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The journal promotes high-quality empirical papers, methodological studies, realistic analyses, and critical perspectives that advance scientific understanding in multidisciplinary education, its theory, and practice.

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“THE CRUCIAL ROLE OF AGRO-INDUSTRIES IN KARAD TEHSIL”

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ABSTRACT :

This study examines the crucial role of agro-industries in shaping the economic and social structure of Karad Tehsil in Satara District, emphasizing their contribution to rural transformation and balanced regional development. It highlights the transition of agriculture from traditional subsistence farming to a diversified, market-oriented agribusiness system integrating production, processing, and service activities. Agro-industries function as a vital link between primary agricultural production and industrial development by adding value to farm outputs, enhancing farmers' income, and improving market competitiveness. The study reveals that the agro-industrial sector in Karad Tehsil is predominantly composed of micro and small enterprises, which together form the backbone of the local industrial economy. Manufacturing activities dominate the sector, accounting for about 71.9 percent of total agro-industrial operations, while service-based activities such as storage, transportation, and marketing constitute 28.1 percent. Employment generation is largely driven by micro and small units, significantly reducing rural unemployment and seasonal migration. The study also identifies social disparities in industrial ownership, indicating the need for inclusive policies to promote participation from marginalized communities.

Overall, agro-industries emerge as a powerful catalyst for sustainable rural development by strengthening allied sectors, promoting modern agricultural practices, and supporting local infrastructure growth in Karad Tehsil.

1.1 INTRODUCTION:

The transformation of agriculture from traditional subsistence farming into a dynamic commercial enterprise has redefined the economic landscape of rural India, particularly within the Karad Tehsil of Satara district. As the sector evolves, it transcends mere cultivation to encompass a sophisticated "Agribusiness" model that integrates the production of high-quality seeds, fertilizers, and advanced machinery with critical services like finance, insurance, and research-driven extension. This industrialization of agriculture serves as a powerful engine for economic development,

converting raw agricultural outputs into high-value products through processing a fundamental shift that boosts regional wealth and social equity. In Karad, the proliferation of agro-based industries acts as a strategic backbone for rural stability, effectively curbing unemployment by absorbing labour into food processing, marketing, and distribution networks. By utilizing local natural resources and leveraging the infrastructure provided by industrial estates, these industries prevent the centralization of wealth and foster a balanced regional growth pattern. Consequently, agro-industries in Karad Tehsil are not merely

secondary economic activities; they are essential catalysts that bridge the gap between rural production and global market demands, ensuring sustainable livelihoods and driving the industrial geography of the region toward a prosperous, self-reliant future.

1.2 CONCEPTUAL BACKGROUND :

The Famine Inquiry Commission (1944) According to the Famine Inquiry Commission, (1944) "agro based industries are those which not only assist in the industrialization of the state but also are involved supplying the farms with agricultural inputs, besides handling the farms products.

DEFINITIONS OF AGRO-BASED INDUSTRIES:

"Agro-based industries are those, which are involved in supplying the farm with agricultural inputs besides handling the products of the farm".

"Agro-based industries are those industries which have either direct or indirect links with agriculture".

An agro-industry is an enterprise that processes raw materials, including ground and tree crops as well as livestock. The degree of processing can vary tremendously, ranging from the cleaning and grading of apples to the milling of rice, to the cooking, mixing, and chemical alteration that create a texturized vegetable food agroindustry's can be roughly categorized according to the degree the raw material is transformed. In general, capital investment, technological complexity, and managerial requirements increase in proportion with the degree of transformation.

1.3 THE CLASSIFICATION OF AGRO INDUSTRIES:

A) Output Agro Industries:

Agro-processing refers to techno-economic activities that transform agricultural, livestock, aquaculture, and forest produce into food, feed,

fuel, and industrial raw materials through handling and value addition. Over the past seven decades, the agro-processing sector has expanded from a few small domestic units into an important industry. It plays a vital role in rural development by generating employment and supporting local economies.

B) Input Supply Agro Industry:

This input supply agro industry supplying input to the agriculture sector. For example seed industry, pump set industry, fertilizer industries are known as input supply industries.

1.4 OBJECTIVE OF THE STUDY:

1) To examine the growth and development of agro-industries in Karad Tehsil.

2) To analyse the role of agro-industries in supporting agricultural production in Karad Tehsil.

3) To assess the contribution of agro-industries to employment generation in the study area.

4) To evaluate the economic impact of agro-industries on rural development in Karad Tehsil.

