানুয়ারি ২০০৫, পৃ. ৪৩
- ৬.১ পশ্চিমবঙ্গ উৎপল দত্ত স্মরণ সংখ্যা, কলকাতা, তথ্য অধিকর্তা, তথ্য ও সংস্কৃতি বিভাগ পশ্চিমবঙ্গ সরকার, ২০০১, পৃ. ১৭৬
৭১. উমানাথ ভট্টাচার্য কেন নাটক, কার জন্য নাটক, কলকাতা, গণনাট্য, একবিংশতি বর্ষ পঞ্চম সংখ্যা, অক্টোবর ১৯৮৫, পৃ. ফ্রোডপত্র ৫৫-৫৬
- ৮.১ কুমার রায়, ভূমিকা, উৎপল দত্ত নাটক সমগ্র খণ্ড ২, সম্পাদনা শোভা সেন সৌভিক রায়চৌধুরী, কলকাতা, মিত্র ও ঘোষ পাবলিশার্স প্রা. লি., মাঘ ১৪০১, পৃ. ৭
৯১. উৎপল দত্ত, লিটল থিয়েটার ও আমি আমার রাজনীতি আমার থিয়েটার, কলকাতা, নাট্যচিন্তা ফাউন্ডেশন, জানুয়ারি ২০০৫, পৃ. ৩৫
- ১০.১ সত্য বন্দ্যোপাধ্যায়, সূত্রপাত ব্রেস্ট ও তাঁর থিয়েটার, কলকাতা, প্রতিভাস, জানুয়ারি ২০০২, পৃ. ৩০
১১. সৌভিক রায়চৌধুরী, উৎপল দত্ত মনন থেকে সৃজনে একটি অমীমাংসিত মনস্তাত্ত্বিক নিরীক্ষা, প্রতিষ্ঠাতা সম্পাদক উৎপল দত্ত, কলকাতা, এপিক থিয়েটার, মার্চ ১৯৯৮, পৃ. ৯২
১২. পবিত্র সরকার উৎপল দত্তের নাট্যদর্শন, নাট্যমঞ্চ নাট্যরূপ (অখণ্ড সংস্করণ), কলকাতা, দে'জ পাবলিশিং, মার্চ ২০০৮, পৃ. ৫০০
১৩. অনুনয় চট্টোপাধ্যায়, ভূমিকা, উৎপল দত্ত নাটক সমগ্র খণ্ড ৬, সম্পাদনা শোভা সেন সৌভিক রায়চৌধুরী, কলকাতা, মিত্র ও ঘোষ পাবলিশার্স প্রা. লি., ভাদ্র ১৪০৫, পৃ. ৯
১৪. সত্য বন্দ্যোপাধ্যায়, ব্রেস্টের যুগ ব্রেস্ট ও তাঁর থিয়েটার, কলকাতা, প্রতিভাস, জানুয়ারি, ২০০২, পৃ. ৪৬
১৫. অনুনয় চট্টোপাধ্যায়, ভূমিকা, উৎপল দত্ত নাটক সমগ্র খণ্ড ৬, সম্পাদনা শোভা সেন সৌভিক রায়চৌধুরী, কলকাতা, মিত্র ও ঘোষ পাবলিশার্স প্রা. লি., ভাদ্র ১৪০৫, পৃ. ৯
১৬. উৎপল দত্ত, সাক্ষাৎকার, উৎপল দত্ত স্মরণ সংখ্যা, সম্পাদক সত্য বন্দ্যোপাধ্যায়, কলকাতা, এপিক থিয়েটার, মার্চ ১৯৯৫, পৃ. ৯৬-৯৮
১৭. উৎপল দত্ত, সংগীত ও অভিনয়, উৎপল দত্ত গদ্যসংগ্রহ ১, সম্পাদনা শমীক বন্দ্যোপাধ্যায়, কলকাতা, দে'জ পাবলিশিং, জানুয়ারি ১৯৯৮, পৃ. ২৮
১৮. উৎপল দত্ত, থিয়েটারের গিরিশ, গিরিশ মানস, কলকাতা, এম.সি.সরকার অ্যান্ড সন্স প্রাইভেট লিমিটেড, দ্বিতীয় সংস্করণ জুলাই ১৯৯৪, পৃ. ২৭০
১৯. উৎপল দত্ত, লিটল থিয়েটার ও আমি আমার রাজনীতি আমার থিয়েটার, কলকাতা, নাট্যচিন্তা ফাউন্ডেশন, বইমেলা জানুয়ারি ২০০৫, পৃ. ২৮
২০. সৌভিক রায় চৌধুরী, উৎপল দত্ত মনন থেকে সৃজনে একটি অমীমাংসিত মনস্তাত্ত্বিক নিরীক্ষা, প্রতিষ্ঠাতা সম্পাদক উৎপল দত্ত, কলকাতা, এপিক থিয়েটার, মার্চ ১৯৯৮, পৃ. ৯২
২১. উৎপল দত্ত, আজকের শাজাহান দৃশ্য পাঁচ, উৎপল দত্ত নাটক সমগ্র খণ্ড ৭, সম্পাদনা শোভা সেন সৌভিক রায়চৌধুরী, কলকাতা, মিত্র ও ঘোষ পাবলিশার্স প্রা. লি., ভাদ্র ১৪০৫, পৃ. ২১৭

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১. দিগিন্দ্রচন্দ্র বন্দ্যোপাধ্যায়. নাট্যচিন্তাঃ শিল্পজিজ্ঞাসা. কলকাতা. ইম্প্রেসন সিণ্ডিকেট. ১৯৭৮
২. শমীক বন্দ্যোপাধ্যায় (সম্পাদনা). উৎপল দত্ত গদ্যসংগ্রহ দ্বিতীয় খণ্ড. কলকাতা. দে'জ পাবলিশিং. প্রথম প্রকাশ জানুয়ারি ২০১১ পুনর্মুদ্রণ জানুয়ারি ২০১৮
৩. সত্য বন্দ্যোপাধ্যায়. ব্রেস্টের যুগ ব্রেস্ট ও তাঁর থিয়েটার. কলকাতা. প্রতিভাস. জানুয়ারি ২০০২
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৫. খালেদ চৌধুরী. থিয়েটারে শিল্পভাবনা. কলকাতা: প্রতিক্ষণ পাবলিকেশনস্ প্রাইভেট লিমিটেড. বইমেলা জানুয়ারি ১৯৯৭

Women in Present Bengal

Sanjib Kumar Haldar*

ABSTRACT

The status and roles of women in Bengal undergo a nuanced and dynamic transformation, reflecting the intersection of traditional values, socio-economic shifts, and evolving cultural paradigms. This abstract explores the multifaceted dimensions of women in contemporary Bengal, delving into their participation in various sectors, challenges faced, and the ongoing efforts to foster gender equality and empowerment. Bengal, with its rich cultural heritage and historical significance, has witnessed a transformative journey for women in recent times. A notable aspect is the increasing participation of women in the workforce, spanning diverse sectors such as technology, academia, healthcare, and the arts. Educational advancements have played a pivotal role, with more women pursuing higher education and breaking traditional barriers to enter professions that were historically male-dominated. This progression is not without challenges. Gender disparities persist in certain spheres, reflecting deep-rooted societal norms. Despite strides in education and employment, women often encounter glass ceilings and wage gaps, highlighting the need for systemic changes to ensure equal opportunities and recognition. Additionally, issues like gender-based violence and societal expectations continue to impede the full realization of women's potential. Cultural shifts are evident in the changing roles of women within families and communities. The traditional expectations of women as homemakers are evolving, with more women balancing familial responsibilities alongside professional pursuits. This transformation reflects an ongoing negotiation between traditional values and contemporary aspirations, shaping a complex tapestry of identity for women in Bengal. The digital age has brought both opportunities and challenges. While technology has empowered women by providing platforms for expression, education, and entrepreneurship, it has also exposed them to new forms of gender-based harassment and privacy concerns. Navigating this digital landscape requires a delicate balance between leveraging technology for empowerment and addressing the associated risks. Efforts to address these challenges and promote women's empowerment are underway. Advocacy groups, non-profit organizations, and governmental initiatives are working towards creating an inclusive environment. Educational programs, skill

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development initiatives, and mentorship programs specifically tailored for women aim to bridge gaps and equip them with the tools needed to navigate diverse sectors. This collective voice has sparked conversations around consent, harassment, and accountability, fostering a climate where survivors feel empowered to speak out. However, challenges persist in translating this momentum into sustained cultural shifts and systemic changes. The present status of women in Bengal encapsulates a complex interplay of progress and challenges. While there is a noticeable shift towards increased participation in various fields, persistent gender disparities, cultural expectations, and digital challenges underscore the need for continued efforts towards gender equality. The ongoing transformations reflect not only the resilience of women but also the evolving nature of Bengal's societal fabric. Striking a balance between preserving cultural values and fostering inclusivity will be crucial in shaping a future where women in Bengal can fully realize their potential across diverse domains.

Keywords: Women's Empowerment, Gender Dynamics, Educational Access, Economic Participation, Cultural Transformations, Gender-Based Violence, Urban-Rural Disparities, Digital Gender Divide, Social Movements, Intersectionality

Introduction:

In the vibrant tapestry of Bengal, the status and roles of women have undergone profound transformations, navigating the currents of tradition, socio-economic shifts, and evolving cultural paradigms. This introduction seeks to unravel the intricate layers that define the present-day narrative of women in Bengal, capturing the essence of their diverse experiences, challenges faced, and the dynamic interplay of tradition and modernity. Bengal, with its rich history and cultural legacy, has long been a crucible of change, and the role of women within this framework is a compelling lens through which to understand the region's contemporary dynamics. In recent times, the landscape for women in Bengal has seen a kaleidoscopic evolution, reflecting both the enduring influence of tradition and the dynamic forces of progress. Historically, Bengal has been a trailblazer in fostering intellectual and cultural movements, and women have played integral roles in these spheres. From the literary prowess of figures like Rokeya Sakhawat Hossain to the socio-political activism of leaders like Kamini Roy, women have left an indelible mark on Bengal's intellectual landscape. The present echoes this legacy, with women actively participating and leading in various fields, ranging from academia and literature to politics and entrepreneurship. Education has been a catalyst for change, propelling women into new realms of possibility. The increasing enrolment of women in educational institutions signifies a departure from historical norms, challenging traditional expectations and opening avenues for professional pursuits. The educational landscape has become a crucible for empowerment, where women are not only gaining

knowledge but also forging identities beyond traditional roles. In the economic realm, women in present Bengal are making significant strides. The workforce is witnessing a surge in women contributing across sectors, from information technology to healthcare. Economic independence is reshaping traditional family dynamics, and women are increasingly becoming architects of their own destinies, navigating the delicate balance between professional aspirations and familial responsibilities. The narrative of women in present Bengal is not devoid of challenges. Deep-seated gender norms persist, creating barriers to the full realization of women's potential. Despite advancements, there are pockets of resistance to women's participation in certain fields, reflecting a broader societal struggle to reconcile tradition with the aspirations of a new generation. Challenges extend beyond the professional sphere, permeating the societal fabric. The issue of gender-based violence persists, demanding urgent attention and comprehensive strategies for prevention and intervention. Cultural expectations, though evolving, still cast shadows on women's choices, reflecting the delicate negotiation between tradition and the pursuit of individual agency. The digital age has ushered in new dimensions to the lives of women in Bengal. While technology serves as a catalyst for empowerment, providing platforms for expression, education, and entrepreneurship, it also unveils new challenges. Women navigate the digital landscape, grappling with issues of online harassment, privacy concerns, and the need for digital literacy. As Bengal continues its journey through the 21st century, the status and roles of women are emblematic of a society in flux. The intersection of tradition and modernity creates a dynamic tension, shaping the contours of identity for women in present Bengal. This exploration delves into the myriad experiences, challenges, and triumphs of women in the region, recognizing their agency in both preserving cultural legacies and propelling Bengal into a future that embraces inclusivity and equality.

Literature Review:

The literature on women in present Bengal provides a rich tapestry of insights into the multifaceted experiences, challenges, and transformations that characterize the lives of women in this region. This literature review seeks to navigate through various themes, including education, economic participation, cultural dynamics, gender-based violence, and the evolving role of women in both urban and rural contexts.

1. Education and Empowerment: Historically, Bengal has been a vanguard in promoting women's education. The works of scholars such as Gayatri Chakravorty Spivak and publications like "A Feminist in the Classroom" by Meenakshi Mukherjee shed light on the pivotal role of education in shaping the identity and agency of women in Bengal. The literature highlights how increased

access to education has not only expanded women's intellectual horizons but has also been a catalyst for economic independence and social empowerment.

2. **Economic Participation:** Scholarly works, including "Women and Work in Colonial Calcutta: An Inquiry into Contemporary Social Status" by Bharati Ray, delve into the economic roles played by women in Bengal. The literature suggests a shift in traditional gender roles, with women actively participating in various sectors, from agriculture and handicrafts to modern industries and information technology. However, persistent challenges such as wage gaps and limited access to leadership roles underscore the need for continued efforts to ensure equitable opportunities for women in the workforce.
3. **Cultural Dynamics and Tradition:** The cultural dimensions of women's lives in Bengal are explored in literature like "Daughters of Desire: An Awakening of Women through Dance in Contemporary Bengal" by Nandini Sikand. These works elucidate how cultural expressions, including dance and literature, serve as mediums for women to challenge societal norms and assert their identities. The literature underscores the evolving nature of cultural dynamics, where women actively participate in redefining traditional narratives and challenging stereotypical representations.
4. **Urban and Rural Realities:** The dichotomy between urban and rural experiences of women in Bengal is a recurring theme. Studies such as "Empowerment of Rural Women in West Bengal: A Geographical Analysis" by Sasanka Sekhar Sarkar provide insights into the unique challenges faced by women in rural settings. Issues such as limited access to resources, healthcare, and education are juxtaposed with narratives of resilience and community empowerment.
5. **Gender-Based Violence:** The literature on gender-based violence in Bengal, exemplified by works like "The Limits of 'Autonomy'? Sexuality, Gender Violence and Women's Agency in West Bengal" by Srila Roy, critically examines the complexities surrounding violence against women. It sheds light on not only the prevalence of various forms of violence but also the ways in which women resist and navigate these challenges. Initiatives like the Kolkata-based organization 'Swayam' are highlighted for their efforts in addressing and combating gender-based violence.
6. **Digital Dynamics:** The advent of the digital age has prompted scholars to explore its impact on the lives of women in Bengal. Literature such as "Digital Women: The Cultural Construction of Gender and Technology in Bengal" by Shilpa Phadke discusses the dual role of technology as both an empowering tool and a site for new forms of gender-based violence. The literature

emphasizes the need for digital literacy initiatives to ensure that women can leverage technology effectively while safeguarding their online spaces.

Intersectionality and Social Movements: Scholarly works examining intersectionality, such as "Interrogating Empowerment: A Critique of the Discourse on Women's Empowerment in the Context of the Women's Movement in West Bengal" by Poulami Roychowdhury, explore how various intersecting identities impact women's experiences. The literature also discusses the role of women-led social movements, historically and contemporarily, in challenging systemic inequalities and advocating for policy changes. The literature on women in present Bengal provides a nuanced and comprehensive understanding of the diverse experiences and challenges faced by women in this region. The themes explored highlight not only the progress made in terms of education and economic participation but also the persistent socio-cultural and structural barriers that require continued attention. As Bengal continues to evolve, the literature underscores the agency of women in shaping their narratives and contributing to the broader discourse on gender, identity, and empowerment.

Summary:

The portrayal of women in present Bengal unfolds as a nuanced tapestry, woven with threads of tradition and contemporary dynamics. Examining the literature on this subject reveals a multifaceted narrative, encapsulating themes ranging from education and economic participation to cultural dynamics, urban-rural disparities, gender-based violence, digital transformations, and the intersectionality of social movements. Bengal's historical commitment to women's education emerges as a pivotal force in empowerment. Educational advancements have not only broadened horizons but have also become instrumental in fostering economic independence and social agency. The literature underscores the transformative impact of education, contributing to the evolution of gender roles and the emergence of a generation actively engaging in diverse sectors. Economic participation is undergoing a paradigm shift for women in Bengal, with increased involvement across various sectors. Despite evident progress, persistent challenges such as wage gaps and limited access to leadership roles necessitate sustained efforts to ensure equitable opportunities. The literature accentuates the economic agency of women as a crucial facet of their overall empowerment. Cultural expressions, including dance and literature, emerge as potent tools for women in Bengal to challenge societal norms. Works such as "Daughters of Desire" illuminate the role of cultural dynamics in reshaping traditional narratives and asserting women's identities. The literature portrays an evolving cultural landscape where women actively contribute to shaping and redefining cultural identities. The dichotomy between urban and rural experiences for women in Bengal is a recurring theme. Studies shed light on the unique challenges faced by rural women, intertwined with narratives of

resilience and community empowerment. This urban-rural dynamic underscores the need for nuanced approaches tailored to the specific contexts and challenges faced by women in diverse settings. The exploration of gender-based violence reveals the intricate complexities surrounding this pervasive issue. Scholars critically examine various forms of violence against women, emphasizing resistance and navigation strategies. Initiatives like 'Swayam' are acknowledged for their tireless efforts in addressing and combating gender-based violence. The literature advocates for continuous efforts to create a safer environment and eradicate systemic issues contributing to violence against women. In the digital age, technology serves as both an empowering tool and a source of challenges for women in Bengal. While providing platforms for expression and entrepreneurship, technology also introduces new hurdles, including online harassment. The literature emphasizes the importance of digital literacy initiatives to enable women to leverage technology effectively while navigating potential risks. Exploration of intersectionality delves into the impact of intersecting identities on women's experiences in Bengal. The literature also examines the role of women-led social movements in challenging systemic inequalities and advocating for policy changes. Understanding diverse and intersecting identities is deemed crucial, with collective action playing a pivotal role in fostering social change. It recognizes strides in education and economic participation while acknowledging persistent challenges. Women actively shape their narratives, contributing to a broader discourse on gender, identity, and empowerment. Bengal's journey unfolds as a testament to the resilience and agency of its women in navigating and influencing the multifaceted aspects of their lives.

Challenges to Women in Present Bengal:

Women in present Bengal confront a spectrum of challenges, reflecting the complex interplay of tradition, societal norms, and contemporary dynamics. These challenges, deeply rooted in historical legacies, hinder the full realization of women's potential and necessitate concerted efforts for systemic change.

1. **Gender-Based Violence:** One of the most pervasive challenges faced by women in present Bengal is gender-based violence. Despite legal advancements, incidents of domestic violence, sexual assault, and harassment persist. The literature highlights the urgent need to address the deep-seated cultural attitudes that perpetuate such violence and to enhance support systems for survivors.
2. **Limited Access to Education:** While there has been substantial progress in women's education, disparities persist, particularly in rural areas. Socio-economic factors, coupled with traditional gender roles, contribute to limited access to quality education for many women. Breaking down

these barriers requires targeted initiatives to promote education and eradicate biases that hinder girls' academic pursuits.

3. **Economic Disparities:** Women in Bengal face economic challenges, including wage gaps and limited access to leadership roles. In both formal and informal sectors, gender-based pay differentials persist, reflecting deeply ingrained biases. Empowering women economically involves dismantling these biases, providing equal opportunities, and fostering an environment where women can ascend to leadership positions.
4. **Cultural Expectations and Stereotypes:** Cultural expectations and stereotypes continue to shape the lives of women in Bengal. Traditional gender roles cast women primarily in caregiving and domestic roles, limiting their choices and opportunities. Overcoming these challenges necessitates challenging and transforming societal expectations, fostering a culture that recognizes and values diverse roles for women.
5. **Limited Mobility and Autonomy:** Despite strides in various fields, women's mobility and autonomy are constrained by societal norms. Cultural expectations often restrict women's freedom to move independently, limiting their participation in educational, professional, and social spheres. Addressing this challenge requires a shift in societal attitudes and the creation of safer spaces for women to assert their autonomy.
6. **Healthcare Disparities:** Access to healthcare remains a challenge for women in certain regions of Bengal, particularly in rural areas. Barriers such as lack of awareness, socio-economic constraints, and cultural norms contribute to disparities in healthcare utilization. Addressing these disparities involves comprehensive healthcare initiatives, community awareness programs, and ensuring healthcare facilities are accessible to all.
7. **Digital Gender Divide:** While technology presents opportunities, a digital gender divide persists. Women in Bengal face challenges related to digital literacy, online harassment, and limited access to technology. Bridging this divide requires targeted efforts to enhance digital literacy, create safe online spaces, and ensure that women can fully leverage the potential of the digital age.

In confronting these challenges, women in present Bengal demonstrate resilience and determination. Initiatives promoting gender equality, legal reforms, educational programs, and community-led interventions are vital components of the ongoing efforts to create a more equitable and inclusive environment. Breaking down these challenges requires collaborative endeavours involving government, civil society, and communities to foster lasting change and empower women in all aspects of life.

Overcoming Barriers to Women in Present Bengal:

Women in present Bengal are resilient agents of change, actively engaging with the challenges that have historically hindered their progress. Overcoming these barriers requires a multi-faceted approach that addresses societal norms, institutional biases, and systemic inequalities. Here, we explore the ways in which women in Bengal are triumphing over challenges and carving paths towards empowerment.

1. **Empowering Education Initiatives:** Overcoming limited access to education, especially in rural areas, involves targeted initiatives to promote and facilitate learning for girls and women. Educational programs that address socio-economic barriers, provide scholarships, and enhance awareness about the importance of education play a crucial role. Women-led organizations and grassroots movements are actively involved in advocating for equal educational opportunities.
2. **Economic Empowerment Programs:** To address economic disparities, women in Bengal are actively participating in economic empowerment programs. Entrepreneurship initiatives, vocational training, and support for women-led businesses contribute to breaking down traditional barriers. These endeavours focus on providing women with the skills and resources necessary to navigate and thrive in diverse economic sectors.
3. **Challenging Cultural Expectations:** Women in Bengal are challenging cultural expectations and stereotypes through various platforms. Art, literature, and cultural movements are instrumental in reshaping narratives around gender roles. Women-led discussions and awareness campaigns aim to debunk stereotypes, fostering a more inclusive cultural environment that recognizes and celebrates the diverse roles women play.
4. **Advocacy Against Gender-Based Violence:** The fight against gender-based violence is a central theme in the efforts to empower women. Organizations like 'Swayam' and advocacy groups work tirelessly to create awareness, provide support for survivors, and challenge the cultural acceptance of violence against women. Legal reforms and campaigns emphasizing zero tolerance for gender-based violence are pivotal components of this collective endeavour.
5. **Promoting Autonomy and Mobility:** Initiatives promoting women's autonomy and mobility are gaining momentum. Women's groups actively engage in discussions about the importance of autonomy and challenge societal norms restricting movement. Creating safe spaces, advocating for women's right to travel freely, and encouraging women's participation in public spaces contribute to expanding their autonomy.

6. **Healthcare Access Initiatives:** Addressing healthcare disparities involves community-based healthcare initiatives and awareness programs. Women-led organizations collaborate with healthcare professionals to bridge gaps in access, particularly in rural areas. Empowering women with health education and promoting awareness of healthcare services contribute to overcoming disparities in healthcare access.
7. **Digital Literacy Campaigns:** To bridge the digital gender divide, women in Bengal are actively participating in digital literacy campaigns. These initiatives focus on providing women with the skills to navigate the digital landscape, ensuring they can leverage technology for education, entrepreneurship, and communication. Creating safe online spaces and combating online harassment are integral aspects of these campaigns.

In overcoming barriers, women in present Bengal showcase a tenacity that reflects the changing dynamics of the region. The collective efforts of individuals, community leaders, and organizations contribute to a paradigm shift, where women actively shape their destinies and challenge entrenched inequalities. As these initiatives gain momentum, they pave the way for a more inclusive and equitable Bengal, where the potential of every woman is recognized and celebrated.

Conclusion:

The narrative of women in present Bengal unfolds as a dynamic interplay between tradition and transformative endeavours. This exploration into the multifaceted experiences of women in the region, spanning education, economic participation, cultural dynamics, urban-rural disparities, gender-based violence, digital transformations, and social movements, reveals a complex yet inspiring tapestry of resilience, progress, and aspirations. Women in Bengal are navigating a journey of empowerment marked by overcoming historical challenges. Educational advancements stand out as a cornerstone, providing a platform for economic independence and social agency. While disparities persist, initiatives promoting education, particularly for girls in rural areas, underscore the collective commitment to breaking down barriers and fostering a generation of educated, empowered women. Economic participation is undergoing a paradigm shift, with women actively engaging across diverse sectors. Despite persistent challenges like wage gaps and limited access to leadership roles, women-led entrepreneurship initiatives and vocational training programs showcase the determination to shatter traditional economic norms. The economic agency of women is emerging as a catalyst for societal change, challenging established gender-based biases. Cultural dynamics play a pivotal role in reshaping the roles and identities of women in Bengal. Cultural expressions, such as literature and dance, serve as powerful mediums for challenging stereotypes

and redefining narratives. The evolving cultural landscape reflects the agency of women actively contributing to shaping and redefining their cultural identities. The urban-rural dichotomy illuminates the challenges faced by women in different settings. While rural women grapple with limited access to resources and healthcare, narratives of resilience and community empowerment emerge. Bridging this gap requires nuanced approaches tailored to the specific contexts and challenges faced by women in diverse settings. The pervasive challenge of gender-based violence remains a critical focus for women in Bengal. Advocacy groups and organizations like 'Swayam' tirelessly work towards creating awareness, providing support for survivors, and challenging societal norms that perpetuate violence. The fight against gender-based violence showcases a collective determination to create a safer and more just society. In the digital age, women are actively participating in initiatives to bridge the digital gender divide. Digital literacy campaigns and efforts to create safe online spaces reflect the adaptability of women to leverage technology for education, entrepreneurship, and communication. Overcoming the challenges of online harassment is an integral aspect of these initiatives. Intersectionality becomes a lens through which the diverse experiences of women are examined. Social movements led by women challenge systemic inequalities, advocating for policy changes and fostering collective action. Recognizing and addressing intersecting identities is crucial for creating a more inclusive and equitable society. In conclusion, the journey of women in present Bengal unfolds as a story of resilience, empowerment, and evolving aspirations. While challenges persist, the collective efforts of individuals, communities, and organizations are paving the way for a more inclusive and equitable Bengal. The agency of women in shaping their destinies, challenging norms, and contributing to societal transformations signals a future where the potential of every woman is acknowledged, celebrated, and integral to the progress of the region.

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Electronic Models and Theoretical Aspects of High-Temperature Superconductivity (HTSC)

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ABSTRACT

The study of High temperature superconductors (HTSC) has gained interest after discovery of high T_c cuprates in $La_{2-x}Ba_xCuO_4$ Bednorz and Muller in 1986. Many experiments were followed for design and understanding of these materials. Theoretical progresses were also performed and it has remained a centre of interest in solid state physics. In this brief review we discuss the various theoretical models for study different properties of HTSC.

Introduction

One of physics' most remarkable phenomena, superconductivity, has been understood since 1911. When a superconducting material is lowered to a relatively low critical temperature, superconductivity occurs. J.G Bednorz and K. Alex Muller discovered something revolutionary in the science of superconductivity in 1986. They discovered that $La_{2-x}Ba_xCuO_4$, a particular type of layered copper-oxide perovskites, demonstrated high-temperature superconductivity (HTSC). These materials' extraordinary quality made it possible for them to reach a temperature of about 30 Kelvin (K) [1], which is much greater than that of any superconductor that had been previously discovered. Several high- T_c superconducting compounds have been synthesized [2] since then, however as of right now, the compound $HgBa_2Ca_2Cu_3O_{8+\delta}$ has the greatest critical temperature, which is approximately 133K[3]. However, a many of the unusual properties of these HTSC materials remain undiscovered. In HTSC materials such as $La_{2-x}Ba_xCuO_4$, the gap exhibits $d_{x^2-y^2}$ symmetry and has a considerable angular dependence. Anisotropic behavior results from the precise way that the superconducting electrons pair up. Above a certain critical temperature (T_c), HTSC materials exhibit a phenomenon known as the pseudogap. The pseudogap appears in the single-particle excitation spectrum of the metallic phase. Its existence is a clear departure from the predictions of the standard BCS theory for superconductivity. The pseudogap could be related to phase fluctuations of the superconducting order parameter [4].

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By partially replacing La with Sr, or doping La_2CuO_4 , one of the most well-known examples of HTSC materials is obtained, yielding $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$. A metallic phase is generally expected with $x = 0$, since there are one or an odd number of electrons per unit cell. However, these HTSC cuprates undoped parent compounds are anti-ferromagnetic (AF) Mott insulators. The superconducting phase appears when charge carriers are added to the CuO_2 plates, causing the anti-ferromagnetic phase to disappear. It is now commonly acknowledged that the symmetry of HTSC is in $d_{x^2-y^2}$ wave [5] and that the CuO_2 planes are crucial in determining these materials physical properties. Angle-resolved photoemission spectroscopy (ARPES) investigations clearly determined the aforementioned fact as well as the Fermi surface [6] is form. As one electron band theory [7,8] anticipated, a true Fermi liquid phase with a well-developed huge Fermi surface appears to occur in the overdoped regime.

The comprehension of the mechanisms underlying high-temperature superconductivity is largely dependent on theoretical models. Different theoretical models have been proposed, but the traditional BCS theory is unable to properly describe these novel kinds of superconductors. The behavior of high-Tc superconductors has been studied using one-, two-, and three-band Hubbard models, according to Hubbard Models. As explained by the t-J Model the properties of these materials can also be studied using the t-J model, another theoretical framework. Interpreting experimental data becomes more difficult when there are several interactions present, including charge density waves (CDW), spin-spin interaction, electron-phonon interaction, and spin density waves (SDW). High-Tc superconductor mechanisms may be better understood by examining theories that combine pairing interactions in the presence of strong anti-ferromagnetic correlations [9].

Based on the discourse presented here, it is evident that the topic remains open despite almost thirty years of intense research. In order to gain a deeper understanding of these substances, scientists have been compelled by the unusual features of cuprates to create new theoretical instruments and conduct more complex and creative experiments. Scientists propose that unlike typical superconductors, these materials' superconductivity is not caused by a single contact. To determine the impact of different interactions on both the superconducting and normal phases of these materials, new experiments are conducted on them. The Hubbard model and the t-J model with different interactions were examined theoretically in relation to cuprates at half-filling or at optimal doping.

The traditional BCS theory of superconductivity relies heavily on the electron-phonon (EP) interaction. It is the origin of the dynamical effect for pair formation as well as the effective attraction between the electrons. On the other hand, strong electronic correlations are thought to be the primary source of superconductivity in the unusual HTSC materials. Recent experimental findings, however, indicate that

the electron-lattice interaction may have played a role in some of the pairing mechanisms of the HTSC materials. High temperature superconductivity should predominantly result from strong coupling to many phonon modes, according to experimental observations. The significance of EP interaction and strong e-e correlation in cuprates and other high-T_c materials is reinforced by recent findings from inelastic scattering and ARPES studies. Long-range Fröhlich type EP contact has been proposed.

In this review we discuss the various models used for the study of the unusual properties of HTSC. Then we discuss few properties of HTSC obtained by studying these models.

Electronic Models

A key idea in quantum physics, the Hamiltonian describes the overall energy of a system. The Hamiltonian is essential to comprehending the behavior of electrons in the CuO₂ planes of high-temperature cuprates, which are copper oxide materials distinguished by their superconducting characteristics. The investigation focuses on the unique movement of electrons inside the CuO₂ plates. Atoms of copper (Cu) and oxygen (O) are organized in a lattice structure in these planes. Simplifications are required because of the complex structure of these materials. Scientists use assumptions in order to build a useful Hamiltonian that describes the fundamental physics of the CuO₂ planes. The strong Cu-O bonds found within the CuO₂ planes provide justification for the notion that the Hamiltonian should be restricted to these planes. The behavior of the electronic components is greatly influenced by these linkages.

Three-band model

The electrical characteristics of high-temperature superconducting cuprates are explained theoretically by the three-band model. The fundamental feature of the model is the copper oxide (CuO₂) plane, which is essential to cuprate superconductors. Three energy bands are taken into consideration within this plane, each of which is connected to a distinct electronic state. These bands are the result of interactions between the atoms of copper (Cu) and oxygen (O). We consider a simplified generic 2D crystal square lattice, equivalent to CuO₂ planes, which, in each unit cell, has one copper and two oxygen atoms. It is necessary to add extra layers to genuine materials in order to justify the 3D illusion.

In the undoped parent complex, the oxygen atom gains two electrons (one from copper and the other from the charge reservoir) and is in the O²⁻ (2p⁶) valence state, while the in-plane copper atom loses one 4s electron and one of the 3d electrons to transition to the valence state Cu²⁺(3d⁹). Cu 3d-orbitals and O 2p-orbitals no longer have a degeneracy due to the crystal fields in the solid; instead, they tend to hybridize

[2], as seen in Fig. 1.1. Then, the maximum energy single band consisting of one of the O 2p-orbitals and the Cu $d_{x^2-y^2}$ orbital can explain the physics of the high-Tc cuprates.

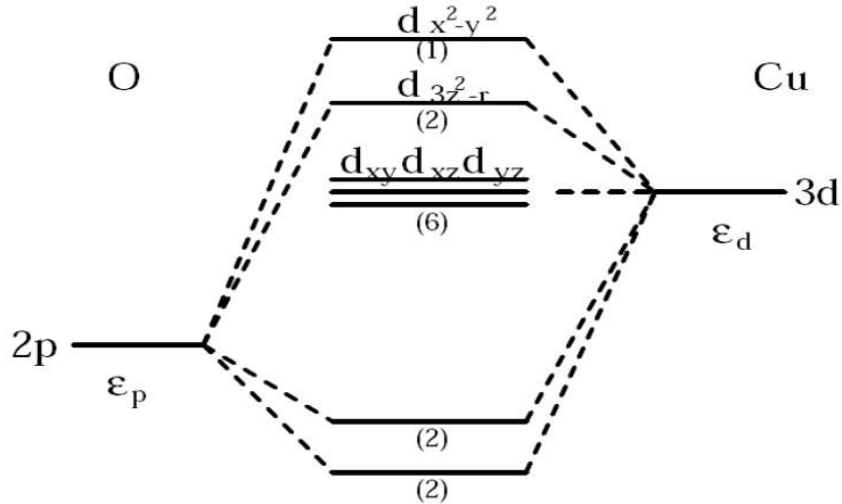


Figure 1.1: Level separation of O^{2-} and Cu^{2+} ions. Only the P_x , P_y , and 3d Cu electron orbitals are taken into account. The numbers in parenthesis indicate which levels in the undoped compound are occupied [2].

The well-known antiferromagnetic (AF) Heisenberg model can be used to describe the effective Hamiltonian for understanding HTSC. At exact half-filling (undoped scenario), the Cu^{2+} be the only 3d Cu electron and behaves as a localized spin-1/2 on the CuO_2 plane.

$$H=J\sum_{\langle i,j \rangle} \vec{S}_i \cdot \vec{S}_j$$

Where the summation $\langle i, j \rangle$ is over the nearest neighbor sites, \vec{S}_i is spin operator at site i . Undoped CuO compounds were initially highlighted by Anderson as Mott insulators [3]. The findings of x-ray absorption experiments (XAS) and x-ray photoemission spectroscopy (XPS) demonstrated that undoped copper oxides are charge-transfer insulators (CT), a particular kind of Mott insulator [4].

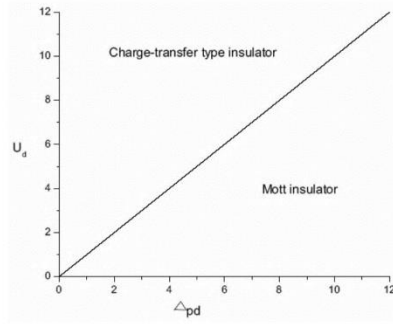


Figure 1.2: An illustration showing the distinction between Mott and charge-transfer type insulators. Here, the level difference between the upper Hubbard band and the oxygen 2p level is denoted by Δ_{pd} and U_d is the on-site Coulomb repulsion on Cu sites.

In Fig. 1.2, the schematic diagram distinguishing the CT insulator from the Mott insulator is displayed. U_d is the onsite Coulomb repulsion on Cu sites and $\Delta_{pd} = \vec{\epsilon}_d - \vec{\epsilon}_p$ where $\vec{\epsilon}_d$ is the on-site energy level of copper and $\vec{\epsilon}_p$ is the energy level for oxygen. The system is a charge transfer insulator in cuprates, U_d is around three times larger than the charge transfer gap Δ_{pd} , and the holes are bonded to the Cu at half filling [4-6]. Since Coulomb resistance between holes strongly opposes double-occupancy of the Cu₂ $d_{x^2-y^2}$ orbital, the extra holes prefer to settle onto the highest O-level upon doping. The Cu hole, which is the essential component of HTSC, and this doped hole create a Zhang-Rice singlet [7].

Based on these concepts, Emery presented a three-band model [8] that includes the maximum oxygen 2p-level, the Cu $d_{x^2-y^2}$ orbital, and the on-site Coulomb repulsions. The three-band Hubbard model, often known as the matching Hamiltonian, can be expressed as

$$H = -t_{pd} \sum_{\langle i,j \rangle} (p_j^\dagger d_i + h.c) - t_{pp} \sum_{\langle j,j' \rangle} (p_j^\dagger p_{j'} d_i + h.c) + \epsilon_d \sum_i n_i^d + \epsilon_p \sum_j n_j^p + U_d \sum_i n_{i\uparrow}^d n_{i\downarrow}^d + U_p \sum_j n_{j\uparrow}^p n_{j\downarrow}^p + U_{dp} \sum_{\langle i,j \rangle} n_i^d n_j^p$$

In this case, annihilation operators at the copper ions at site i , are represented by the symbol d_i , and fermion operators that eliminate holes at the oxygen ions labeled j are represented by p_j . The nearest neighbor Cu-O pairs are denoted by $\langle i,j \rangle$. The hopping terms, roughly proportional to the overlap between Cu and O orbitals, correspond to the hybridization among nearest neighbor Cu and O atoms. t_{pp} represents the direct hopping amplitude between O-O atoms. U_d and U_p are on-site repulsions (positive) between holes when they are in the same d and p orbitals respectively. U_{dp} is the Coulomb interaction strength between two holes occupying adjacent Cu-O ions. Due to the screening effect by the finite density of electrons, interactions at longer distances are minimal.