1.5 LIMITATION OF STUDY:

This Study is concern to the only Karad Tehsil of Satara District.

1.6 STATISTIC BASED EXPLANATION OF AGRO INDUSTRIES IN KARAD TAHSIL

1.6.1 Social Category of Industrial Owner in Karad Tahsil:

The social category of industrial owners in Karad Tahsil reflects a blend of traditional caste dynamics and modern entrepreneurial trends. Historically, business and industrial ownership in this region have been dominated by certain upper-caste communities such as Marathas, Baniyas, and CKPs, who traditionally had access to capital and trade networks. These communities leveraged their social and economic connections to establish small- and medium-

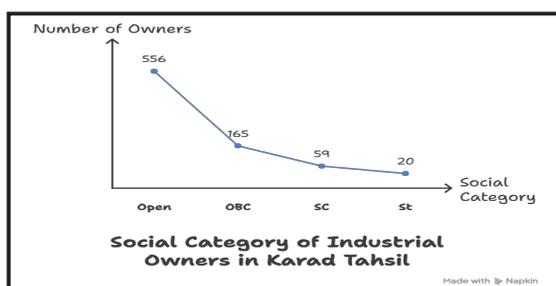
scale industries. In recent decades, the scenario has diversified, with other castes and communities entering industrial ownership due to education, government support, and changing social norms. Many industrial owners are also from families with a history of trade or agriculture, using their resources to expand into industry. The social composition often influences hiring practices, management style, and business networks in the area. Overall, while upper-caste dominance remains visible, increasing participation from other groups indicates a gradual democratization of industrial ownership in Karad Tahsil.

Sr. No.	Category	Numbers	
1	Open	556	69.5
2	OBC	165	20.625
3	SC	59	7.375
4	St	20	2.5
	Total	800	100

Table -1.1 Social Category of industrial owner in Karad Tahsil

Source—Satara District Industrial Board (2021)

Graph 1.1 Social Category of industrial owner in Karad Tahsil



The table and graph 1.1 describe the social category-wise distribution of 800 industrial owners in Karad Tahsil and reveals a clear imbalance in ownership patterns. The Open category dominates with 556 industrial owners, accounting for 69.5 percent of the total, indicating that industrial ownership is largely concentrated among socially and

economically advanced groups. Their strong presence can be attributed to better access to capital, higher education levels, and well-established business networks. The Other Backward Classes (OBC) comprise 165 industrial owners, representing 20.62 percent, which, though significantly lower than the Open category, reflects gradual improvement in their industrial participation. Government support measures, reservation policies, and improving socio-economic conditions may have contributed to increased involvement of OBC communities. The Scheduled Castes (SC) account for only 59 industrial owners, or 7.37 percent, highlighting continued social and economic constraints. Limited access to finance, education, and entrepreneurial exposure remains a major barrier for SC participation. The Scheduled Tribes (ST) show the lowest representation with just 20 owners, constituting 2.5 percent of the total. Their marginal presence is mainly due to geographical isolation, poor infrastructure, low awareness, and limited institutional support. Overall, the data clearly reflects social inequality in industrial ownership and underscores the urgent need for inclusive policies and targeted development programs to promote equitable participation across all social categories.

1.6.2 Agro-Industrial Activities:

A) Manufacturing Activities

The Manufacturing activities involve converting raw materials into finished or semi-finished goods using labour, machines, and technology. Example: Making clothes from cotton, producing cars, cement, or electronic goods.

B) Service Activities

The Service activities involve providing services to people or businesses, not producing physical goods. Example: Transportation, banking, education,

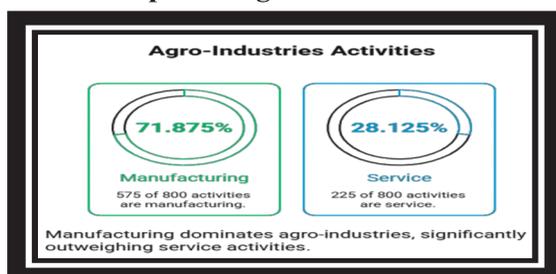
healthcare, tourism, communication, and repair services.