One-Band Models

Even with today's computer capabilities, it is challenging to investigate the three band Hubbard model due to its many parameters and high number of states (for N sites, $4N$ basis states).

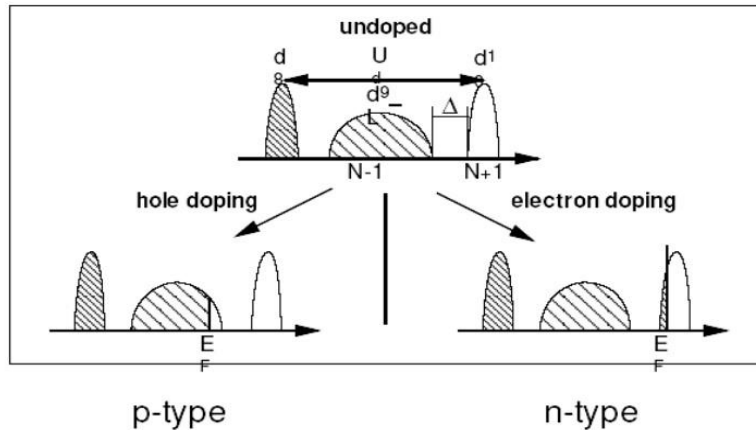


Figure 1.3: Doping scheme for a charge-transfer CuO_2 plane. While electron doping goes into the upper Hubbard band, hole doping moves the Fermi level into the charge transfer band [10].

The three-band Hubbard Model was simplified into a "t-J model" by Zhang and Rice (1988) by taking the following points into account. A Cu ion is encircled by four oxygen atoms in HTSC materials. In relation to the central hole at the copper ion, an oxygen hole can be either singlet (symmetric) or triplet (antisymmetric). They made the assumption that solving the problem in the singlet subspace, or lowest energy state, is permissible without altering the "physics" of the situation [7]. A spin singlet state centered at the copper has then taken the position of the hole that was first made at the oxygen. This can be interpreted as removing one copper spin $\frac{1}{2}$ from the square lattice of copper spins. As a result, the effective model lacks oxygen ions and matches spin and holes on the 2D square lattice.

The three-band Hubbard Model was simplified to a "t-J model" by Zhang and Rice (1988) based on the following arguments: in HTSC materials, a Cu ion is surrounded by four oxygen atoms; a hole at oxygen can be in a singlet (symmetric) or triplet (antisymmetric) state with respect to the central hole at the copper ion; they assumed that working in the singlet subspace, which is the lowest energy state, is acceptable without changing the "physics" of the problem [7]. Afterward, the hole that was initially placed at the oxygen has been substituted by spin singlet state centered at the copper. This is the same as removing one copper spin $\frac{1}{2}$, from the square lattice of copper spins. As a result, the effective model does not include oxygen ions and instead corresponds to spin and holes on the 2D square lattice.

After a few computations, the effective Hamiltonian for the three-band Hubbard model also known as the "t-J model" is obtained.

$$H = J \sum_{\langle i,j \rangle} \left[\vec{S}_i \cdot \vec{S}_j - \frac{1}{4} n_i n_j \right] - t \sum_{\langle i,j \rangle, \sigma} [c_{i\sigma}^\dagger (1 - n_{i-\sigma}) (1 - n_{j-\sigma}) c_{j\sigma} + H.c.]$$

In a two-dimensional square lattice, the S_i 's represent the spin $\frac{1}{2}$ operators at site i , and J represents the AF coupling between the nearest neighbor sites. The electrons can move without changing their spin thanks to the hopping concept. Double occupancy is not included by the projector operator $(1 - n_{i-\sigma})$.

Theorists have investigated the more general one-band Hubbard model in great detail [11], primarily in the strong coupling limit, in addition to the t-J and the three-band Hubbard model. The definition of this model is

$$H = -t \sum_{\langle i,j \rangle, \sigma} [c_{i\sigma}^\dagger c_{j\sigma} + H.c.] + U \sum_i n_{i\uparrow} n_{i\downarrow}$$

When a square lattice with spin σ has an electron created at site i by the fermionic operator $c_{i\sigma}^\dagger$, as is customary. t is the hopping amplitude, and U is the repulsive interaction that occurs on-site.

Results of different calculations of hubbard model

Numerous numerical investigations indicate that the fundamental HTSC phenomena are exhibited by the 2D Hubbard model. The existence of long range AF order in the ground state of the Hubbard model at half filling is known to be caused by the super exchange interaction U [19, 35]. Short-range AF correlations appear when doping causes the AF order to be quickly destroyed. The AF order was totally disrupted at quarter fills [20], and the systems seem to be Fermi liquids.

According to A. Moreo [36], the magnetic susceptibility for $U/t=4.0$ reaches its maximum at half filling and then falls with doping. On the other hand, the susceptibility rises with hole doping at $U/t=10.0$ (figure 2.1) and close to 50% filling [18]. For the two sub-lattices, spin-spin correlation calculations for the $N \times N$ Hubbard model at half fills exhibit AF behavior with distinct signs [21]. The scientists used the diagram technique, which is appropriate for high electron correlations, to investigate the magnetic susceptibility of the 2D repulsive Hubbard model. They found that the staggered susceptibility diverged with decreasing temperature, confirming the emergence of the long-range AF order. No evidence of ferromagnetic correlations is seen in the range of electron concentrations taken into consideration, which is $0.8 \leq \tilde{n} \leq 1.2$ for the repulsion parameters $8|t| \leq U \leq 16|t|$. This range is consistent with the earlier Monte Carlo findings. When $U/|t|$ and $|1-\alpha|$ are larger than 0.2, the NN correlations turn ferromagnetic. [22].

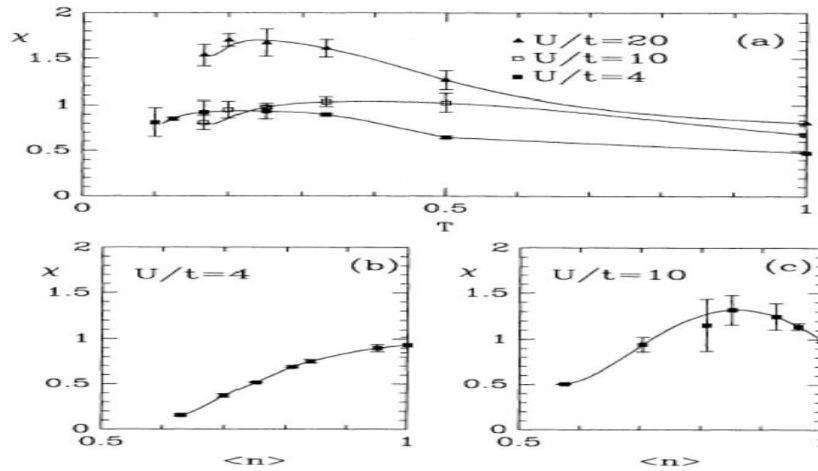


Figure 2.1: (a) A 4x4 lattice with uniform magnetic susceptibility for varying U/t as a function of temperature at 50% filling. (b) For a 4x4 lattice with $U/t=4.0$, uniform magnetic susceptibility as a function of density at temperature 0.25 (c) At temperature 0.25 on a 4x4 lattice, uniform magnetic susceptibility as a function of density for $U/t=10$ [17].

For various cluster geometries and fillings, the magnetic characteristics of the Hubbard model in one, two, three, and infinite dimensions have been investigated. When both on-site and nearest neighbor repulsive interactions are much larger than the hopping terms, it has been demonstrated that a stabilized ferromagnetic ground state is formed at and away from quarter filling for one-dimensional trestle lattice in an extended Hubbard model through a third-order electron exchange process around a triangle [23]. Additionally taken into consideration are the general susceptibilities at zero temperature in the half-filled Hubbard model in infinite dimensions surrounding the metal-to-insulator transition.

The 2D Hubbard model's superconducting gap structure proves that superconductivity results from the exchange of collective electronic fluctuations with a magnetic cause that occur at relatively low frequencies [25]. The NNN hopping t' is crucial to the conflict between superconductivity and antiferromagnetism. A significant pairing gap is also produced by it [27].

It has been suggested that superconductivity and d-wave symmetry can be observed in the half-filled 2D Hubbard model when NNN hopping is included. Even even above the superconducting transition temperature, there are indications that pairing fluctuation predominates in the normal-conducting state [28]. A two-dimensional square lattice of elemental 2×2 plaquettes with NN hopping t and on-site repulsion U connected by an inter-plaquettes hopping $t' < t$ is used to examine the determinant QMC of the Hubbard model. The results show that for $U/t=4.0$, the pairing vertex is most attractive for $t'/t \approx 0.4$. With increasing U/t , the ideal t'/t grows [29].

On a square lattice, the stability of the 2D t - t' Hubbard model has been investigated [30] for a range of NNN hopping t' and electron concentration values. We witness several phases, some of which have an order parameter with a large number of nodes in k -space. Antiferromagnetism, $d_{x^2-y^2}$ -wave singlet superconductivity, flux phase, and d -wave Pomeranchuk instability are the ordered phases that have been seen. Additionally, a number of instabilities have been found, including a g -wave Pomeranchuk instability, a band splitting phase with p -wave character, a triplet analog of the flux phase, a particle-hole instability with p -type symmetry in the triplet channel, and a magnetic phase.

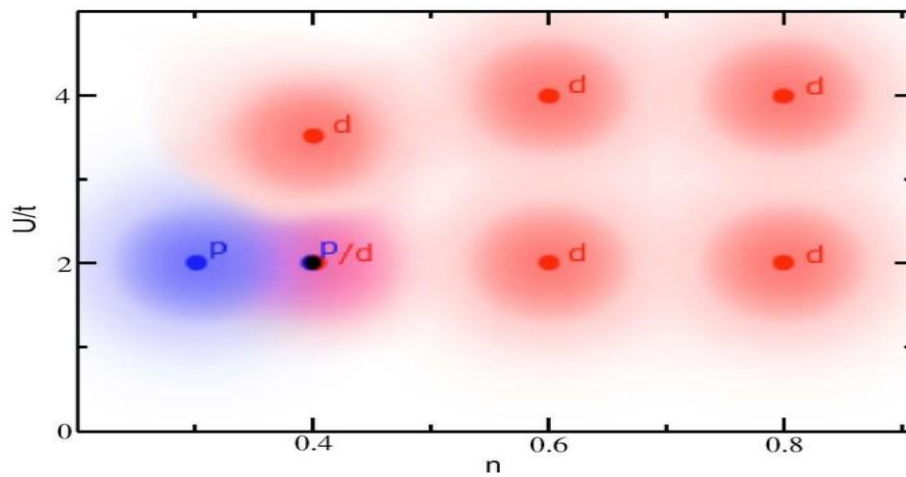


Figure 2.2: The dominant pairing symmetry is displayed in the U - n phase diagram; for $n=0.4$, $U=2t$, it is too near to determine which instability is greatest [26].

At low temperatures and doping away from half-filling, the emergence of a striped phase [17], pseudogap regime [31, 32], and D -wave pairing [24] have been noted. The expanded Hubbard model's real-space Hartree-Fock computations demonstrate that NNN (t') hopping prevents the development of static charge stripes. It has been suggested that whilst abnormally tiny t' values provide an additional explanation for the emergence of static stripes in LSCO, large t' values in YBCO inhibit the creation of static stripes [33]. Charge stripe phases have been demonstrated to be promoted by positive t' and repressed by negative t' [34].

Conclusion

The physics of HTSC seem to be confined in the CuO_2 Plane of the cuprates. Three band Hubbard model and one band model has been proposed to study essential physics of these cuprates. However well-known Hubbard and t-J model has been studied most for extracting the physics of HTSC.

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Moving towards a Cultural Landscape as a resort to save the natural milieu – In the light of the ecological insights of Mahatma Gandhi

Shampa Dutta*

ABSTRACT

Ecology of natural science and development in their true sense, imply designing strategies for natural resource management by linking environmental and allied developmental activities with more social and humanitarian processes. It is in these contexts, that we need to go through a series of reconciliations for sustainable development of our biosphere and one obvious way is to reconcile between ecology, economics and ethics and connect the broken links between them. Mohandas Karamchand Gandhi, being the custodian of global human welfare, came up with his deliberations where human were seen as a part of the ecosystem functioning. Gandhiji's thoughts have been visualized as ancient endeavors to recognize a paradigm shift in ecology, even before the concept of 'sustainable development' got popularized amongst the masses and entered the ecological dictionary. The purpose of this work being simple yet solicitous, has been to show the pathways of new social ethics to be inculcated by the existing and the upcoming generations, leaning on Gandhiji's insights, so that they can realize the concern for environment, for not only the professional development but also for the personal growth and peaceful coexistence. Thus, this paper highlights the pertinence in addressing the contemporary ecological and developmental challenges by depending on and re-examining Gandhiji's imminence. It tries to put forward a holistic paradigm integrating ethical considerations with practical strategies for a more enlightened future.

Mahatma Gandhi's philosophy of simplicity, self-sufficiency, and harmony with nature formed the bedrock of his environmental outlook. Repeated readings of these aspects of Gandhiji from books in access as well as the internet have helped in my compilation of ideas and thereby highlight the interconnectedness of all life forms as advocated by Mahatma Gandhi for a balanced coexistence between humanity and the environment. Gandhiji's critique of unchecked industrialization, consumerism, and

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exploitation of natural resources underscores the need for responsible and ethical development and these have been the focus of my exercise, being undertaken at present.

Key words: Sustainable development, ecology, natural resource management, paradigm shift, holistic approach, Sarvodaya, cultural landscape

Introduction

The concept of sustainable development first articulated by the *World Commission on Environment* in 1987 through the well-known Brundtland Report⁽¹⁾ reveals a shift in our thinking on the concept of economic development, which had so far assumed that natural resources are inexhaustible and are available to be exploited for human welfare. Sustainable development is now seen as that process of development which meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

Munasinghe⁽²⁾ in 1994 opined that, Sustainable development may be described as a process for improving the range of opportunities that will enable individual human beings and communities in achieving their desires and full prospective over a continued span of time, maintaining the pliability of socio-economic and environmental systems. This concept has evolved to encompass three major points of view: economic, social and environmental.

Each and every opinion relates to a sphere (and a system) that has its own specific motivating forces and directives. The economy is geared mainly towards improving the welfare of the humans, through the increase in the utilization of goods and services. The environmental domain focuses on protection of the reliability and resilience of ecological systems. The social domain focuses on the fortification of human relationships and achievement of individual and group targets. In other words, sustainable development requires increase both in adaptive capacity and in opportunities for advancement of economic, social and ecological systems (Gunderson and Holling 2001)⁽³⁾. Improving adaptive capacity will increase buoyancy and sustainability.

Global change (involving climate change, biological invasion, land use and biodiversity depletion) has triggered this shift in paradigm on economic development linked to sustainable natural resource management. Depending upon the kind of global change issues with which the society is trying to cope up with, the problem of sustainability takes different meanings. The issues to be resolved such as global warming due to green house effect, acidification of soil and water, decline in the quality of air, soil and water, wild exploitation of natural resources, drastic changes in the land use, land cover through over

exploitation of natural resources leading to desertification of landscapes are dangerous for mankind. All these predicaments demand a variety of additional and alternative pathways for development. Further depending upon the disciplinary emphasis of the individual concerned with developmental issues, sustainability assumes diverse meaning. Thus issues relevant to conservation of natural resources have to be addressed differently, depending upon the ecological, socio-economic and cultural framework in which one is operating. Indeed global change has become the catchword in recent times but with different implications for the developed and developing worlds. This arises out of this great divide between the two worlds in terms of social-economic and ecological ethos.

Traditionally all societies have strong cultural correlations with nature and natural resources. This trend still remains for many traditional societies as part of their lifeline, and today there is an increased awareness in the world about the state of our environment caused by overexploitation of natural resources for economic development. In the developing world, resource exploitation is largely due to meeting the basic needs of food, shelter, fodder, fuel wood for large section of deprived societies. On the other hand, in developed countries maintenance and acceleration of the already very high levels of resource consumption are prime concerns, blessed as they are with the early initiative taken and advantage gained through industrialization. Natural resources are often viewed as in ample by the industrialized world because of the development and faith in technology providing substitute for the natural resource capital. Natural resource management thus acquires specific importance in resource rich areas still left under exploited. This is also applicable for the developing tropics where the long-established social setups still exist.

Undoubtedly economic development is the most important marker of a country's growth and to achieve this developing and developed countries are unreasonably exploiting the natural resources without an understanding of how and what to utilize. If correct balance is struck between the usage of resources and the availability of resources, then the veracity of the planet could be managed well.

Linking Gandhiji and sustainability may seem like a stylish device at first glance. However, if sustainability is considered in a holistic way, more as a transformation of man–environment relations as well as of social and economic structures, this image changes. If one also takes seriously that Mahatma Gandhi's understanding of non-violence does not only include the avoidance of physical violence, but a fundamental attitude in different spheres of life, such as economy or the use of technology, it becomes clear that sustainability, as it is currently being upheld by the United Nations in Agenda 2030, and Gandhi's concept of satyagraha practice mystically, the identical goals⁽⁴⁾. This is why and how we remain indebted to this Man for years after years. Without a Gandhian analysis and reformation of the

ideological and foundational underpinnings of sustainable development, the Sustainable Development Goals cannot be easily realized. Gandhi's emotion and writings on sustainability are calm and extremely judicious. It has been acknowledged by ecologists that Gandhian insights serve as a guide to understanding the environmental concerns from an apt perspective.

Gandhi's perception of development and environmental resilience

In Mahatma Gandhi's opinion⁽⁵⁾, in any design of development, man should be at the centre point. He has to make a sensible use of natural resources so that the ecological balance should not be disturbed. It places more emphasis on moral and ethical accountability of the individual at the personal, social, national and universal level.

Gandhi believed in 'Sarvodaya' and therefore the welfare of all was the basis of his thinking; hence his community centered approach towards sustainability emphasized on 'betterment of human life' and 'ensuring accomplishment of basic needs of all human needs'. Gandhi was an economist but for the masses and an preservationist without any ordered model. Although he did not give a stipulated model of environmental conservation and sustainable development, connecting all his thoughts together, we get his logically built up environmentally sustainable development illustration.

Gandhi recommended for decentralization of power in society. His trusteeship concept being Sarvodaya, every member of the society is the custodian of the wealth generated out of the joint efforts of all. Thus, it denies individual pursuit and collection of wealth and converts it into community wealth of all for a better society. He expected that the trusteeship will result into non-violent and non-exploitative socio-economic relations and development frameworks, based on production systems, centering on the preservation of nature⁽⁶⁾.

Gandhi's sustainable development is based on a holistic paradigm which lays stress on all round development of individual and society in relation with nature. This entire thinking was based upon the ethical visualization in which the individual is at a central position. A smart shift from the consumer society to the Conserver Society seems to be the claim of modern age.

Sustainable development is an ideology, drawn at the global level, showing human beings are interrelated to each other and with the ecosphere. It is a movement as it suggests a way of life which involves the active participation of all the people of the society. Self-help, self-reliance, decentralization of industries and labour-intensive technology; are the qualitative goals of satisfying meaningful life. This is quite reflective of what the present scenario and government lays stress on.

Gandhi wrote in the first decade of 20th century in 'Hind Swaraj'⁽⁷⁾ that a persistent quest for material goods and services and a corresponding civilization driven by endless wants is 'Satanic' and rather redesigned and redefined civilization in terms of the preferences of duties; adherence to moralities and exercise of restraint', thus limiting greed. As aptly Gandhi remarked 'Earth has enough resources for everybody's needs and not for anybody's greed.' Harmonious existence of mankind and nature presupposes an approach based on equity and justice and coexistence of all cultures and civilization.

Looking at the Dandi Yatra launched by Gandhiji, from the independence struggle point of view, its broader objective was of freeing the world from the gruesome greed of materialism. This action along with his opinion that the mother Earth has enough resources in store to fulfill everybody's needs but not for anybody's unnecessary greed, has eternal lasting impact on the minds of the world.

Once during the struggle for independence, drought was experienced in the Kathiawar district. Knowing that planting of trees on a large scale can be an effectual step to face water crisis, Gandhi asked for plantation of trees. At a prayer meeting in Delhi in 1947, he suggested that water harvesting has to be practiced for irrigational purposes to avoid calamities such as famines and food shortages. Startlingly the same was suggested by the Committee headed by M. S. Swaminathan in the year 2006. This means that Gandhi was much forward of his time.

The above instances are eye-openers to the fact that sustainable development is a combination of economic and ecological ideas-Socio-economical, political and ecological concepts are put together to solve environmental crises. At the ecological level, it is calculated as a science dealing with organized relation between plants and animals with their habitat and environment.

Sustainable development which is a movement and just not an ideology is visualization with revelation of the truth behind a falsified world. As an ideology it has drawn our attention to the global responsibility indicating that human beings are unified with the ecosphere. As a movement, it suggests a way of life and calls for active participation of all the stakeholders of the society.

Revelations to save the Environment

In globalization, when the general tendency is towards the creation and accumulation of wealth, there are calls for a need to change our approach towards this creation. We need a changed impression of the economic order based on Gandhi's concept of gratification and control of wants. We need to change our outlook and approach towards accommodating one and all for making this earth a suitable living

place for all. We need to change the methods of creation of wealth through fairer means that will not endanger nature.

Gandhi emphasized that creation of wealth through justified means and without putting sustainable development at stake. His ideas are piously orientated and is a holistic approach leaning towards creation of an all-inclusive nature.

Conservation and sustainable development are closely interlinked, in that one cannot be achieved at the expense of the other. From a human angle such an integrated approach demands satisfying human needs in an equitable manner, maintenance and promotion of social, cultural and biological diversity, and ecological integrity of the system. Harmony with nature implies that development cannot be sectoral, it has to be holistic. Holistic approach also implies that the entire actor concerned with development namely the government agencies, non-governmental organizations, scientists and indeed the beneficiary local communities, all have to work together through appropriate institutional mechanisms. Further sustainable development demands efficiency in resource use in such a manner that contributes to equity with social justice, at the same time avoiding social disruptions. This again involves strong community participation.

Indeed, we are passing through a transitional phase. In the context of rural development, land use, animal husbandry and the domestic sectors have to be looked at as an integrated whole for a given village. On the science and technology front, the rapid decline in the availability of fossil fuels will mean transition from the non-renewable energy sources to renewable energy sources with profound consequences on global ecology. With the realization that human development depends upon a strong mind-body inter-connection, on the social front, the emphasis is now upon sustainable use of natural resources, rather than its exploitative use.

A gradual change in the value system and cultural values though slow, has already been a stated happening. The traditional wisdom, embedded in the concept of sacred species, ecosystems and landscapes, and its revivalism in the contemporary context of biodiversity conservation is something to be taken note of. A greater appreciation of the interconnectedness leading to an organic and ecological world view, akin to the views of the ancient seers is emerging.

For a changed perspective to emerge, the need is to reconcile between the three E's - ecology, economics and ethics, otherwise there is every chance to fall prey to anthropocentric thinking that has been the bane of traditional ecological paradigm which dominated the Earth once. Gandhi, a Man with *Mahan Atma* has said 'The path is the goal', and it was needed to start with ourselves so that future

generations do not blame us. This sums up what that emerging ecological paradigm and the non-violent ecological economics is all about.

The universal acceptance of market reforms based on demand and supply which primarily focus on 'Survival of the fittest' is opposing to Gandhi's attitude of making everyone fit to survive in this world. Change is inevitable but it is necessary to know, for what to change, to what extent to change and what be the price to be paid to bring this change. Indiscriminate changes could bring in disastrous consequences. Unless the feelings and aspirations of all are taken care of, there cannot be permanent peace and contentment.

Even after so many years, Gandhiji's beliefs continue to be inspiring for India as also the rest of the world. His political accomplishments gave us independence. Prof Herbert Girardet⁽⁸⁾ in his book, "Surviving the Century: Facing the Climate Chaos" gives the concept of 'Earth community' and while doing so he leaned on to Mahatma's words: "Earth has enough resources for everybody's needs and not for anybody's greed." Even the Time Magazine in 2007 came out with 51 Global Warming Survival Guides. The 51st guide is/ sharing more and consuming less for a easy and simplified life. It teaches us to live simply and make room for others to live simply and happily and asks for man to be more with an optimistic mindset. Mahatma Gandhi Institute of Education for Peace and Sustainable Development was established in New Delhi, in the year 2012 as integral part of United Nation's UNESCO, likely to promote peaceful and sustainable communities via education for peace, sustainable development, and global citizenship.

Conclusion

A repeatedly asked question is whether people are looking for a standardized single developmental pathway for meeting with their immediate aspirations for an improved quality of living, to which the optimistic answer that is likely to emerge out of the pertinent disclosure of Gandhi's perspectives is that the discussions on sustainable management of natural and human –managed ecosystems have to be tailor-made to value system that the local communities can understand and appreciate and therefore can participate in the process of development. Having so empowered, these societies can then move along a trajectory for development which is in harmony with the given socio-ecological system that they chose for themselves. Such an approach would then become the basis for sustainable landscape management. Such a developmental paradigm implies connecting the ecological with social, economic, cultural and above all humanitarian dimensions to ultimately create a 'cultural landscape', that a given society dreams to have and that they can connect with. The aim is now to rediscover the flow of value system to

the extent possible, or even construct it a new, under changed socio-ecological circumstances. The objective in all these efforts should be to strike the right balance between cultural diversity linked to organic diversity. Such an approach alone can perhaps contribute towards larger 'global human security' wherein an atmosphere in parity with the dream world as envisioned by Gandhiji can be crafted, where in primacy to human efforts governing their complex social and economic interactions, be given.

When asked about our past days, still we remember of some of the finer moments that our parents have tried to provide us amidst a more congenial environment. This realization at the same time makes us feel ashamed that we still belong to a generation, which is responsible for the damage caused to the environment or at least ignoring all the alarming signals. Needless to say that if the future is not realizable enough to understand the impending crises, is the world sure to face an upheaval that may lead to the perishing of a civilization. Therefore situating Gandhi securely in discussions on environment is appropriate and significant at this juncture and that has been the motto behind me, embarking upon this work.

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মহাত্মা গান্ধীর চেতনায় আদর্শ গ্রাম গঠনের ভাবনা: একটি ঐতিহাসিক বিশ্লেষণ

তন্ময় দে*

সারসংক্ষেপ: বর্তমানে ভারতের প্রায় ৭০ শতাংশ মানুষ গ্রামাঞ্চলে বসবাস করে এবং তাদের মধ্যে বেশিরভাগই আবার প্রাথমিক স্তরের বিভিন্ন জীবিকা যেমন- কৃষিকাজ, কুটির শিল্প প্রভৃতির সাথে যুক্ত রয়েছে। ভারতে শহরের প্রগতির সাথে গ্রামীণ ভারতের প্রগতির এক বিরাট ব্যবধান তৈরি হয়েছে এবং এই ব্যবধান দিন দিন বেড়েই চলেছে। তবে এই অবস্থা থেকে গ্রামীণ ভারতকে মুক্ত করতে না পারলে ভারতের কাঙ্ক্ষিত উন্নতি কোনদিনই সম্ভব হবেনা। যদিও গ্রামীণ ভারতের উন্নতির জন্য সরকার একাধিক জনকল্যাণমূলক পদক্ষেপ গ্রহণ করেছে, কিন্তু স্বাধীনতার পঁচাত্তর বছর পরেও গ্রামীণ ভারতে কিন্তু কাঙ্ক্ষিত পরিবর্তন আসেনি। গ্রামীণ ভারতের উন্নতির জন্য রবীন্দ্রনাথ ঠাকুর, মহাত্মা গান্ধী প্রমুখ মনীষীরা তাদের সুচিন্তিত অভিমত প্রকাশ করে গেছেন। মহাত্মা গান্ধী ছিলেন এমনই একজন ব্যক্তি যিনি স্বাধীনতা আন্দোলন পরিচালনার পাশাপাশি সমাজ সংস্কারের জন্যও আজীবন লড়াই করেছেন। তিনি বিভিন্ন গ্রন্থে লেখালেখির পাশাপাশি নিজের কাজের মাধ্যমেও এই বিষয়ে উজ্জ্বল নজির তৈরি করেছেন। তিনি গ্রামের কৃষি, শিল্প, শিক্ষা, স্বাস্থ্য সবকিছুর বিকাশ ঘটিয়ে ভারতকে জগত-সভায় শ্রেষ্ঠ আসনে বসানোর স্বপ্ন দেখেছিলেন। গ্রামীণ জনগনের আত্মোন্নতি ঘটানোর মাধ্যমে তাদেরকে দিয়েই আত্মনির্ভরশীল গ্রামীণ সমাজ গড়ে তোলার লক্ষ্যে গান্ধীজি একাধিক গ্রামগঠনমূলক সূত্র উপস্থাপন করেছেন। আমার এই গবেষণা নিবন্ধে আমি গান্ধীজির গ্রাম গঠনের ভাবনা উপস্থাপনের পাশাপাশি তাঁর এই মূল্যবান ভাবনা গ্রহণ করার ক্ষেত্রে বর্তমান সমাজ তথা প্রশাসনের অপারাগতা তথা ব্যর্থতার দিকগুলি তুলে ধরেছি।

সূচক শব্দ: মহাত্মা গান্ধী, কুটির শিল্প, খাদি, পঞ্চায়েত ব্যবস্থা, গ্রামের শিক্ষা, রাষ্ট্র ভাবনা ইত্যাদি।

মহাত্মা গান্ধী গ্রাম গঠনের ক্ষেত্রে এক অভিনব ভাবনা ব্যক্ত করেছিলেন, তিনি ভারতের গ্রামোন্নয়ন নিয়ে চিন্তিত ছিলেন। তিনি তাঁর রচনায় গ্রামীণ স্বরাজের কথা বলেছেন যেখানে-“গ্রামের মানুষের দ্বারাই গ্রাম শাসিত হবে, প্রত্যেক গ্রামে থাকবে একটি পঞ্চায়েত। পাঁচজন ব্যক্তিকে নিয়ে গড়ে উঠবে এই পঞ্চায়েত, এরা প্রত্যেক বছর গ্রামের মানুষদের ভোটে নির্বাচিত হবেন, তবে এই সদস্যদের নির্দিষ্ট গুণমান থাকতে হবে। নির্বাচিত পঞ্চায়েতের হাতেই যাবতীয় নীতি নির্ধারণ ও বিচারের অধিকার থাকবে। যদিও এখানে কোনো কঠিন শাস্তির বিধান দেওয়া হবেনা; পঞ্চায়েত আইনসভা, বিচারসভা এবং প্রশাসনিক দফতর হিসেবে তার দায়িত্ব পালন করবে।”^১ তাঁর মতে সবার আগে গ্রাম-ভারতে স্বাধীনতা আনতে হবে; গড়ে তুলতে হবে পূর্ণ শক্তিসম্পন্ন পঞ্চায়েত। এভাবে প্রত্যেকটি গ্রাম সকল বিষয়ে স্বাবলম্বী হয়ে উঠবে এবং বহির্বিশ্বের প্রভাব থেকে নিজেদের মৌলিকত্ব অক্ষুণ্ণ রাখতে পারবে। গ্রামগুলিতে সমাজ কোনো পিরামিডের আকারে গড়ে উঠবেনা, এখানে সকলে সমতার একটি বৃত্তে আবদ্ধ থাকবে। রাম কুমার বেপার মতে, ইজরায়েল এবং চীনে যেমন কমিউনিটি ভিত্তিক সমাজ গড়ে উঠেছে ঠিক তেমনই গান্ধীজিও চেয়েছেন ভারতেও যেন এমনই গ্রামীণ সমাজের বিকাশ ঘটে। চরন সিং বলেছেন-“গান্ধীজি ভারতের অর্থনৈতিক বিকাশকে বুঝতে চেয়েছেন ভারতের প্রেক্ষিতে, ভারতের যা কিছু সম্পদ আছে তাকে দেশীয় কায়দায় কীভাবে ব্যবহার করলে সবথেকে ভালো ফল পাওয়া যেতে পারে তিনি তার বিধান দিয়েছেন। আমাদের দেশের সাথে খাপ খায় এমন একটি যথাযথ অর্থনৈতিক বৃদ্ধির কৌশল গ্রহণ ও লাগু করতে হবে। আমাদের আত্ম-নির্ভরশীল হিসেবে গড়ে ওঠা উচিত। অতীতের প্রতি অতিরিক্ত আবেগ আমাদের চোখে একটি পর্দা বেঁধে দিতে পারে যার ফলে আমরা ইতিহাস থেকে প্রকৃত শিক্ষা নাও পেতে পারি, আমাদের সত্য জানা নাও হতে পারে।”^২

গান্ধীজি ও কুটিরশিল্প

আধুনিক বিশ্বের বৃহত কারখানা নির্ভর অর্থনৈতিক ব্যবস্থার মাঝেও গান্ধীজি গ্রামীণ কুটিরশিল্প রক্ষার উপর জোর দিয়েছিলেন। তিনি চেয়েছিলেন পরিবর্তিত সমাজেও যেন সাধারণ গ্রামবাসীরা নিজেদের অস্তিত্ব রক্ষা করতে পারে। তাঁর মতে কুটিরশিল্পের বিকাশের ফলে বহু মানুষের চাকরির সুযোগ হবে, অপচয় বন্ধ করা যাবে, দূষণ কমবে এবং পাশাপাশি দেশীয় সংস্কৃতি, মূল্যবোধ ও সামাজিক ন্যায়বিচারের উপরও গুরুত্ব অক্ষুণ্ণ থাকবে। এই প্রসঙ্গে বলতে হয়-“ক্ষুদ্রশিল্প

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সম্পর্কে জাতীয় পরিকল্পনা কমিটি ১৯৩৮ সালে তাদের প্রথম পদক্ষেপ গ্রহণ করেছিল। যেভাবেই হোক ক্ষুদ্র ও কুটির শিল্প ১৯৪৮ সালে শিল্প আইন পাশ হওয়ার আগে এবং শিল্প আইন পাশ হওয়ার পরবর্তী ত্রিশ বছর ধরে সরকারের নজর কাড়তে সফল হয়েছিল। পরিকল্পনা নীতি রূপায়নের সময় পরিকল্পকরা ভাবতো কীভাবে ক্ষুদ্র ও কুটির শিল্পের বিকাশকে দ্রুত করা যায়। পঞ্চবার্ষিকী পরিকল্পনার ফলে ভারতের কুটির শিল্পের ধারাবাহিক উন্নতি ঘটেছে। শেষের দশকগুলিতে বিকাশের গতি ছিল অত্যন্ত উৎসাহব্যঞ্জক।^{১০} গ্রামীণ কুটিরশিল্প ভারতের গ্রামীণ দরিদ্র মানুষের জীবনে এক গভীর অবদান রেখেছে; বেকারত্ব দূরিকরণের ক্ষেত্রে এই শিল্পের অবদানকে গাঙ্কীজ অস্বীকার করতে পারেন নি। গ্রামীণ কুটির শিল্পকে তিনটি ভাগে ভাগ করা যেতে পারে:-

প্রথম প্রকারের ক্ষেত্রে গ্রামের কাঁচামাল থেকে চিরাচরিত পদ্ধতিতে হস্তশিল্পজাত ও সূক্ষ্ম কারুকার্যসম্পন্ন বিভিন্ন পণ্য তৈরি করা হয়। দ্বিতীয় প্রকারে আধুনিক পদ্ধতিতে তুলনামূলক অধিক শ্রম নিয়োগের মাধ্যমে আধুনিক পণ্য উৎপাদিত হয়। তবে আধুনিক পণ্য তৈরি করা হলেও চিরাচরিত রীতি অনুসরণ করে দেশলাই, সাবান, মোমবাতি সহ অন্যান্য পণ্যও তৈরি করা হয়। তৃতীয় প্রকারে ছোট ছোট ভাগে একাধিক ইউনিট গড়ে তুলে বর্তমান অর্থনীতির সাথে সাযুজ্যপূর্ণ বিভিন্ন পণ্য তৈরি করা হয়। ভারতবর্ষে ১৯৫১ সালে এই মর্মে একটি আইন পাশ করা হয়েছিল-“১৯৫১ সালের শিল্পবিকাশ ও নিয়ন্ত্রণ আইনের বক্তব্য অনুযায়ী স্মল স্কেল ইন্ডাস্ট্রী চাষ এবং যন্ত্র তৈরি করার ক্ষেত্রে ৭,৫০,০০০ টাকা বিনিয়োগ করবে। তবে জমিতে বিনিয়োগ কিংবা গৃহনির্মাণের ক্ষেত্রে কোনোপ্রকার নির্দিষ্ট উচ্চসীমা থাকবে না।”^{১১} বর্তমানে স্মল স্কেল ইন্ডাস্ট্রীর অন্তর্ভুক্ত রয়েছে আধুনিক স্মল স্কেল ইন্ডাস্ট্রী, তাঁতশিল্প, হস্তশিল্প, রেশম প্রস্তুতকরণ, পাওয়ারলুম, খাদি এবং অন্যান্য গ্রামীণ ক্ষুদ্র শিল্প।