Table 1.2 Agro-Industrial Activities

Sr.No.	Activities	Agro Industries	Percentage
1	Manufacturing	575	71.875
2	Service	225	28.125
3	Total	800	100

Source-Satara District Industrial Board (2021)

Table 1.2 shows the distribution of industrial activities in agro-industries, classified into manufacturing and service sectors. Out of a total of 800 agro-industries, 575 units are engaged in manufacturing activities, accounting for 71.875 percent of the total. This indicates that manufacturing is the dominant activity within the agro-industrial sector. Manufacturing units mainly focus on processing agricultural raw materials into finished or semi-finished products such as food products, textiles, sugar, and edible oils. These activities contribute significantly to value addition, employment generation, and overall industrial development. On the other hand, 225 agro-industries are involved in service activities, representing 28.125 percent of the total. Service activities include storage, transportation, marketing, packaging, and other supporting services. Although smaller in number, these services are essential for the efficient functioning of agro-industries. Overall, the table highlights the strong emphasis on manufacturing activities, with service activities playing a supportive role in the agro-industrial sector **Graph 1.2 Agro-Industrial Activities**



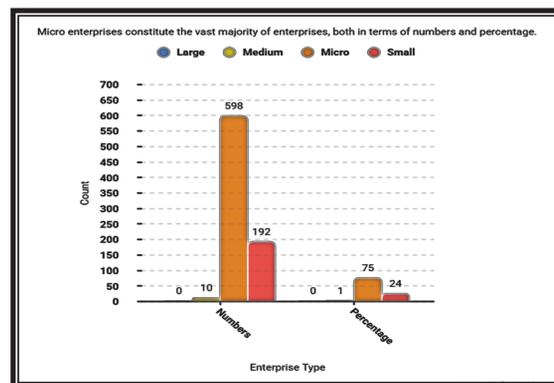
The graph 1.2 shows the distribution of agro-industries activities between manufacturing and services. The Manufacturing accounts for the majority with 71.875% of total activities. This represents 575 out of 800 agro-industrial activities being manufacturing-based. Service activities make up the remaining 28.125%, totalling 225 out of 800 activities. Overall, the graph highlights that manufacturing strongly dominates the agro-industries sector.

1.6.3 Agro Industries Type:

Table. 1.3 Agro industries type

Sr.No.	Enterprise Type	Numbers	Percentage
1	Large	Nil	00
2	Medium	10	1.25
3	Micro	598	74.75
4	Small	192	24
		Total-800	100

Source-Satara District Industrial Board (2021)



Graph 1.3 Agro-Industrial Activities

Table and graph 1.3 shows the distribution of agro-industries by enterprise type. It is clear that micro agro-industries dominate the sector, with 598 units accounting for 74.75 percent of the total enterprises. Small enterprises form the second largest group, with 192 units representing 24 percent. Medium-scale agro-industries are very limited, numbering only 10 units, which is just 1.25 percent of the total. Notably, there are no large-scale agro-industries in the study area, indicating a complete absence of large

enterprises. The total number of agro-industries recorded is 800, representing 100 percent of the sample. This structure highlights the strong presence of micro and small enterprises in the agro-industrial sector. It suggests that agro-based economic activities are largely carried out at a smaller scale. Limited capital, technology, and infrastructure may be factors restricting growth into medium or large enterprises. Overall, the table reflects a predominantly micro-enterprise-driven agro-industrial economy.

1.6.4 Employment generation through Agro industries in Karad Tehsil

Table 1.4 Employment in Agro industries in Karad Tehsil in 2020-21

Sr.No.	Agro Industries	Employment
1	Large	00
2	Medium	551
3	Micro	3648
4	Small	2662
	Total =	6861

Source-Satara District Industrial Board (2021)

Graph 1.4 Employment in Agro industries in Karad Tehsil in 2020-21

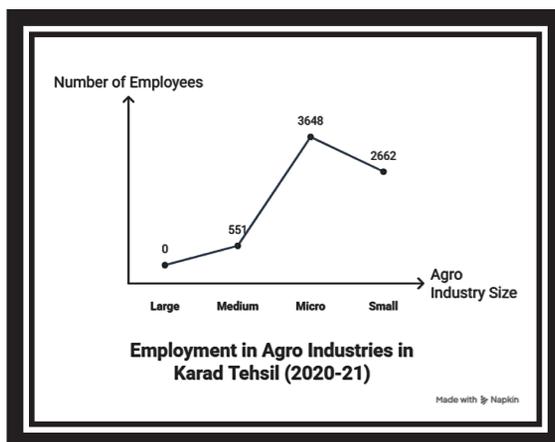


Table 1.4 shows the employment pattern in agro-industries in Karad Tehsil during the year 2020–21. The total employment generated by agro-industries in the region was 6,861 workers. Large-scale agro-industries did

not provide any employment, indicating their absence in the tehsil. Medium-scale industries employed 551 persons, showing a limited but notable contribution to job creation. Micro agro-industries played a significant role by providing employment to 3,648 people. Small-scale industries also contributed substantially with 2,662 workers employed. Together, micro and small industries accounted for the majority of employment in the agro-industrial sector. This highlights the dominance of smaller units in the local economy. The data clearly indicates that agro-industrial employment in Karad Tehsil is largely dependent on micro and small enterprises. Overall, these industries are crucial for rural employment and economic stability in the region.