গাঙ্কীজই প্রথম গ্রামীণ অর্থনীতি বিকাশের উপর জোর দিয়েছিলেন এবং অহিংস ভাবাদর্শের দ্বারা জনজীবনে স্বদেশী মানসিকতার বিকাশ ঘটাতে চেয়েছিলেন। ভারতের বেশিরভাগ মানুষ কৃষিকাজের উপর নির্ভরশীল কিন্তু সারা বছর যেহেতু কৃষিকাজ হয় না তাই তারা সেসময়ে একপ্রকার কর্মহীন হয়ে পড়ে। এই অনিশ্চয়তা থেকে মুক্তির অন্যতম পথ গ্রামীণ শিল্পের বিকাশসাধন। গ্রামীণ শিল্প গড়ে উঠলে বেকার কৃষকদের কর্মসংস্থান হয়, সাধারণ কৌশল অবলম্বনের মাধ্যমে বিভিন্ন জিনিস তৈরি করা হয়, অর্থনৈতিক কাঠামোর বিকেন্দ্রিকরণ হয়, গ্রামীণ কাঁচামাল ব্যবহার হওয়ায় কৃষকরা কাঁচামালের ভালো দাম পায়, আঞ্চলিক চাহিদা পূরণের ক্ষেত্রে এর জুরি মেলা ভার, মানুষের পরিত্যক্ত জিনিস দিয়েও অনেকসময় উপযোগী পণ্য তৈরি করা হয়; সর্বোপরি এর মাধ্যমে কৃষিমজুর, ছোট জমির মালিক ও কারিগররা নিয়মিত আয়ের সুযোগ পায়। গাঙ্কীজ ১৯২০ সালে **অখিল ভারতীয় সুতোকাটনি সংস্থা** ও পরবর্তীতে **অখিল ভারতীয় গ্রামীণ শিল্প সংস্থা** গড়ে তুলেছিলেন যা স্বাধীনতার পর সংযুক্ত হয়ে **অখিল ভারত সেবা সংঘ** নাম নিয়ে গ্রামীণ শিল্পের বিকাশ ও পুনরুজ্জীবনের ক্ষেত্রে নিরন্তর কাজ করে চলেছে।^{১২} পরবর্তীকালে ভারত সরকার গঠন করেছে **অখিল ভারতীয় খাদি এবং গ্রামীণ শিল্প পর্যদ**, যার উদ্দেশ্য হিসেবে ১৯৫৬ সালের প্রস্তাবে বলা হয়েছে:-

- ১) স্বল্প খরচে গ্রামের বেকার মানুষদের জন্য চিরস্থায়ী কর্মের ব্যবস্থা করা, যার পরিধি হবে বিস্তৃত।
- ২) আঞ্চলিক স্বাবলম্বতা অর্জনের মাধ্যমে উপভোক্তাদের চাহিদা পূরণের লক্ষ্যে পণ্য উৎপাদন।
- ৩) পুঁজি এবং কৌশলের মেলবন্ধন ঘটিয়ে গ্রামীণ জনজীবনে গতিশীলতা বৃদ্ধি করা।
- ৪) জাতীয় আয়কে ভারতের সকল স্থানে ও অঞ্চলে ছড়িয়ে দেওয়া।
- ৫) পরিকল্পনামাফিক ভারতীয় গ্রামের আর্থ-সামাজিক সমস্যার সমাধানের জন্য কাজ করা।^{১৩}

গ্রামীণ শিল্পের বিকাশের অর্থই হল ভারতীয় শিল্পের বিকেন্দ্রিকরণ, জে সি কুমারাপ্পার মতে-“শিল্পক্ষেত্রে বিকেন্দ্রিকরণ সর্বদা রাজনৈতিক ক্ষেত্রে গণতান্ত্রিকব্যবস্থার সাথে সাযুজ্যপূর্ণ। অর্থনৈতিক ক্ষেত্রে একরকম এবং রাজনৈতিক ক্ষেত্রে আরেকরকম বৈশিষ্ট্য থাকতে পারেনা, কারণ এগুলি জাতীয় স্বার্থের সাথে ওতোপ্রোতভাবে যুক্ত। সাম্রাজ্যবাদ, একনায়কতন্ত্র এবং শিল্পের কেন্দ্রিকরণ পারস্পরিক সহাবস্থান করে। সুতরাং আমরা রাজনৈতিক ক্ষেত্রে একনায়কতন্ত্র এবং সাম্রাজ্যবাদ প্রতিষ্ঠা করতে চাইলে শিল্পের কেন্দ্রিকরণের দিকে ঝুঁকতে পারি। যদি আমরা প্রকৃত গণতন্ত্র গড়ে তুলতে চাই তবে আমাদের শিল্পের বিকেন্দ্রিকরণের জন্য কাজ করতে হবে।”^{১৪} ভারতের গ্রামীণ শিল্পের বিকাশের ক্ষেত্রে বেশকিছু সমস্যা রয়েছে, যথা- আর্থিক সহযোগিতার অভাব,

কাঁচামালের অ-সহজলভ্যতা, পরিমান ও গুণমান নিয়ন্ত্রণ সমস্যা, বাজারের সমস্যা ও গবেষণা ঘাটতির দরুন শিল্পোৎপাদনে যুগোপযোগিতা আনতে না পারা। গান্ধীজি যে কুটিরশিল্পের কথা বলেছেন তা হল-“একটি গ্রাম কিংবা গ্রামীণ পরিবারের একজন ব্যক্তির তত্ত্বাবধানে গ্রামীণ শিল্প গড়ে উঠবে এবং পরিচালিত হবে এবং শহরের ক্ষেত্রে কেবলমাত্র ঘরের ভিতরে এই কাজ হবে। এই শিল্পগুলি পণ্য উৎপাদন, প্রক্রিয়াকরণ, পরিষেবা প্রদান এবং এছাড়াও নানান জিনিস তৈরি ও সাড়াইয়ের কাজ করবে।”^১ এই শিল্পের ক্ষেত্রে বেশকিছু সমস্যা রয়েছে যা দূর করার জন্য গান্ধীজি কয়েকটি বিধান দিয়েছেন। তার মতে সহজ ও সস্তা কাঁচামালের সাহায্যে প্রযুক্তিগত উন্নয়নের মাধ্যমে খরচ কমিয়ে লাভের পরিমান বাড়ানো যেতে পারে, উৎপাদিত পণ্য গ্রামেই নয় তা যাতে শহরেও বিক্রি করা যায় সেই ব্যবস্থা নিতে হবে, উৎপাদন-গুণমান-নক্সা প্রভৃতির বৈচিত্র্য আনার জন্য প্রযুক্তিগত পরিবর্তন আনতে হবে এবং পাশাপাশি কারিগরদের জন্য প্রশিক্ষণকেন্দ্র গড়ে তুলতে হবে। ভারতে প্রাথমিকভাবে কৃষিনির্ভর শিল্প গড়ে তোলার কথা তিনি বলেছেন; যার জন্য প্রয়োজন কৃষিক্ষেত্রে দ্রুত বিকাশ, বেকারত্ব সমস্যার সমাধান, গ্রামের সংরক্ষণ প্রভৃতি।

গান্ধীজি এবং খাদি

অহিংস নীতি ও খাদি এই দুইয়ের মাধ্যমে গান্ধীজি ভারতের স্বাধীনতা আন্দোলনে এক অভিনব সংস্করণ ও পরিবর্তন এনেছিলেন। খাদি হল সাধারণ মানুষের বস্ত্রোৎপাদনের ক্ষেত্রে স্ব-নির্ভরতা আনার পাশাপাশি তাদেরকে আদর্শ জীবন দেওয়ার আরেক নাম। তাঁর কাছে খাদি কেবল অপরের চাহিদা পূরণের জন্য অতিরিক্ত উৎপাদন নয়, সকলে যেমন নিজের জন্য প্রত্যহ খাবার রান্না করে তেমনই প্রত্যেকে নিজের জন্য খাদি তৈরি করবে। তিনি বলেছেন-“খাদি একটি বিতর্কিত বিষয়। অনেকেই মনে করে খাদির কথা বলে আমি হাওয়ার বিপরীতে যেতে চাইছি এবং এইভাবে স্বরাজের নৌকা ডোবাবো ও দেশকেও এক অন্ধকারের দিকে বয়ে নিয়ে যাবো। আমি আমার রচনায় খাদি ব্যবহারের বিষয়ে ওকালতি করছি, এই নিয়ে আমি অন্য কোথাও বলবো। আমি এখানে বলতে চাই কীভাবে প্রত্যেকটি কংগ্রেস সদস্য এবং সকল ভারতীয় খাদিকে উন্নতির দিকে এগিয়ে নিয়ে যেতে পারে সেই কথা। এটি দেশে আর্থিক স্বাধীনতা এবং সাম্য আনতে পারে বলে আমার বিশ্বাস।”^২ ১৯৩৪ সালে কংগ্রেসের লাহোর অধিবেশনে গান্ধীজি খাদিকে অঙ্গপূর্ণা বলে চিহ্নিত করেছিলেন। ১৯৩৫ সালের অক্টোবরে আইসা(AISA)’র ওয়ার্ধা অধিবেশনে তিনি বলেছেন-“আমাদের লক্ষ্য হল প্রত্যেকের হাতে চরখা এবং প্রত্যেকের ঘরে তাঁত দেখা। আমরা লক্ষ লক্ষ টাকার খাদি তৈরি করতে পারি কিন্তু এভাবে আমরা নির্দিষ্ট লক্ষ্যে পৌঁছাতে পারবোনা। আমি বলছি শহরের কথা ভুলে যান, ভাবুন কীভাবে দেশের ত্রিশ কোটি মানুষকে খাদি তৈরির সাথে যুক্ত করা যাবে এবং এরপর দেখবেন যে এক কোটি শহরবাসীও খাদি পরতে শুরু করছে।”^৩

১৯৫৫-৫৬ সালে ২৪ মিলিয়ন বর্গমিটার খাদি তৈরি হয়েছিল যা ১৯৮৫-৮৬ সালে বেড়ে হয় ১০৫ মিলিয়ন বর্গমিটার। পূর্বে ৬ কোটি টাকার খাদি তৈরি হত এবং ১৯৮৫-৮৬ সালে তার মূল্যমান বেড়ে হয় ১৯৫ কোটি টাকা। ১৯৫৫-৫৬ সালে যেখানে খাদি উৎপাদনের সাথে ৬.৬ লক্ষ মানুষ যুক্ত ছিল সেখানে ১৯৮৫-৮৬ সালে তা বেড়ে হয় ১৩.৫ লক্ষ। খাদি উৎপাদনের কয়েকটি গুরুত্বপূর্ণ দিক রয়েছে, যথা- সঞ্চয়ের পরিমান বাড়ানো, ঐতিহ্যকে অক্ষুণ্ণ রেখে প্রযুক্তির ক্ষেত্রে ধীরে ধীরে পরিবর্তন আনয়ন, খাদির সাথে যুক্ত কারিগরদের মজুরি প্রদান, গ্রামের দরিদ্র মানুষদের মধ্যে যারা অধিক দুর্বল তাদের জন্য কাজের ব্যবস্থা করা, খাদির মূল্য কাঠামো নির্দিষ্ট করা, খাদি উৎপাদনের সাথে যুক্ত প্রতিষ্ঠানগুলিতেও শিল্প আইন লাগু করা, সরকারি ভর্তুকি ছাড়াই খাদিকে লাভজনক ব্যবসায় পরিণত করা, সরকারি সাহায্যের প্রকৃতি নির্ধারণ করে উপযোগী ব্যবস্থা গ্রহণ, খাদির বাজারজাতকরণের উপর জোর দেওয়া, সর্বোপরি গ্রাম তথা সমাজের এক বিরাট অংশের সমর্থন ও সহযোগিতা লাভ করা।^৪ ভারতের অর্থনীতির ভিত চাঙ্গা করার জন্য খাদির ভূমিকা ছিল অসাধারণ। ১৯৮০-৮১ সালে ভারতের বস্ত্র উৎপাদনের ক্ষেত্রে খাদির অবদান ছিল মাত্র ১ শতাংশ, যদিও বস্ত্রশিল্পের সাথে যুক্ত ১১ শতাংশ শ্রমিক খাদির সাথে যুক্ত ছিল। KVIC (খাদি এবং গ্রামীণ শিল্প কমিশন) একটি উন্নয়নমূলক সংস্থা; এটি খাদির সাথে যুক্ত প্রতিষ্ঠানগুলিকে অর্থনৈতিক ও প্রযুক্তিগত সাহায্য প্রদান করে। ভারতের মোট খাদি উৎপাদনের ৫০ শতাংশ তৈরি হয় উত্তরপ্রদেশ, তামিলনাড়ু, বিহার এবং গুজরাটে; ১৯৫৬ সালের পর থেকে সবজায়গায় খাদির উৎপাদন বেড়েছে। তবে KVIC অন্যান্যদিকের বিকাশে সাহায্য করলেও খাদির বাজারজাতকরণে সেইভাবে সাহায্য করেনা, তাই খাদির বিস্তার সাধনের ক্ষেত্রে সমস্যা দেখা দিয়েছে। খাদি সংক্রান্ত নানান সমস্যা সমাধানের জন্য নিম্নোক্ত পদক্ষেপ নেওয়া যেতে পারে:-

১) নির্দিষ্ট কিছু পণ্য কেবল খাদির সাহায্যেই তৈরি করতে হবে, ভারতের মোট বস্ত্রোৎপাদনের ২০ শতাংশ হবে খাদিবস্ত্র।

- ২) সরকারি বিভিন্ন বিভাগ বা প্রতিষ্ঠানের পাশাপাশি সরকারি সাহায্যপ্রাপ্ত প্রতিষ্ঠানগুলি যাতে খাদি ব্যবহার করে সেইমর্মে সরকারকে বিশেষ ব্যবস্থা নিতে হবে।
- ৩) খাদির দারিদ্রপূর্ণ অবস্থা দেখার পর এখানে কারখানা আইন, শ্রমিক আইন প্রভৃতি প্রয়োগ না করলেই ভাল হয়, কারণ এই ধরনের আইন মেনে চলতে গেলে বাস্তবে খাদি শিল্পকে আর্থিক দিক দিয়ে অত্যধিক বোঝা বহন করতে হবে।
- ৪) আর্থিক সহযোগিতা বাড়ানোর পাশাপাশি যাতে কর সংক্রান্ত ছাড় দেওয়া হয় সেইমর্মেও সরকারকে ব্যবস্থা নিতে হবে।
- ৫) ভারত সরকার খাদি বস্ত্রকে জাতীয় ফেবরিকের মর্যাদা দিলে তা খুব ভালো হবে।^{১১}

গান্ধীজি ও পঞ্চায়েতব্যবস্থা

মহাত্মা গান্ধীর গ্রাম গঠনমূলক ভাবনার সাথে পঞ্চায়েত ব্যবস্থা, গ্রামীণ বিদ্যালয় এবং কো-অপারেটিভ সংস্থার বিকাশও জড়িয়ে রয়েছে। তিনি মনে করতেন গ্রামের পরিপূর্ণ বিকাশের জন্য গ্রামের হাতেই উন্নয়ন সংক্রান্ত যাবতীয় নীতি-নির্ধারণের ক্ষমতা দিতে হবে। তিনি বলেছেন-“আমরা দীর্ঘদিন ধরে একটি ভাবনার সাথে খাপ খাইয়ে নিয়েছি যে সকল ক্ষমতার উৎস হল আইনসভা। আমি মনে করি এই ভাবনা একটি ভুলের গহ্বর তৈরি করে যা আমাদের জড়তা এবং সংবেশন থেকে তৈরি হয়। ব্রিটিশ ইতিহাস সম্পর্কে যেটুকু ধারণা তা থেকে বলতে পারি যে সকল ক্ষমতার উৎস জনগন এবং এরাই আইনসভায় জনপ্রতিনিধি পাঠায়।”^{১২} মহাত্মা গান্ধী পঞ্চায়েতরাজ প্রসঙ্গে যে ধারণা প্রদান করেছিলেন তা আলোচনা করা যেতে পারে:-

- ১) গ্রামীণ মানুষ যাতে নিজেদের কল্যানমূলক দিকগুলি সম্পর্কে অবগত হতে পারে সেইজন্য তাদের দক্ষতার বিকাশ ঘটাতে হবে এবং গ্রাম হল এমনই সম্প্রদায় ভিত্তিক উন্নয়নের আদর্শ একক।
- ২) পঞ্চায়েতব্যবস্থা গঠনের মূলে রয়েছে একটি উদ্দেশ্য এবং তা হল সরকারের বিভিন্ন কর্মসূচীকে জনগনের কর্মসূচীতে পরিনত করা।
- ৩) পঞ্চায়েতের লক্ষ্য হল স্থানীয় শ্রমশক্তি অথবা কো-অপারেটিভ সংস্থার সাহায্যে সর্বোচ্চ বিকাশসাধন।
- ৪) আঞ্চলিক এবং গনতান্ত্রিক ক্ষমতার বিকেন্দ্রিকরণ করতে গেলে পঞ্চায়েত গড়ে তোলাই একমাত্র পথ।

অধ্যাপক জোডের মতে যদি সমাজের কাজের প্রতি মানুষের বিশ্বাসকে পুনরুজ্জীবিত করতে হয় তবে রাষ্ট্রের এজিয়ার সংকুচিত করতে হবে এবং কাজগুলি জনগনের মধ্যে বন্টন করতে হবে। আলদৌস হাঙ্গলের মতে রাজনৈতিকভাবে রাষ্ট্রকল্যানের কথা ভাবা দরকার এবং বিকেন্দ্রীভূত ও দায়িত্বপূর্ণ স্ব-শাসন গড়ে তুলতে পারলেই আদর্শ সমাজ গড়ে তোলা যাবে। অ্যাডাম স্মিথের ধারণানুসারে সমস্যার গভীরে গিয়ে তা অনুধাবন করার পরেই কোনো সাহসী পদক্ষেপ নেওয়া যেতে পারে। গান্ধীজি বলেছেন-“প্রত্যেকটি গ্রামে একটি প্রজাতন্ত্র অথবা পঞ্চায়েত গড়ে তুলতে হবে যার হাতে গ্রামের সমস্ত ক্ষমতা থাকবে। প্রত্যেকটি গ্রাম হবে স্বয়ং-সম্পূর্ণ এবং সেগুলি নিজেরাই নিজেদের সমস্যা দূর করতে সক্ষম থাকবে, এমনকি সেগুলি বহির্বিশ্বের প্রভাব থেকেও নিজেদের রক্ষা করতে পারবে। গ্রামের মানুষদের নানারকম প্রশিক্ষণ দেওয়া হবে যাতে তারা প্রতি আক্রমণের জন্য প্রস্তুত হতে পারে। এইভাবে একজন ব্যক্তি একটি একক হিসেবে গড়ে উঠবে। কিন্তু তার মানে এই নয় যে সে তার প্রতিবেশীদের থেকে কিংবা অন্য রাষ্ট্র থেকে সাহায্য নেবেনা। এখানে সবকিছু চলবে স্বৈচ্ছাসেবা এবং নিঃশুল্ক নীতির উপর ভিত্তি করে। এই ধরনের সমাজের মধ্যকার মানুষ খুঁটিনাটি বিষয় সম্পর্কে অবগত হবে, সেখানে প্রত্যেক মহিলা ও পুরুষ নিজেদের প্রয়োজন সম্পর্কে ওয়াকিবহাল থাকবে এবং যেসকল জিনিস বাকিরা সমান শ্রমের দ্বারা পায়না তারা সেসকল জিনিস ব্যবহার করবেনা।”^{১৩}

গান্ধীজি সর্বোদয়ের কথা বলেছেন, তার মতে পঞ্চায়েত গড়ে তোলার অর্থই হল গ্রামের মানুষদের স্ব-নির্ভরতা বাড়ানো। একজন অর্থনীতিবিদের কাছে এর অর্থ শিল্পের বিকাশ এবং গ্রামবাসীদের উন্নয়ন। পঞ্চায়েতব্যবস্থার বিরোধিতার অর্থই হল বিজাতীয় ভাবনার বিকাশ; গ্রাম পঞ্চায়েত, পঞ্চায়েত সমিতি ও জেলা পরিষদের মাধ্যমে একটি আদর্শ গ্রামীণ স্ব-শাসনের প্রতিষ্ঠান গড়ে উঠতে পারে। পঞ্চায়েতব্যবস্থার মাধ্যমে রাজনৈতিক ক্ষমতার বিকেন্দ্রিকরণ হতে পারে যা জাতীয়তাবাদ বিকাশের পক্ষে উপযোগী। তবে পরাধীন ভারতবর্ষে এমনকিছু না থাকায় কাঙ্ক্ষিত জাতীয়তাবাদের জাগরণ ঘটানোর ক্ষেত্রে সমস্যা দেখা

দিত। পঞ্চায়েতব্যবস্থা গড়ে তোলা হয়েছিল জাতীয় নানান চাহিদা এবং প্রশাসনিক নানান বিধানের সুষ্ঠু প্রয়োগের জন্য। ভারতের মতো একটি বৃহত দেশে যেখানে নানান জটিলতা রয়েছে সেখানে গণতান্ত্রিক কাঠামোর সাথে গ্রামের মানুষদের যুক্ত করার ক্ষেত্রেও রয়েছে নানান অসুবিধা; অথচ আদর্শ গণতান্ত্রিকব্যবস্থার লক্ষ্যই হবে সাধারণ মানুষদের চাহিদার সাথে সঙ্গতি রেখে প্রশাসনিক নীতি নির্ধারণ। যাইহোক, দেশবাসীর বিকাশের জন্য সরকার পরিকল্পনা করছে এবং আঞ্চলিক স্তরের বিকাশের মাধ্যমে সমগ্র দেশের বিকাশের চেষ্টা করছে। জে এস মিল বলেছেন-“Such small places have already a sufficient public to furnish, to tolerate municipal council if they contain any talent or knowledge applicable to public business. It is apt to be all concerned in some one man, who thereby becomes the denominator of place.”²⁸ প্রশাসনের সর্বনিম্ন স্তর হলো পঞ্চায়েত, কিন্তু অনেকসময় তারা দক্ষ প্রশাসক নাও পেতে পারে। তারা প্রযুক্তিগত বিকাশ সম্পর্কে অবগত নাও থাকতে পারে, আবার নিরক্ষরতার কারণে বলিষ্ঠ নেতৃত্ব থেকেও তারা বঞ্চিত হতে পারে; তাই কেউ কেউ একাধিক গ্রামকে একসাথে যুক্ত করে পঞ্চায়েত গঠন করার বিধান দিয়েছেন। তবে গ্রামীণ স্বাবলম্বীকরণের ক্ষেত্রে সর্বোদয়ের বিকাশের কথা অধিক প্রাধান্য পেয়ে থাকে; যদিও স্বাবলম্বীকরণের জন্য স্ব-নির্ভরশীল হিসেবে গ্রামবাসীকে গড়ে তোলা প্রয়োজন। অধ্যাপক জি এইচ সাবিন বলেছেন-“It could not attain self-sufficiency, either in its economic or its politics without adopting a policy of isolation, and it could not isolate itself without suffering stagnation in what that very culture and civilization which Aristotle regarded it as crown of glory. On the other hand, if it chose not to isolate itself it was driven by political necessity to seek alliances with other cities, and these alliances could not be successful without the independence of their members.”²⁹ গান্ধীজি বলেছেন-“বহুবছর পূর্বে, যার হয়তো ইতিহাসও জানা যায়না! সেই সময়েরও ভারতে গ্রামীণ ও আঞ্চলিক শাসনব্যবস্থা ছিল। ভারতে অনেক শাসকেরা শাসন করেছে, অনেক রাজবংশ গড়ে উঠেছে আবার খুলোয় মিশে গেছে; অনেক যুদ্ধ হয়েছে কিন্তু এই গ্রামবাসীদের অবস্থা মোটামুটি একইরকম ছিল। আমাদের একটি গ্রামীণ স্বায়ত্তশাসন ব্যবস্থা ছিল যা গ্রামের মানুষদের জীবন ও সম্পত্তিকে দিয়েছিল নিরাপত্তা এবং তাদের নিয়ে গড়ে তুলেছিল সভ্য সমাজ।”³⁰ ভারতের গ্রামীণ কাঠামো এখনও আছে তবে তার মধ্যে অনেক পরিবর্তন এসেছে, একাধিক রাজবংশের উত্থান-পতনের মধ্যে দিয়ে গ্রামীণ স্ব-শাসনের ভাবনা এগিয়ে চলেছে। পঞ্চ+আয়াত=পঞ্চায়েত, পঞ্চ কথার অর্থ হল পাঁচজন সদস্য এবং আয়াত কথার অর্থ হল ঘর; অর্থাৎ এটি এমন একটি ব্যবস্থা যেখানে একাধিক সদস্য মিলিত হয়ে কোনো বিষয়ে সিদ্ধান্ত নিয়ে কাজ করে। বৈদিক শাস্ত্রে পঞ্চজন বলতে গণপতি, বিষ্ণু, শঙ্কর, দেবী এবং সূর্যের কথা বলা হয়েছে; এরা হলেন পরমেশ্বর।³¹ তবে ব্রিটিশ আমলে ভূমি-রাজস্ব আদায়কে কেন্দ্র করে ভারতের গ্রামীণ প্রশাসন অনেক বদলে গিয়েছিল। ১৮৭০ সালে লর্ড মেয়ো স্ব-শাসনের প্রসার ঘটিয়েছিলেন; তাকে ভারতের ‘স্থানীয় স্বায়ত্তশাসনের জনক’ বলা হয়। ১৮৭০ সালের ১৪ ডিসেম্বর পর্যন্ত সময়ে ভারতে ৩,৩৩৪ টি গ্রামীণ এলাকায় স্বায়ত্তশাসন চালু হয়েছিল, তবে এগুলি তখন পর্যন্ত শহর লাগোয়া এলাকাতাই ছিল। ব্রিটিশ আমলে আশু এই পরিবর্তন সম্পর্কে সি বি মামোরিয়া বলেছেন-“বর্তমানে কেন্দ্রীয় সরকার, শহরের দেওয়ানি ও ফৌজদারি আদালত, নতুন ভূমি-রাজস্ব ব্যবস্থা, জটিল প্রশাসনিক ব্যবস্থা, গ্রাম থেকে যোগ্য ব্যক্তিদের শহরে চলে আসা, শাসনের ব্যক্তিস্বাতন্ত্র্যতা এবং যৌথ পরিবারের ভাঙন পঞ্চায়েতব্যবস্থার মতো একটি গণতান্ত্রিক কাঠামোকে ক্রমশ ধ্বংস ও বিচ্ছিন্নতার দিকে নিয়ে যাচ্ছে। এইভাবে পুরনো আধা-গণতান্ত্রিক গ্রামীণ রাজনীতির আত্ম-নির্ভরশীল চরিত্রটাই নষ্ট হয়ে গেছে এবং এখন যে পঞ্চায়েতব্যবস্থা রয়েছে তা অনেকাংশে দুর্বল।”³²

গান্ধীজি এবং গ্রামের শিক্ষা

গান্ধীজি বুনীয়াদি শিক্ষার কথা বলেছেন, তিনি চেয়েছিলেন শিক্ষার সাথে মানুষের বাস্তব কর্মজীবনের সম্পর্ক স্থাপন করতে; তাইতো তিনি বৃত্তিমূলক শিক্ষার কথা বলেছিলেন। ১৯৩৮ খ্রিষ্টাব্দে গান্ধীজির নেতৃত্বে ও জাতীয় কংগ্রেসের অনুমোদনক্রমে কংগ্রেস শাসিত বিভিন্ন প্রাদেশিক শিক্ষা দপ্তর “নষ্ট তালিম” বা বুনীয়াদি শিক্ষাকে তাদের শিক্ষানীতি হিসেবে গ্রহণ করে। তবে বর্তমানে কোনো কোনো স্থানে এই শিক্ষাব্যবস্থা নামমাত্র টিকে আছে; সেগুলিও আবার গান্ধীজির প্রস্তাবিত “নষ্ট তালিম”-এর সঙ্গে কতটা সামঞ্জস্য রক্ষা করে চলতে পারছে তাও প্রশ্নাতীত নয়। গান্ধীজি, জাকির হোসেনকে নিয়ে একটি কমিটি তৈরি করেছিলেন; আর্থনায়কম দম্পতির মতো মানুষদের শান্তিনিকেতন থেকে নিয়ে গিয়েছিলেন; নতুন শিক্ষানীতি এইভাবেই গড়ে উঠেছিল। বিজয় ভট্টাচার্য, সাধনা ভট্টাচার্য প্রমুখরা এই শিক্ষানীতিকে ফলিত রূপ দিতে চেয়েছিলেন। মানভূমে ‘মাঝিহারা’ গ্রামে চিত্তভূষণ দাশগুপ্তের নেতৃত্বে ১৯৪০ সালে গান্ধীজির নয়া শিক্ষানীতিকে কেন্দ্র করে সংগঠন গড়ে উঠেছিল। যদিওবা ১৯৩৮ সালে সুভাষচন্দ্র বসুর নেতৃত্বে কংগ্রেস স্থির করেছিল যে ভারতীয়দের শিক্ষায় সচেতন ও স্বাবলম্বী করতে গান্ধীজির শিক্ষানীতিকেই প্রয়োগ করতে হবে। তবে গান্ধীজির শিক্ষা ভাবনা যথাযথ রূপে অনুসরণ করা হয়নি। স্বাধীনতার

পর যে শিক্ষাব্যবস্থা প্রযুক্ত হয়েছে তার ফলে গান্ধীজির নয়া শিক্ষাপদ্ধতি ধীরে ধীরে অপসৃত হয়েছে, পরিবর্তিত পরিস্থিতির সাথে সঙ্গতি রেখে বরণ করে নেওয়া হয়েছে ভারী শিল্পনীতির সঙ্গে যুক্ত পাশ্চাত্য শিক্ষানীতিকে। স্বাধীনোত্তর যুগে ভারতে গান্ধীজির ভাবাদর্শে বুনিয়েদি শিক্ষা ও বুনিয়েদি শিক্ষক-শিক্ষণ প্রচলিত ছিল কিন্তু কোঠারী কমিশন বুনিয়েদি শিক্ষাক্রমকে সাধারণ প্রচলিত শিক্ষারই সাথে কর্ম অভিজ্ঞতা নামে সংযুক্ত করে বুনিয়েদি শিক্ষার জীবন ভোমরাকে হত্যা করেছে। প্রকৃতপক্ষে বুনিয়েদি শিক্ষাদর্শন ও তার বাস্তব প্রয়োগ একেবারেই পরিত্যক্ত হয়; পশ্চিমবঙ্গে এই কাজটি অত্যন্ত তড়িৎগতিতে সম্পন্ন হয়েছে।

গান্ধীজির স্বপ্ন ছিল ভারতের প্রতিটি মানুষ স্বনির্ভরশীল ও প্রতিটি গ্রাম স্বয়ংসম্পূর্ণ হয়ে উঠবে; তবে এই স্বপ্ন রাষ্ট্রযন্ত্রের তথাকথিত উন্নয়নের তাগিদে হারিয়ে যেতে বসেছে। ভারতে আজ সমধর্মী সমাজের পরিবর্তে ভোগধর্মী সমাজ কায়ম হতে চলেছে। বুনিয়েদি শিক্ষার কথা বাদ দিলেও পাশ্চাত্যের বিশ্বায়নের সমর্থক যে শিক্ষাব্যবস্থা ভারতে চালু হয়েছে তার একপ্রান্তে একপ্রকার বিনামূল্যে প্রাথমিক ও মাধ্যমিক শিক্ষা এবং অন্যপ্রান্তে লক্ষ লক্ষ টাকার বিনিময়ে শিক্ষাব্যবস্থা চালু করেছে পুনের কাছে প্রতিষ্ঠিত এক কংগ্রেস নেতার নামাঙ্কিত বিদ্যালয়। এই দুই ধরনের বিদ্যালয় থেকে বেরিয়ে যে ছাত্র-ছাত্রী সমাজের দায়িত্ব নেবে, তাদের কি কোনো মিলনবিন্দু আছে? বিদ্যালয় শিক্ষাই ভারতকে নানা শ্রেণীতে ভাগ করে দেবে। তবে ভাবনা ছিল ভারতে বহু নয়, একই ধরনের ‘কমন স্কুল সিস্টেম’ থাকবে, এই ব্যবস্থা থাকলে ভারতের শিক্ষাক্ষেত্রে এত ভেদাভেদ তৈরি হতনা। গান্ধীজি অনুধাবন করেছিলেন নানা জাতি, নানা ভাষা, নানা ধর্ম, নানা সংস্কৃতির মানুষকে ভারতে একত্রিত রাখতে হলে জাতীয় সংহতি চেতনা, ধর্মনিরপেক্ষ মানসিকতা, পরধর্মসহিষ্ণুতা, অস্পৃশ্যতা ও অহিংসাকে জীবনের সকল ক্ষেত্রে প্রয়োগ করা দরকার। গান্ধীজি শিক্ষানীতির কয়েকটি মূলসূত্র রচনা করেছিলেন:- ১) প্রীতি তথা সকল সম্প্রদায়ের মধ্যে সৌভ্রাতৃত্ব ও সম্প্রীতি গড়ে তোলা। ২) মুক্তি তথা স্বাভাবিক হয়ে ওঠা। ৩) অভিব্যক্তি তথা সৃজনশীল কর্মের মাধ্যমে নিজেকে বিকশিত করার চেষ্টা করা। ৪) অহিংসা তথা হিংসার বিপরীতে প্রেম-প্রীতি ও ভালোবাসার বিকাশ ঘটানো। ৫) সত্যগ্রহ তথা সত্যের প্রতি আগ্রহ রেখে অসত্য ও অন্যায়কে প্রতিরোধ করা। ৬) সাফাই তথা পরিবেশ সম্পর্কে সচেতনতা গড়ে তোলার মাধ্যমে সুন্দর পরিবেশ, সুন্দর স্বাস্থ্য ও সুন্দর জীবন গড়ে তোলা।^{১১}

রাষ্ট্র সম্পর্কে গান্ধীজির ভাবনা

মহাত্মা গান্ধী যদিও কোনো রাজনৈতিক বিজ্ঞানী ছিলেন না, তবুও তিনি রাষ্ট্র সম্পর্কে এক সুগভীর ভাবনা ব্যক্ত করেছেন। গান্ধীজির রাষ্ট্রব্যবস্থার মূল ভিত্তিই হল সকলের পারস্পরিক সহযোগিতাপূর্ণ অবস্থান, এখানে আধ্যাত্মিকতা ও নৈতিকতাকে অধিক গুরুত্ব দেওয়া হয়েছে। এই প্রসঙ্গে তাঁর ভাবনা ব্যক্ত করে বলা যায়-“সত্যের অন্বেষণকারী হিসেবে তাঁর বিশ্বাস ছিল যে ভালো কাজের ফল ভালো হয়ে থাকে। ভবিষ্যতে কী ধরনের ফল পাওয়া যাবে সেই আশা না করে বর্তমানে উদ্ভূত সমস্যার দ্রুত নিরসনে কাজ করতে হবে।”^{১২} গান্ধীজি আরও বলেছেন-“ইশ্বর আমাদের দিয়েছেন সীমিত দৃষ্টি এবং সীমিত কর্মপরিধি, তাই এই অল্পসময়ের মধ্যে আমাদের কর্তব্য সম্পাদনের জন্য প্রত্যেকটি দিনকে যথাযথভাবে ব্যবহার করতে হবে আমাদের।”^{১৩} রাষ্ট্রের উৎপত্তি প্রসঙ্গে একাধিক মতবাদ প্রচলিত রয়েছে, যথা- সামাজিক চুক্তির তত্ত্ব এবং বিবর্তনের তত্ত্ব ইত্যাদি। অধ্যাপক গার্নারের অভিমতকে অনুসরণ করে বলা যায় যে রাষ্ট্র ঈশ্বরের দ্বারা সৃষ্ট নয়, নয় তা কোনো অতিভৌতিক উপাদানের সমাহার, বা কিছু প্রস্তাব বা চুক্তির দ্বারাও গড়ে ওঠেনা, বা কিছু পরিবারের সমাহারে গড়ে ওঠেনা। তবে বিভিন্ন তত্ত্বে রাষ্ট্র গড়ে ওঠার ক্ষেত্রে যেকথা বলা হয়েছে তার বিরোধিতা করে গান্ধীজি এক নতুন ভাবনা ব্যক্ত করেছেন। এই প্রসঙ্গে বলা যায়-“মহাত্মা গান্ধী তার সময়ের মহান ও শক্তিশালী রাষ্ট্রকে চ্যালেঞ্জ জানিয়েছিলেন। তিনি শুধু তাকে চ্যালেঞ্জ করেই ক্ষান্ত হননি, তিনি তাকে ঝুঁকতে বাধ্য করেছিলেন।”^{১৪} তিনি বলেছিলেন-“আমার কাছে রাজনৈতিক ক্ষমতার লক্ষ্য হল জনগণের জীবনের প্রত্যেকটি ক্ষেত্রে উন্নত করা। রাজনৈতিক ক্ষমতার লক্ষ্য হল জাতীয় প্রতিনিধিদের দ্বারা জাতীয় স্বার্থ রক্ষা করা। যদি জাতীয় জীবন নিজের মতো করে চালিত হতে সক্ষম হয়ে ওঠে তবে প্রতিনিধি নির্বাচনের প্রশ্নই আসবেনা। যেখানে নৈরাজ্য চলবে সেখানে প্রত্যেকে প্রত্যেকের শাসক।”^{১৫} তার মতে রাষ্ট্রে কিছু সংখ্যক মানুষের হাতে ক্ষমতা কুক্ষীগত থাকে যারফলে তাদের স্বৈরাচারী প্রবণতা বেড়ে যায় ও এইভাবে জনস্বার্থ উপেক্ষিত হয়। রাষ্ট্র এমন হবে যেখানে সাধারণ মানুষ একসাথে আনন্দে থাকবে এবং সরকার তাদের কল্যাণের জন্য সদা তৎপর থাকবে। পাশ্চাত্য রাষ্ট্রকাঠামোর তিনি বিরোধিতা করেছেন কারণ, সেখানে জনকল্যাণের যে ভাবনা তা ভারতীয় প্রেক্ষাপটে যথাযথ হবেনা।^{১৬} তিনি এও বলেছেন-“রাষ্ট্রের ক্ষমতা বৃদ্ধিকে আমি অত্যন্ত ভীতির সাথে দেখি। যদিও এই রাষ্ট্র অনেককিছু ভালো করে থাকে কিন্তু এইভাবে সে ব্যক্তি স্বাধীনতাও সক্ষীর্ণ করতে পারে যার ফলে যাবতীয় বিকাশমূলক ঘটনা তার যথার্থতা লাভে ব্যর্থ হয়ে ওঠে।”^{১৭} গান্ধীজি তাই ‘রামরাজ্য’-এর কথা