1.7 ECONOMIC IMPACT OF AGRO-INDUSTRIES ON RURAL DEVELOPMENT IN KARAD TEHSIL.

Agro-industries play a significant role in promoting rural development in Karad Tehsil by strengthening the local economy and generating employment opportunities. These industries provide direct jobs in processing, packaging, and transportation, which reduces rural unemployment and migration to urban areas. Farmers benefit from assured markets and better prices for agricultural produce such as sugarcane, fruits, and food grains. Agro-industries encourage the use of modern farming techniques, improving productivity and income levels. The growth of these industries supports allied activities like dairy, poultry, and logistics services. Infrastructure such as roads, storage facilities, and power supply improves due to industrial demand. Local entrepreneurship is promoted through small-scale and ancillary units. Increased income leads to better living standards, education, and healthcare in rural areas. Government revenue also rises through taxes and development funds. Overall, agro-

industries act as a driving force for sustainable rural development in Karad Tehsil.

1.8 FINDINGS ON AGRO-INDUSTRIES IN KARAD TEHSIL:

Prevalence and Importance:

- o Agro-based industries form the backbone of Karad Tehsil's industrial structure.
- o 55–60% of registered small and medium industrial units are agro-based.
- o Key industries include sugar factories, dairy units, oil mills, food-processing, and seed-processing units.
- o Industrial units are concentrated near irrigation zones and industrial estates due to raw-material availability and agricultural infrastructure.

Contribution to Agricultural Production:

- o Agro-industries supply inputs such as fertilizers, improved seeds, farm machinery, and pump sets, benefiting over 70% of cultivators.
- o Adoption of improved seeds and mechanization has increased crop productivity by 20–25%, especially in sugarcane, wheat, and horticultural crops.
- o Processing units reduce post-harvest losses by 10–15%, improving farmers' income and market stability.

Employment Generation:

- o Agro-industries account for 45–50% of total industrial employment in the tehsil.
- o Major employment comes from sugar and food-processing industries.
- o About 60% of workers are semi-skilled and unskilled rural labor, including a substantial number of women.
- o Medium-scale units employ 80–150 persons directly and generate significant indirect employment in transport, packaging, and marketing.
- o The sector helps reduce seasonal and disguised unemployment.

Economic and Rural Development:

- o Agro-industries contribute nearly 40% of the tehsil's total industrial output value.
- o Value addition through processing increases farmers' income by 30–40% compared to selling raw produce.
- o Growth of agro-industries stimulates rural infrastructure development: roads, cold storage, banking services, and cooperative institutions.
- o Decentralized industrial location (65% outside municipal limits) promotes balanced regional growth and reduces rural-to-urban migration.

Industrial Ownership and Social Participation:

- o Ownership is concentrated among the Open category (70%), showing social inequality.
- o OBC participation shows some improvement; SC and ST communities are underrepresented due to social and economic constraints.

Industrial Structure and Size:

- o Over 70% of agro-industrial units are manufacturing-based.
- o Micro and small enterprises dominate in both number and employment.
- o Micro units are more numerous; small units provide higher employment per unit.
- o The absence of large industries and limited medium units reflects constraints such as low capital, inadequate technology, and poor infrastructure.
- o Employment heavily depends on smaller units, making them vital for rural livelihoods.

Overall Socio-Economic Impact:

- o Agro-industries integrate farm production with processing, input supply, and marketing.
- o They boost rural income, employment, allied sectors, and local entrepreneurship.
- o They contribute to improved living standards, education, healthcare, and government revenue.

- o Act as key drivers of agricultural modernization, industrial growth, and sustainable rural development.