বলেছেন, এই রামরাজ্য হল একটি আদর্শ সমাজ। রামরাজ্য প্রসঙ্গে তার বক্তব্য-“যদি জাতীয় জীবনের প্রত্যেকটি দিকের যথাযথ বিকাশ ঘটে এবং আত্ম-পরিচালনের মন্ত্রে দীক্ষিত হয়ে ওঠে তবে সেক্ষেত্রে তার আলাদাভাবে প্রতিনিধি নির্বাচনের দরকার হয়না। এই ধরনের রাষ্ট্রে জনগন নিজেদের নানান সুবিধা অসুবিধার দিকগুলি নিজেরাই সমাধান করে থাকে। নিজেদের মতো করে স্বশাসন গড়ে তোলে এবং এইভাবে একটি আদর্শ সমাজ তথা রাষ্ট্র গড়ে ওঠে।”^{২৬}

গান্ধীজি বর্ণিত রামরাজ্য কোনোমতেই ভগবান শ্রীরামের আদর্শ বা ধর্মীয় ভাবাবেগ দ্বারা পরিচালিত রাষ্ট্রব্যবস্থা নয়; তার মতে-“ধর্মতাত্ত্বিক বিশ্লেষণে এটিকে ঈশ্বরের রাজ্য বলা যেতে পারে। রাজনৈতিক দৃষ্টিকোণ থেকে বিচার করলে বলা যেতে পারে এটি এমন একটি রাজ্য যেখানে অসাম্য থাকবেনা, থাকবেনা লিঙ্গ-জাতি-বর্ণভেদ অর্থাৎ একটি আদর্শ গণতন্ত্রের কথা এখানে বলা হয়। এই রাজ্যে সকল জমির মালিক জনগন; এখানে বিচারপ্রক্রিয়া অত্যন্ত দ্রুত, সস্তা এবং সঠিক; এখানে থাকবে ধর্মাচরণের স্বাধীনতা, বাকস্বাধীনতা, সংবাদপত্রের স্বাধীনতা। এই ধরনের রাজ্যে থাকবে সত্য ও অহিংসা; এখানে সমৃদ্ধি, সুখ এবং স্ব-নির্ভরশীলতা থাকবে।”^{২৭} ঔপনিবেশিক শাসনের বিরুদ্ধে সমালোচনা করে গান্ধীজি রামরাজ্য প্রতিষ্ঠার কথা বলেছিলেন, তিনি স্বাধীনতা নয় বরং স্বরাজের উপর জোর দিয়েছিলেন। ইংরেজদের অপসারণ মানেই কিন্তু স্বরাজ অর্জন নয়, ইংরেজদের অপসারণের ফলে ভারতে একটি শাসকের স্থলে আরেকটি শাসক নিযুক্ত হবে। তাই এমন একটি শাসনব্যবস্থা গড়ে তুলতে হবে যেখানে সমাজের প্রত্যেকটি স্তরের মানুষ অংশগ্রহণ করবে এবং তারা নিজেরাই নিজেদের ভাগ্য নির্ধারিত করতে পারবে। তার মতে দেশ স্বাধীন থাকুক কিংবা পরাধীন উভয় সময়েই সরকারি নিয়ন্ত্রণ থেকে নিজেদের মুক্ত রাখতে পারাই হল স্বরাজ। তবে স্বরাজ অর্জন খুব সহজ কাজ নয়, প্রত্যেকটি মানুষকে এখানে স্বরাজ অর্জনের যোগ্য হিসেবে নিজেকে গড়ে তুলতে হবে, সকলে অহিংসা ও সত্যগ্রহের মন্ত্রে দীক্ষিত হবে। গান্ধীজি তাই বলেছেন-“স্ব-শাসন নির্ভর করে আভ্যন্তরীণ শক্তির উপর, যাবতীয় প্রতিকূলতার বিরুদ্ধে লড়াই করার দৃঢ় মানসিকতার উপর। এখানে ব্যাপক সংখ্যায় পুরুষ ও মহিলারা নিজেদের মতো করে শাসনব্যবস্থা রূপায়ন করে, এখানে থাকেনা কোন বহিঃপ্রভাবক।”^{২৮}

গান্ধীজির ভাবনা ছিল ভারতের স্বাধীনতা একেবারে গোঁড়া থেকেই শুরু করতে হবে; অতএব এমন একটি ব্যবস্থা গড়ে তুলতে হবে যেখানে প্রত্যেকটি গ্রাম হবে এক একটি পঞ্চায়েত এবং এভাবেই প্রত্যেকটি গ্রাম স্ব-নির্ভর হিসেবে গড়ে উঠবে। তার এই কল্পিত আদর্শে রাষ্ট্রে তথা সমাজে কোনো সশস্ত্র সেনাবাহিনী থাকবেনা, এখানে থাকবেনা কোন হিংসা, সকলে অপরাধ প্রবনতা থেকে মুক্ত হয়ে কাজ করবে এবং গড়ে উঠবে প্রকৃত রামরাজ্য। তাই পরিশেষে বলা যেতে পারে যদিও এই লক্ষ্য অর্জন সহজ নয়, তবুও গান্ধীজি বিকল্প কোনো পথের কথা বলেন নি। এই ভাবনা নিয়েই তিনি কাজ করেছিলেন, কারণ তার বিশ্বাস ছিল ভারত একদিন জগতসভায় শ্রেষ্ঠ আসন নেবে। তাই অধ্যাপক গোপীনাথ ধাওয়ান যথার্থই বলেছেন-“The ideal non-violent society of Gandhi, unattainable due to human imperfection, indicates the direction rather than the destination, the process rather than the consummation. The Gandhian alternative is thus no rigid model; it is a process.”^{২৯}

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Strong bi-semilattice of Seminearrings

Tuhin Manna*

ABSTRACT

An attempt has been made to obtain some sort of analogue of structure theorem of Clifford semigroups *i.e.*, “A semigroup is Clifford if and only if it is strong semilattice of groups” in the setting of seminearrings. To accomplish this the notion of strong bi-semilattice of seminearrings has been introduced. Then those left (right) Clifford seminearrings, which are strong bi-semilattice of near-rings (zero-symmetric near-rings) have been characterized.

Key Words and Phrases: left (right) Clifford seminearrings, strong bi-semilattice of near-rings.

1 Introduction

Seminearring is a natural generalization of semiring as well as of near-ring. A semiring without one distributive property becomes a seminearring and a near-ring without the existence of additive inverse becomes a seminearring. Following Weinert [14] we call $(S, +, \cdot)$ is a seminearring if (1) $(S, +)$ is a semigroup (not necessarily commutative), (2) (S, \cdot) is a semigroup (not necessarily commutative), (3) $(a + b) \cdot c = a \cdot c + b \cdot c$ for all $a, b, c \in S$ (“right distributive law”). A (right) seminearrings $(S, +, \cdot)$ is said to be with zero if 0 is the additive identity of S and 0 satisfies the property $0 \cdot a = 0$. A seminearring S is said to be *zero-symmetric* if S is a seminearring with 0 in which $s \cdot 0 = 0$ for each $s \in S$. The seminearring considered in [3] was zero-symmetric. But throughout this paper, unless mentioned otherwise, the seminearring need not have to be with zero. Though the theory of seminearrings has not been as developed as that of semirings but it has a sustained research interest which is evident from good many publications such as [1], [3], [10], [11], [14], [15] and [16].

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Semirings occur naturally as the (semigroup) endomorphisms of additively commutative semigroups and near-rings occur naturally as the set of all self-maps of additive groups. In a similar way seminearrings occur naturally as $M(S)$, the set of all self-maps of an additive semigroup S . Though the natural seminearring $M(S)$ is not additively regular for an arbitrary additive semigroup S but it is so if and only if S is additively regular semigroup (*cf.* Proposition 2.4 of [12]). Thus, there are plenty of additively regular seminearrings.

The study of additively regular seminearring initiated in [12] and continued in [4]. One nice aspect of studying additively regular seminearrings is to obtain semigroup theoretic analogues. In this connection it may be recalled that there are some important structure theorems, in general for regular semigroups, in particular for completely regular semi- groups and for Clifford semigroups. In [4] while studying additively completely regular seminearrings the authors obtain a characterization of a left (right) completely regular seminearring as a bi-semilattice¹ of left (right) completely simple seminearrings (*cf.* Theorems 2.23 and 2.24 of [4]) which is the semigroup theoretic analogue of “A semigroup is completely regular if and only if it is a semilattice of completely simple semigroups”. They also obtained a characterization of left (right) Clifford seminearring as a distributive lattice of near-rings (zero-symmetric near-rings) (*cf.* Theorems 3.13, and 3.14) which is the semigroup theoretic analogue of “A semigroup is Clifford if and only if it is a semi- lattice of groups”. But they did not obtain the characterization of left (right) Clifford seminearrings either as strong bi-semilattice of near-rings (zero-symmetric near-rings) or as strong distributive lattice of near-rings (zero-symmetric near-rings) which is the semi- group theoretic analogue of “A semigroup is Clifford if and only if it is strong semilattice of groups” (*cf.* Concluding remark of [4]).

The main purpose of the present paper is to make an attempt to complete the unfinished work of [4] as mentioned above. In this direction the notion of strong bi-semilattice of seminearrings has been introduced, by adopting the concept of strong b-lattice of semirings [13]. Then a characterizations of left (right) Clifford seminearrings which are strong bi-semilattice of near-rings (zero-symmetric near-rings) has been obtained.

2 Strong bi-semilattice of Seminearrings

Definition 2.1. [4] A seminearring $(S, +, \cdot)$ is said to be a *left Clifford seminearring (right Clifford seminearring)* if it satisfies the following conditions:

(A) S is a left completely regular seminearring (resp. (A') S is a right completely regular

seminearring) and

(B) the additive idempotents of S commute additively with each other.

Definition 2.2. [4] A congruence ρ on a seminearring $(S, +, \cdot)$ is said to be a *bi-semilattice*¹¹ congruence on S if the factor seminearring S/ρ becomes a bisemilattice.

Definition 2.3. [4] A seminearring $(S, +, \cdot)$ is called a *bi-semilattice T of seminearrings $S_i (i \in T)$* if S admits of a bi-semilattice congruence β such that $T = S/\beta$ with each S_i a β -class.

Notations 2.4. Throughout this paper, unless mentioned otherwise,

- (i) for a seminear-ring S , $E^+(S)$ denotes the set of all additive idempotents;
- (ii) L^+ , R^+ , H^+ and J^+ denote the Green's relations L , R , H and J on the semigroup $(S, +)$, the additive reduct of the seminear-ring S ;
- (iii) in a seminearring S , L_a^+ , R_a^+ , H_a^+ and J_a^+ denote the L^+ , R^+ , H^+ and J^+ classes of $a \in S$, respectively;

Definition 2.5. [8] A *near-ring* is a set N together with two binary operations '+' and ' \cdot ' such that

- (1) $(N, +)$ is a group (not necessarily abelian),
- (2) (N, \cdot) is a semigroup (not necessarily commutative), and
- (3) for all $a, b, c \in N$, $(a + b) \cdot c = a \cdot c + b \cdot c$ ('right distributive law').

Definition 2.6. Let T be bi-semilattice and $\{S_\alpha : \alpha \in T\}$ be a family of pairwise disjoint seminearrings which are indexed by the elements of T . For each $\alpha \leq \beta$ in T , we now define a seminearring monomorphism $\phi_{\alpha,\beta} : S_\alpha \rightarrow S_\beta$ satisfying the following conditions:

- (1) $\phi_{\alpha,\alpha} = I_{S_\alpha}$, where I_{S_α} denotes the identity mapping on S_α ,
- (2) $\phi_{\beta,\gamma} \phi_{\alpha,\beta} = \phi_{\alpha,\gamma}$, if $\alpha \leq \beta \leq \gamma$,
- (3) $\phi_{\alpha,\gamma} S_\alpha \phi_{\beta,\gamma} S_\beta \subseteq \phi_{\alpha\beta,\gamma} S_{\alpha\beta}$, if $\alpha + \beta \leq \gamma$.

¹¹ Bi-semilattice is a suitable substitute of semilattice in the setting of seminearring.

On $S = \cup S_\alpha$ we define addition \oplus and multiplication \odot as follows:

$$(4) \quad a \oplus b = \phi_{\alpha, \alpha+\beta}a + \phi_{\beta, \alpha+\beta}b$$

and

$$(5) \quad a \odot b = c \in S_{\alpha\beta} \text{ such that } \phi_{\alpha\beta, \alpha+\beta}c = \phi_{\alpha, \alpha+\beta}a \cdot \phi_{\beta, \alpha+\beta}b$$

where $a \in S_\alpha, b \in S_\beta$. We denote the above system by $S = \langle T, S_\alpha, \phi_{\alpha, \beta} \rangle$ and call it the Strong bi-semilattice T of the seminearrings $S_\alpha, \alpha \in T$.

Theorem 2.7. *With the same notation as in Definition 2.6, the system $S = \langle T, S_\alpha, \phi_{\alpha, \beta} \rangle$ is a seminearring.*

Proof. We first show that the operation of multiplication defined above is well defined. For this purpose, we let $a \in S_\alpha$ and $b \in S_\beta$ with $\alpha, \beta \in T$. Then by (3) of Definition 2.6, there exists an element $c \in S_{\alpha\beta}$ satisfying (5) and the uniqueness of the element follows directly from the injectivity of the function $\phi_{\alpha\beta, \alpha+\beta}$. We now check the associativity of the addition. For this purpose, we let $a \in S_\alpha, b \in S_\beta$ and $c \in S_\gamma$ with $\alpha, \beta, \gamma \in T$.

$$\begin{aligned} a \oplus (b \oplus c) &= a \oplus (\phi_{\beta, \beta+\gamma}b + \phi_{\gamma, \beta+\gamma}c) \\ &= \phi_{\alpha, \alpha+\beta+\gamma}a + \phi_{\beta+\gamma, \alpha+\beta+\gamma}(\phi_{\beta, \beta+\gamma}b + \phi_{\gamma, \beta+\gamma}c) \\ &= \phi_{\alpha, \alpha+\beta+\gamma}a + \phi_{\beta, \alpha+\beta+\gamma}b + \phi_{\gamma, \alpha+\beta+\gamma}c \end{aligned}$$

and

$$\begin{aligned} (a \oplus b) \oplus c &= (\phi_{\alpha, \alpha+\beta}a + \phi_{\beta, \alpha+\beta}b) \oplus c \\ &= \phi_{\alpha+\beta, \alpha+\beta+\gamma}(\phi_{\alpha, \alpha+\beta}a + \phi_{\beta, \alpha+\beta}b) + \phi_{\gamma, \alpha+\beta+\gamma}c \\ &= \phi_{\alpha, \alpha+\beta+\gamma}a + \phi_{\beta, \alpha+\beta+\gamma}b + \phi_{\gamma, \alpha+\beta+\gamma}c. \end{aligned}$$

Therefore

$$a \oplus (b \oplus c) = (a \oplus b) \oplus c.$$

Now to check the multiplicative associativity, let $a \in S_\alpha, b \in S_\beta$ and $c \in S_\gamma$ with $\alpha, \beta, \gamma \in T$. Let $x = a \odot b$ and $d = x \odot c = (a \odot b) \odot c$. Then by definition we have

$$\phi_{\alpha\beta, \alpha+\beta}x = \phi_{\alpha, \alpha+\beta}a \cdot \phi_{\beta, \alpha+\beta}b. \dots\dots\dots(1.1)$$

and

$$\phi_{\alpha\beta\gamma, \alpha+\beta+\gamma}d = \phi_{\alpha\beta, \alpha+\beta+\gamma}x \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \dots\dots\dots (1.2).$$

In (1.1) applying $\phi_{\alpha+\beta, \alpha+\beta+\gamma}$ to both side of it

$$\phi_{\alpha\beta, \alpha+\beta+\gamma}x = \phi_{\alpha, \alpha+\beta+\gamma}a \cdot \phi_{\beta, \alpha+\beta+\gamma}b \dots\dots\dots (1.3)$$

and applying $\phi_{\alpha\beta+\gamma, \alpha+\beta+\gamma}$ to both side of (1.2)

$$\begin{aligned} \phi_{\alpha\beta\gamma, \alpha+\beta+\gamma}d &= \phi_{\alpha\beta, \alpha+\beta+\gamma}x \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \\ &= \phi_{\alpha, \alpha+\beta+\gamma}a \cdot \phi_{\beta, \alpha+\beta+\gamma}b \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \dots\dots\dots (1.4) \text{ [using (1.3)].} \end{aligned}$$

Again let $y = b \odot c$ and $e = a \odot y = a \odot (b \odot c)$. Then by definition,

$$\phi_{\beta\gamma, \beta+\gamma}y = \phi_{\beta, \beta+\gamma}b \cdot \phi_{\gamma, \beta+\gamma}c \dots\dots\dots (1.5)$$

and

$$\phi_{\alpha\beta\gamma, \alpha+\beta+\gamma}e = \phi_{\alpha, \alpha+\beta+\gamma}a \cdot \phi_{\beta\gamma, \alpha+\beta+\gamma}y \dots\dots\dots (1.6).$$

In (1.5) applying $\phi_{\beta+\gamma, \alpha+\beta+\gamma}$ to both side,

$$\phi_{\beta\gamma, \alpha+\beta+\gamma}y = \phi_{\beta, \alpha+\beta+\gamma}b \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \dots\dots\dots (1.7)$$

and applying $\phi_{\alpha+\beta\gamma, \alpha+\beta+\gamma}$ to both side of (1.6)

$$\begin{aligned} \phi_{\alpha\beta\gamma, \alpha+\beta+\gamma}e &= \phi_{\alpha, \alpha+\beta+\gamma}a \cdot \phi_{\beta\gamma, \alpha+\beta+\gamma}y \\ &= \phi_{\alpha, \alpha+\beta+\gamma}a \cdot \phi_{\beta, \alpha+\beta+\gamma}b \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \text{ [using (1.7)]} \\ &= \phi_{\alpha\beta\gamma, \alpha+\beta+\gamma}d \text{ [from (1.4)].} \end{aligned}$$

(i) Since the mapping $\phi_{\alpha\beta\gamma, \alpha+\beta+\gamma}$ is injective, we have $e = d$, i.e.,

$$a \odot (b \odot c) = (a \odot b) \odot c.$$

(ii) Finally to prove the right distributivity of the seminearring S , let $a \in S_\alpha$, $b \in S_\beta$ and

(iii) $c \in S_\gamma$ with $\alpha, \beta, \gamma \in T$. Let

(iv) $d = (a \oplus b) \odot c = (\phi_{\alpha, \alpha+\beta}a + \phi_{\beta, \alpha+\beta}b) \odot c.$

(v) Then by definition

(vi) $\phi_{(\alpha+\beta)\gamma, \alpha+\beta+\gamma}d = \phi_{\alpha+\beta, \alpha+\beta+\gamma}(\phi_{\alpha, \alpha+\beta}a + \phi_{\beta, \alpha+\beta}b) \cdot \phi_{\gamma, \alpha+\beta+\gamma}c$

$$\begin{aligned}
 \text{(vii)} &= (\phi_{\alpha+\beta, \alpha+\beta+\gamma}(\phi_{\alpha, \alpha+\beta}a) + \phi_{\alpha+\beta, \alpha+\beta+\gamma}(\phi_{\beta, \alpha+\beta}b)) \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \\
 \text{(viii)} &= (\phi_{\alpha, \alpha+\beta+\gamma}a + \phi_{\beta, \alpha+\beta+\gamma}b) \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \\
 \text{(ix)} &\dots\dots\dots = \\
 &\phi_{\alpha, \alpha+\beta+\gamma}a \cdot \phi_{\gamma, \alpha+\beta+\gamma}c + \phi_{\beta, \alpha+\beta+\gamma}b \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \dots\dots\dots (1.8) \\
 \text{(x)} & \text{ [using right distributivity of seminearring } S_{\alpha+\beta+\gamma}\text{]}.
 \end{aligned}$$