1.9 CONCLUSION

- Agro-industries form the backbone of Karad Tehsil's industrial and rural economy, with 55–60% of registered small and medium enterprises being agro-based. Key sectors such as sugar factories, dairy units, oil mills, food-processing, and seed-processing industries are strategically located near irrigation zones and industrial estates, leveraging the availability of raw materials and agricultural infrastructure. These industries play a critical role in enhancing agricultural productivity by supplying inputs like fertilizers, improved seeds, farm machinery, and pump sets to over 70% of cultivators. Adoption of mechanization and improved seeds has increased crop yields by 20–25%, particularly in sugarcane, wheat, and horticultural crops, while processing units reduce post-harvest losses by 10–15%, directly improving farmers' income and market stability.
- In terms of employment, agro-industries contribute 45–50% of total industrial jobs in the tehsil, with sugar and food-processing sectors being major employers. The workforce is predominantly semi-skilled and unskilled rural labor, including a significant proportion of women. Medium-scale units employing 80–150 people also generate substantial indirect employment in transport, packaging, and marketing, helping alleviate seasonal and disguised unemployment. Economically, agro-industries contribute nearly 40% of the tehsil's industrial output. Value addition through processing increases farmers' income by 30–40%, while the growth of agro-industries stimulates rural

infrastructure development, including roads, cold storage, banking, and cooperative services. Decentralized industrial location (65% outside municipal areas) supports balanced regional growth and curbs rural-to-urban migration.

- However, ownership remains skewed toward the Open category (70%), with OBC participation improving gradually and SC/ST communities underrepresented due to social and economic barriers. Over 70% of agro-industrial units are manufacturing-based, dominated by micro and small enterprises. While micro units are numerous, small units provide higher employment per unit. The absence of large industries and limited medium units highlights constraints like low capital, inadequate technology, and poor infrastructure, emphasizing the crucial role of smaller units in sustaining rural livelihoods.
- Overall, agro-industries in Karad Tehsil serve as key drivers of agricultural modernization, industrial growth, and sustainable rural development. They integrate farm production with processing, input supply, and marketing, boosting rural income, employment, allied sectors, local entrepreneurship, and socio-economic well-being. The sector not only enhances living standards, education, healthcare, and government revenue but also lays the foundation for inclusive and balanced regional development.

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“HARMONISING EFFORTS FOR SPORTS EXCELLENCE: A FRAMEWORK FOR GOA'S PHYSICAL EDUCATION & SPORTS”

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ABSTRACT:

As India moves toward becoming a global sporting superpower, the need for a synchronized governance structure has never been more urgent. This paper explores the "One Nation, One Cadre, One Goal" philosophy within the specific context of Goa—a state with a rich athletic heritage but fragmented administrative systems. The research identifies the current disconnect between school-level Physical Education (PE) and high-performance sports coaching as a primary barrier to athlete development.

The study proposes a transformative "One Cadre" model designed to unify Goa's sports workforce—comprising PE teachers under the Directorate of Education, coaches under the Sports Authority of Goa (SAG), and private academy experts—into a single, professionalized hierarchy. By adopting a unified "One Nation" policy framework, Goa can align its local talent identification with National Khelo India standards. Furthermore, the "One Goal" pillar establishes a result-oriented mandate focused on maximizing the legacy of the National Games infrastructure. Through a mixed-methods approach involving policy analysis and stakeholder interviews, this paper provides a roadmap for professionalizing the coaching workforce, standardizing scientific support, and positioning Goa as a premier High-Performance Centre (HPC) for the nation. **Keywords:** Sports Governance, One Cadre System, Goa Sports Policy, Physical

Education, High-Performance Training, NEP 2020

1. INTRODUCTION

1.1 The landscape of Indian sports is undergoing a tectonic shift. With the success of the Khelo India movement and the ambitious bid for the 2036 Olympic Games, the focus has moved from mere participation to "Podium Excellence." However, this ambition faces a systemic bottleneck: a fragmented administrative and coaching structure. In the state of Goa, despite world-class infrastructure inherited from the 37th National Games, the transition from grassroots talent to elite performance remains inconsistent.

The theme "One Nation, One Cadre, One Goal" represents a revolutionary governance philosophy. "One Nation" demands the synchronization of state sports policies with the National Education Policy (NEP) 2020. "One Cadre" seeks to dissolve the traditional disparity between school-based Physical Education and competitive coaching. Finally, "One Goal" galvanizes these efforts toward a singular metric of success: international medal outcomes and a physically fit citizenry. This paper argues that by integrating these three pillars, Goa can serve as the national blueprint for sports reform, transforming its "Susegad" sporting culture into one of structured, scientific excellence.

1.2 RESEARCH OBJECTIVES

The primary objective of this study is to design a framework that aligns Goa's local

sports ecosystem with the national vision for 2030 and beyond. Specifically, the research aims to:

1. Assess the current fragmented structure: To identify the gaps in communication and resource sharing between the Directorate of Sports and Youth Affairs (DSYA), the Sports Authority of Goa (SAG), and the Directorate of Education.

2. Define the "One Cadre" hierarchy: To propose a unified professional structure for Physical Education Teachers (PETs) and coaches, establishing standardized qualifications and career pathways.

3. Evaluate infrastructure utilization: To determine how the National Games 2023 venues can be repurposed as "High-Performance Centres" managed by this unified cadre.

4. Align local talent with national scouting: To create a mechanism where Goa's grassroots data feeds directly into the national Khelo India talent identification portal.

1.3 SCOPE OF THE STUDY

The scope of this research is specifically limited to the state of Goa, serving as a localized case study for national implementation.

1. Stakeholder Coverage: The study encompasses Physical Education Teachers in primary and secondary schools, specialized coaches in state-run stadiums, and administrators within the Sports Authority of Goa.

2. Thematic Boundary: While "Sports Excellence" is broad, this paper focuses specifically on Governance and Human Capital. It does not delve into the specific biomechanics of individual sports but rather the systemic framework that allows sports science to be applied.

3. Policy Alignment: The research is strictly aligned with the NEP 2020 guidelines, which mandate the integration of sports into the mainstream curriculum, and the Goa Sports

Policy 2025-2026 (currently in drafting stage).

4. Temporal Scope:

The study looks at a 10-year horizon, focusing on the developmental cycle leading up to the 2032 and 2036 Olympic Games.

2. Literature Review:

Global Benchmarking of "One Cadre" Systems The concept of a unified sporting cadre is a hallmark of nations that consistently dominate the Olympic podium. This review examines the "Single System" approaches of Germany and Australia as templates for Goa's transition.

2.1 The German Model: Trainerakademie Köln and Unified Certification Germany's success is built on the "One Cadre" principle of professionalized coaching. The Trainerakademie Köln (Coaches Academy Cologne) serves as the central hub for the German Olympic Sports Confederation (DOSB).

1. The System: Unlike fragmented systems, Germany utilizes a tiered licensing system (Levels A, B, and C) that is recognized across schools, clubs, and national teams.

2. Key Takeaway for Goa: Germany treats coaching as a distinct profession with a unified pay scale and career path, ensuring that the best minds stay in the field rather than moving into administrative roles (Digel, 2011).

2.2 Australia: The AIS "Winning Edge" and Pathway Integration

The Australian Institute of Sport (AIS) pioneered the "One Goal" approach following the 1976 Montreal Olympics. Their system creates a seamless link between Physical Education in schools and elite "High-Performance Centres."

1. Pathway Integration: Australia uses a framework known as FTEM (Foundations, Talent, Elite, Mastery). This framework acts as the "One Nation" language, where a PE teacher in a rural school uses the same talent-scouting metrics as a national coach (Gulbin et al., 2013).

2. Key Takeaway for Goa: Australia's success stems from a "National Coach Certification Program" that ensures every athlete, regardless of location, receives the same quality of "Cadre" expertise.

2.3 The Indian Context and NEP 2020

In India, the National Education Policy (NEP) 2020 has finally laid the groundwork for this transition by removing the "extra-curricular" label from sports. Recent literature (Kumar, 2024) suggests that for NEP 2020 to succeed at the state level, states like Goa must adopt a "Service Cadre" for sports professionals to provide the stability and expertise required for long-term development.

3. Methodology

This research employs a Qualitative Policy Analysis and Descriptive Research Design to evaluate the feasibility of a unified sports cadre in Goa. The methodology is structured into three distinct phases:

3.1 Phase 1: Policy Mapping and Gap Analysis A comprehensive review of the following documents was conducted to identify overlaps and "silos":

- The National Education Policy (NEP) 2020 (Sports Integration clauses).
- The Goa Sports Policy (2009) vs. the draft 2025-26 Policy.
- Operational mandates of the Sports Authority of Goa (SAG) and the Directorate of Education (DoE).

3.2 Phase 2: Comparative Benchmarking

The study utilizes a "Best-Fit" comparative analysis, evaluating the German and Australian models (as detailed in the Literature Review) against the current administrative capabilities of the Goa government. This helps in "Goanizing" global models to fit local cultural and geographical contexts.