Let $e = a \odot c$ and $f = b \odot c$. Then by definition

$$\phi_{\alpha\gamma, \alpha+\gamma}e = \phi_{\alpha, \alpha+\gamma}a \cdot \phi_{\gamma, \alpha+\gamma}c \dots\dots\dots (1.9)$$

and

$$\phi_{\beta\gamma, \beta+\gamma}f = \phi_{\beta, \beta+\gamma}b \cdot \phi_{\gamma, \beta+\gamma}c \dots\dots\dots (1.10).$$

Applying $\phi_{\alpha\gamma, \alpha+\beta+\gamma}$ in both side of (1.9), we get

$$\phi_{\alpha\gamma, \alpha+\beta+\gamma}e = \phi_{\alpha, \alpha+\beta+\gamma}a \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \dots\dots\dots (1.11)$$

and applying $\phi_{\beta\gamma, \alpha+\beta+\gamma}$ in both side of (1.10) we get

$$\phi_{\beta\gamma, \alpha+\beta+\gamma}f = \phi_{\beta, \alpha+\beta+\gamma}b \cdot \phi_{\gamma, \alpha+\beta+\gamma}c \dots\dots\dots (1.12).$$

Using above two results in (1.8) we get

$$\phi_{(\alpha+\beta)\gamma, \alpha+\beta+\gamma}d = \phi_{\alpha\gamma, \alpha+\beta+\gamma}e + \phi_{\beta\gamma, \alpha+\beta+\gamma}f \dots\dots\dots (1.13).$$

Now

$$e \oplus f = \phi_{\alpha\gamma, \alpha+\beta+\gamma}e + \phi_{\beta\gamma, \alpha+\beta+\gamma}f$$

Applying $\phi_{(\alpha+\beta)\gamma, \alpha+\beta+\gamma}$ both side we get,

$$\begin{aligned}
 \phi_{(\alpha+\beta)\gamma, \alpha+\beta+\gamma}(e \oplus f) &= \phi_{\alpha\gamma, \alpha+\beta+\gamma}e + \phi_{\beta\gamma, \alpha+\beta+\gamma}f \\
 &= \phi_{(\alpha+\beta)\gamma, \alpha+\beta+\gamma}d \text{ [using (1.13)].}
 \end{aligned}$$

Since $\phi_{(\alpha+\beta)\gamma, \alpha+\beta+\gamma}$ is injective, $d = e \oplus f$ whence

$$(a \oplus b) \odot c = a \odot c \oplus b \odot c.$$

□

Example 2.8. Let N be a zero symmetric near-ring and L be a distributive lattice. Let $S = N \times L$ be the seminearring direct product of $N \times L$. Then this is a strong distributive lattice of near-rings.

Lemma 2.9. *Let S be a bisemilattice L of near rings $N_\alpha (\alpha \in L)$. Then*

(1) $a + b \in N_\beta$ whenever $\alpha \leq \beta$, $a \in N_\alpha$, $b \in N_\beta$;

(2) $0_\alpha + 0_\beta = 0_\beta$ whenever $\alpha \leq \beta$;

(3) $0_\alpha \cdot 0_\beta = 0_{\alpha\beta}$.

Proof. (1) Let $a \in N_\alpha$ and $b \in N_\beta$ where $\alpha, \beta \in L$ with $\alpha \leq \beta$. Then $a H^+ \alpha$ and $b H^+ \beta$. Since H^+ is a congruence on S , $(a + b) H^+ (\alpha + \beta)$, whence $(a + b) H^+ \beta$ ($\because \alpha \leq \beta$). Thus $a + b \in N_\beta$.

(2) It follows from the previous part that $0_\alpha + 0_\beta \in N_\beta$.

Now, $0_\alpha + 0_\beta + 0_\alpha + 0_\beta = 0_\alpha + 0_\beta$ ($\because (S, +)$ is clifford). So $0_\alpha + 0_\beta \in N_\beta \cap E^+(S)$ whence $0_\alpha + 0_\beta = 0_\beta$.

(3) Clearly $0_\alpha \cdot 0_\beta \in N_{\alpha\beta}$. Now, $0_\alpha \cdot 0_\beta = (0_\alpha + 0_\alpha) \cdot 0_\beta = 0_\alpha \cdot 0_\beta + 0_\alpha \cdot 0_\beta$, So $0_\alpha \cdot 0_\beta \in N_{\alpha\beta} \cap E^+(S)$. whence $0_\alpha \cdot 0_\beta = 0_{\alpha\beta}$.

(4) **Theorem 2.10.** *S is a strong bi-semilattice of near rings iff S is a bi-semilattice of near rings which is E^+ unitary and in which for all $a, b \in S$, $e \in E^+(S)$, $a(b + e) = ab + a^0e$ whenever $a^0 + e = a^0$, and $b^0 + e = b^0$.*

(5) *Proof.* Let S be a bi-semilattice of near rings. Then S is a bi-semilattice $L = S/H^+$ of near rings $N_\alpha = [a]_{H^+}$ where $a \in S$ and $\alpha \in L$. Then clearly S is a left Clifford seminearring (cf. Corollary 3.2.11 of [4]). For $\alpha, \beta \in L$ with $\alpha \leq \beta$ let us define maps

(6) $\phi_{\alpha,\beta} : N_\alpha \rightarrow N_\beta$ by $\phi_{\alpha,\beta}(a) = a + 0_\beta$.

(7) In view of Lemma 2.9 the definition of the map is meaningful. Now let $a, b \in N_\alpha$ and

(8) $\alpha \leq \beta$. Then

(9) $\phi_{\alpha,\beta}(a) + \phi_{\alpha,\beta}(b) = (a + 0_\beta) + (b + 0_\beta)$

(10) $= a + (b + 0_\beta) + 0_\beta$ ($\because (S, +)$ is clifford)

(11) $= a + b + 0_\beta$ ($\because 0_\beta, (b + 0_\beta) \in N_\beta$ (cf. Lemma 2.9))

(12) $= \phi_{\alpha,\beta}(a + b)$

(13) and

(14) $\phi_{\alpha,\beta}(a) \cdot \phi_{\alpha,\beta}(b) = (a + 0_\beta) \cdot (b + 0_\beta)$

(15) $= a(b + 0_\beta) + 0_\beta(b + 0_\beta)$

(16) $= a(b + 0_\beta) + 0_\beta (\because 0_\beta, (b + 0_\beta) \in N_\beta).$

(17) Now in L , $\alpha \leq \beta$ implies that $[a]_{H^+} \leq [0_\beta]_{H^+}$ where $a \in N_\alpha$. Hence $[a]_{H^+} + [0_\beta]_{H^+} = [0_\beta]_{H^+}$.

Thus $(a + 0_\beta)^0 = [0_\beta]^0$ whence $a^0 + 0_\beta = 0_\beta$. Similarly, $b^0 + 0_\beta = 0_\beta$. We then deduce

(18)

$$\begin{aligned} a(b + 0_\beta) &= ab + a^0 0_\beta \\ &= ab + 0_\alpha 0_\beta \\ &= ab + 0_{\alpha\beta} \text{ (cf. Lemma 2.9) } \end{aligned}$$

(19) which gives

(20) $\phi_{\alpha,\beta}(a) \cdot \phi_{\alpha,\beta}(b) = ab + 0_{\alpha\beta} + 0_\beta$

(21) $= ab + 0_\beta$ (cf. Lemma 2.9)

(22) $= \phi_{\alpha,\beta}(ab)$

(23) whence $\phi_{\alpha,\beta}$ is a seminearring morphism. Again let $a, b \in N_\alpha$ such that $\phi_{\alpha,\beta}(a) = \phi_{\alpha,\beta}(b)$, for some $\beta \in L$ with $\alpha \leq \beta$. Then, $a + 0_\beta = b + 0_\beta$ i.e., $b^* + a + 0_\beta = b^* + b + 0_\beta$ whence $b^* + a + 0_\beta = 0_\alpha + 0_\beta$. Therefore $b^* + a + 0_\beta \in E^+(S)$. Since S is E^+ -unitary, $b^* + a \in E^+(S)$. Then $b^* + a = 0_\alpha = a^* + a$. Thus $b^* = a^*$ as N_α is a near ring. So $b = a$, whence $\phi_{\alpha,\beta}$ is a monomorphism. Now let $\alpha, \beta, \gamma \in L$ with $\alpha \leq \beta \leq \gamma$. Let $a \in N_\alpha$. Then

(24) $\phi_{\beta,\gamma}\phi_{\alpha,\beta}(a) = \phi_{\beta,\gamma}(a + 0_\beta)$

(25) $= a + 0_\beta + 0_\gamma$

(26) $= a + 0_\gamma$ (cf. Lemma 2.9)

(27) $= \phi_{\alpha,\gamma}(a)$

(28) i.e., $\phi_{\beta,\gamma}\phi_{\alpha,\beta} = \phi_{\alpha,\gamma}$. Again let $\alpha, \beta, \gamma \in L$ with $\alpha + \beta \leq \gamma$ and $a \in N_\alpha, b \in N_\beta$. Then

(29) $\alpha \leq \gamma$ and $\beta \leq \gamma$, whence $[a]_{H^+} \leq [0_\gamma]_{H^+}$. So $[a]_{H^+} + [0_\gamma]_{H^+} = [0_\gamma]_{H^+}$. Thus $a^0 + 0_\gamma = 0_\gamma$.

(30) Similarly, $b^0 + 0_\gamma = 0_\gamma$. Then by hypothesis

(31) $a(b + 0_\gamma) = ab + a^0 0_\gamma$

(32) $= ab + 0_{\alpha\gamma}$

(33) = $ab + 0_{\alpha\gamma}$ (1)

(34) Now

(35) $\phi_{\alpha,\gamma}(a) \cdot \phi_{\beta,\gamma}(b) = (a + 0_\gamma)(b + 0_\gamma)$

(36) $= a(b + 0_\gamma) + 0_\gamma(b + 0_\gamma)$

(37) $= a(b + 0_\gamma) + 0_\gamma (\because 0_\gamma, (b + 0_\gamma) \in N_\gamma)$

(38) $= ab + 0_{\alpha\gamma} + 0_\gamma$ (Using (1))

(39) $= ab + 0_\gamma$ (cf. Lemma 2.9)

(40) $= \phi_{\alpha\beta,\gamma}(ab)$

(41) whence $\phi_{\alpha,\gamma}N_\alpha\phi_{\beta,\gamma}N_\beta \subseteq \phi_{\alpha\beta,\gamma}N_{\alpha\beta}$. Thus S is a Strong bi-semilattice of near-rings.

(42) Conversely, let $S = \langle L, N_\alpha, \phi_{\alpha,\beta} \rangle$ is a strong bi-semilattice L of near rings $N_\alpha (\alpha \in L)$.

Let us define a relation ρ on S by

(43) apb if and only if $a, b \in N_\alpha$ for some $\alpha \in L$.

(44) Then clearly ρ is an equivalence relation on S . Now let apb and $c \in N_\gamma$ for some $\gamma \in L$.

(45) Then $a, b \in N_\alpha$ for some $\alpha \in L$. Therefore

(46) $a \oplus c = \phi_{\alpha,\alpha+\gamma}(a) + \phi_{\gamma,\alpha+\gamma}(c) \in N_{\alpha+\gamma}$ and $b \oplus c = \phi_{\alpha,\alpha+\gamma}(b) + \phi_{\gamma,\alpha+\gamma}(c) \in N_{\alpha+\gamma}$

(47) whence $(a \oplus c) \rho (b \oplus c)$. Similarly, $(c \oplus a) \rho (c \oplus b)$. Again $a \odot c \in N_{\alpha\gamma}$ and $b \odot c \in N_{\alpha\gamma}$ implies that $(a \odot c) \rho (b \odot c)$. Similarly, $(c \odot a) \rho (c \odot b)$. Thus ρ is such a congruence on S that each ρ class is a near-ring. Also $S/\rho = L$ is a bi-semilattice whence S is a bi-semilattice of near-rings. Let in S ,

(48) $a^0 \oplus e = e$ and $b^0 \oplus e = e$

(49) where $a \in N_\alpha, b \in N_\beta$ and $e \in N_\gamma$ for some $\alpha, \beta, \gamma \in L$. Hence $a^0 \oplus 0_\gamma = 0_\gamma, b^0 \oplus 0_\gamma = 0_\gamma$ and $e = 0_\gamma$. Thus $[0_\alpha]_{H^+} + [0_\gamma]_{H^+} = [0_\gamma]_{H^+}$ whence $\alpha + \gamma = \gamma$. So $\alpha \leq \gamma$. Similarly, we get $\beta \leq \gamma$.

Let $a \odot (b \oplus 0_\gamma) = c$. Then $c \in N_{\alpha(\beta+\gamma)}$. Now

(50) $\phi_{\alpha(\beta+\gamma),\alpha+\beta+\gamma}(c) = \phi_{\alpha,\alpha+\beta+\gamma}(a) \cdot \phi_{\beta+\gamma,\alpha+\beta+\gamma}(b \oplus 0_\gamma)$

(51) $= \phi_{\alpha,\alpha+\beta+\gamma}(a) \cdot \phi_{\beta+\gamma,\alpha+\beta+\gamma}(\phi_{\beta,\beta+\gamma}(b) + \phi_{\gamma,\beta+\gamma}(0_\gamma))$

(52) $(\because b \oplus 0_\gamma = \phi_{\beta,\beta+\gamma}(b) + \phi_{\gamma,\beta+\gamma}(0_\gamma))$

(53) $= \phi_{\alpha,\alpha+\beta+\gamma}(a) \cdot (\phi_{\beta,\alpha+\beta+\gamma}(b) + \phi_{\gamma,\alpha+\beta+\gamma}(0_\gamma))$

(54) = $\phi_{\alpha,\alpha+\beta+\gamma}(a) \cdot \phi_{\beta,\alpha+\beta+\gamma}(b) (\because \phi_{\gamma,\alpha+\beta+\gamma}(0_\gamma) = 0_{\alpha+\beta+\gamma})$ (2).

(55) Again let $a \odot b = d \in N_{\alpha\beta}$. Then

(56) $\phi_{\alpha\beta,\alpha+\beta}(d) = \phi_{\alpha,\alpha+\beta}(a) \cdot \phi_{\beta,\alpha+\beta}(b)$ (3).

(57) Now

(58) $x = d + 0_{\alpha\gamma}$

(59) = $\phi_{\alpha\beta, \alpha\beta+\alpha\gamma}(d) + \phi_{\alpha\gamma, \alpha\beta+\alpha\gamma}(0_{\alpha\gamma})$ (4).

(60) Now applying $\phi_{\alpha\beta+\alpha\gamma, \alpha+\beta+\gamma}$ to both side of (4) we get,

(61)

$$\begin{aligned} \phi_{\alpha\beta+\alpha\gamma, \alpha+\beta+\gamma} &= \phi_{\alpha\beta+\alpha\gamma, \alpha+\beta+\gamma} (\phi_{\alpha\beta, \alpha\beta+\alpha\gamma}(d) + \phi_{\alpha\gamma, \alpha\beta+\alpha\gamma}(0_{\alpha\gamma})) \\ (x) & \\ &= \phi_{\alpha\beta, \alpha+\beta+\gamma}(d) + \phi_{\alpha\gamma, \alpha+\beta+\gamma}(0_{\alpha\gamma}) \\ &= \phi_{\alpha\beta, \alpha+\beta+\gamma}(d) \quad (\because \phi_{\alpha\gamma, \alpha+\beta+\gamma}(0_{\alpha\gamma}) = 0_{\alpha+\beta+\gamma}) \dots\dots\dots (5). \end{aligned}$$

(62) Now applying $\phi_{\alpha+\beta, \alpha+\beta+\gamma}$ to both side of (3) we get,

(63)

$$\begin{aligned} \phi_{\alpha+\beta, \alpha+\beta+\gamma} (\phi_{\alpha\beta, \alpha+\beta}(d)) &= \phi_{\alpha+\beta, \alpha+\beta+\gamma} (\phi_{\alpha, \alpha+\beta}(a) \cdot \phi_{\beta, \alpha+\beta}(b)) \\ \Rightarrow \phi_{\alpha\beta, \alpha+\beta+\gamma}(d) &= \phi_{\alpha, \alpha+\beta+\gamma}(a) \cdot \phi_{\beta, \alpha+\beta+\gamma}(b) \dots\dots\dots (6). \end{aligned}$$

(64) From (5) and (6) we obtain the following

(65) $\phi_{\alpha(\beta+\gamma), \alpha+\beta+\gamma}(x) = \phi_{\alpha, \alpha+\beta+\gamma}(a) \cdot \phi_{\beta, \alpha+\beta+\gamma}(b) = \phi_{\alpha(\beta+\gamma), \alpha+\beta+\gamma}(c)$ (Using (2))

(66) whence $x = c$ using injectivity of $\phi_{\alpha(\beta+\gamma), \alpha+\beta+\gamma}$.

(67) Hence in S , whenever $a^0 \oplus e = e, b^0 \oplus e$

(68) $= e, a \odot (b \oplus e) = a \odot b \oplus 0_{\alpha\gamma} = a \odot b \oplus 0_{\alpha} \odot 0_{\gamma} = a \odot b \oplus a^0 \odot e.$

(69) Now to prove $E^+(S)$ is E -Unitary, let $a \oplus b \in E^+(S)$ and $b \in E^+(S)$. It is known that $E^+(S) = \{0_{\alpha} | \alpha \in L\}$. So, $b = 0_{\gamma}$ for some $\gamma \in L$.

(70) Case I : Let $a \in N_{\gamma}$.

(71) Then $a + 0_{\gamma} + a + 0_{\gamma} = a + 0_{\gamma}$

(72) $\Rightarrow a + a = a$ [$\because a \in N_{\gamma}$ and 0_{γ} is the zero element of N_{γ}]

(73) $\Rightarrow a \in E^+(S)$

(74) Case II : Let $a \in N_{\beta}$ for some $\beta \neq \gamma$ in L .

Therefore,

(75) $a \oplus 0_{\gamma} = \phi_{\beta, \beta+\gamma}(a) + \phi_{\gamma, \beta+\gamma}(0_{\gamma})$

(76) $= \phi_{\beta, \beta+\gamma}(a) + 0_{\beta+\gamma} \in N_{\beta+\gamma} \cap E^+(S)$

(77) *whence,*

$$(78) \quad \phi_{\beta, \beta+\gamma}(a) + 0_{\beta+\gamma} = 0_{\beta+\gamma}$$

$$(79) \quad \Rightarrow \phi_{\beta, \beta+\gamma}(a) = 0_{\beta+\gamma}$$

$$(80) \quad \Rightarrow a = 0_{\beta}, \text{ As } \phi_{\beta, \beta+\gamma} \text{ is one-one}$$

$$(81) \quad \Rightarrow a \in E^+(S)$$

(82) *So, S is E^+ unitary, which completes the proof.* □

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