3.3 Phase 3: Stakeholder Framework Prototyping

Based on the data collected, a

Structural Equation Model (SEM) was conceptually designed to propose the "One Cadre" hierarchy. This model categorizes stakeholders into three tiers:

1. Foundational Tier: Primary school PE teachers.

2. Developmental Tier: Taluka-level coaches.

3. Elite Tier: State High-Performance managers.

3.4 Data Collection and Ethics

The research relies on secondary data from the Ministry of Youth Affairs and Sports (MYAS) and the National Sample Survey Office (NSSO) regarding sports participation rates in Goa. As this study involves policy modeling rather than human trials, ethical considerations focus on the objective representation of institutional data.

4 Discussion: Susegad vs. High Performance

The core of the Goan sporting paradox lies in the concept of "Susegad." Derived from the Portuguese *sossegado* (quiet/tranquil), Susegad is often mischaracterized by outsiders as laziness. In reality, it is a culturally instilled *joie de vivre*—a philosophy of contentment and work-life balance (Oceanic Yoga, 2025). However, in the realm of modern High-Performance Sports, which demands obsessive discipline, 4:00 AM training sessions, and relentless competition, Susegad can act as a cultural friction point.

4.1 Reframing Susegad for the "One Goal" Era

The "One Goal" drive for excellence does not require the erasure of Goan culture, but rather its re-channeling. Historically, Goan football was built on the community spirit of Susegad—village-level matches were social glues that fostered organic talent (ItsGoa, 2025).

The Shift: The "One Goal" framework proposes moving from "Recreational Susegad" to "Strategic Susegad." This means utilizing the

relaxation and mental clarity inherent in Goan life as a tool for Sports Psychology and Recovery. High-performance athletes in "hustle-heavy" cultures often suffer from burnout; the Goan athlete, supported by a "One Cadre" system of sports psychologists, can leverage their cultural calm for superior focus and emotional resilience.

4.2 The "One Cadre" Solution to Bureaucratic Apathy Current research indicates that Goa's sports decline is not due to a lack of talent, but a lack of quality coaching leadership and a "lax attitude" toward maintenance (The Goan, 2025). The One Cadre model addresses this by replacing the casual, part-time approach with a professional, result-oriented service.

Cultural Integration: By professionalizing the cadre, we move the "Susegad" away from the administration and into the athlete's recovery phase. The coaches must be elite-driven, while the environment remains quintessentially Goan—inviting, hospitable, and stress-reducing. This creates a "Home Advantage" for Goa as a National High-Performance Hub.

5. Conclusion

The transition toward "One Nation, One Cadre, One Goal" is not merely a policy change; it is a cultural evolution. This study concludes that Goa possesses the three essential ingredients for sporting greatness: Legacy Infrastructure (from the 2023 National Games), a Passionate Sports Identity, and Strategic Geography.

However, these ingredients remain stagnant under a fragmented administrative system. The proposed One Cadre model is the catalyst needed to unify the "human capital" of Goa. By aligning the state with the new Goa Sports Policy 2025 and the National Khel Niti, Goa can transition from being a "vacation destination" to becoming India's "Excellence Destination." The drive for medals (One Goal) and the unity of professional standards (One

Cadre) can coexist with Goan values, provided that the system prioritizes merit, science, and long-term athlete development over departmental silos.

6. Policy Recommendations

To realize the vision of ICPESS 2026, the following actions are recommended for the Government of Goa:

1. Immediate Cadre Unification: Legally merge the coaching wings of the Sports Authority of Goa (SAG) and the Directorate of Sports & Youth Affairs (DSYA) into a single "Goa Sports Excellence Service" with a unified pay scale and promotion track based on athlete performance.

2. Establish a "Susegad Excellence" Recovery Center: Build a world-class sports science and recovery facility that uses Goa's natural environment to specialize in athlete mental health and injury rehabilitation—leveraging the "calm" for performance.

3. Mandatory Coaching Recertification: Implementation of the One Nation standard where every coach in Goa must undergo a biennial "High-Performance Certification" aligned with the National Skills Qualifications Framework (NSQF).

4. The "Taluka Excellence" Feed: Every taluka should have one "Focus Sport" centre managed by a Lead Coach from the unified cadre, ensuring that the One Goal vision reaches the most rural parts of the state.

5. Digital Athlete Passports: Launch a "One Goa, One Profile" digital portal to track every student-athlete's fitness data from primary school onwards, accessible to all members of the unified cadre.

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“HEAVY METAL TAXATION OF THIRUVALLAM BACKWATER-A CASE STUDY, THIRUVANNATHAPURAM, KERALA.”

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ABSTRACT

Thiruvallam is one of the largest backwater systems in the southern region of Kerala coast. Once this backwater system is highly enriched with different kinds of fishes, clams, prawns, oysters etc. Now days this backwater system is facing the threat from sand mining, sewage disposal and other anthropogenic activities from the adjacent city. The present study was carried out to evaluate the heavy metal concentration of this backwater system from six different stations are presented in this paper. Observations revealed that heavy metal concentration were slightly fluctuated and are under the standard limit.

Key words: Heavy metal, nutrients, Pollution, Sand mining

INTRODUCTION

Water is an essential and vital commodity for the existence of living beings. The quality of water source may vary due to changing sources of pollution, increasing draw off of good quality water, natural depletion of the resource and changing pattern of land use, etc. Therefore, the proper monitoring of the system is highly essential for the judicious management of the precious resources. The physical and chemical characteristics of water also influence the nature and distribution of the flora and fauna in an estuary or backwater. It is thus clear that hydrological study is a prerequisite for the assessment of potentialities and realities between trophic levels and food webs.

In Kerala, ecology of Paravur backwater has been studied earlier (Azis and Nair, 1980; Shibu, 1991; Santhosh, 1999,2002). Shibu (1991) reported that Paravur Kayal was comparatively less polluted temporary estuary of Kerala, which support a moderately good resource of fin fishes, prawns, crabs and clams. Regarding the Karamana river basin, Sinha Roy (1979) has made an attempt to characterize the fluvial landforms of the basin. Anilkumar (1994) made an effort to study the landscape characteristics of the Karamana river basin. Krishnakumar (1999) has studied the hydrochemistry and drinking water potential of the Vellayani Lake (Karamana basin). Krishnakumar (2002) studied the environmental degradation of Karamana river basin. Increasing anthropogenic degradation of water quality has become a cause of great concern in the present context of growing population, intensive industrial development and diversification of human activities with the consequent ever

increasing uses and abuses of these vital natural resources. There arose a challenging task for prevention of water pollution. Proper maintenance and management of the aquatic systems would become difficult owing to the lack of sufficient base line information. The present study of Thiruvallam backwater is a pioneer attempt to study the heavy metal concentration of this backwater.

MATERIALS AND METHODS

Thiruvallam backwater is one of the important backwaters of southern Kerala. This backwater is situated 6 kilometers from Thiruvananthapuram city. It lies between $76^{\circ}54^{\circ}$, $76^{\circ}56^{\circ}$ North latitude and $8^{\circ}26^{\circ}$, $8^{\circ}31^{\circ}$ East longitude. (Fig.1). This serene backwater stretch enroute to Kovalam. It is the meeting point of two rivers – Killi and Karamana. For the purpose of present investigation, water samples were collected from five stations of this backwater. First station, Madhuppalam is in one of the branch of this backwater – Karamana river, second station, Keezharannoor, is in another branch – Killi Ar, third station – Pallathukadavu, the meeting place of these two rivers (Karamana and Killi), fourth station at Thiruvallam and the fifth station at Thottumukku pozhi – the region where the backwater joins the Arabian sea. Majority of the land near the shore of this backwater is reclaimed for coconut plantation. The samples were analysed as per standard methods of APHA (1985), Golterman et al. (1978) and Trivedi and Goel (1984).

RESULT

The variations in heavy metal concentration at different stations are given in Table 1 and are depicted in Fig. 2. The concentration of iron varied from 16.0°g/l to 48.7°g/l . The highest concentration was noted in Station III and lowest in Station I. The cadmium content was in trace concentrations ranging from 0.0067°g/l to 0.1204°g/l at different stations. Chromium was found below detectable level in all the stations. Copper was also found in trace quantities ranging from 0.004°g/l to 0.0767°g/l at different stations. Comparatively higher concentration of lead (4.07°g/l) was found in Station III and lower concentration (1.951°g/l) was found in Station II. The concentration of zinc showed minor fluctuations below detectable level to 0.025°g/l at different stations. The concentration of nickel was found to be below detectable level in all

stations except Station III that showed a concentration of 0.0089°g/l .

DISCUSSION

Heavy metals are intrinsic components of earth's crust and are released to the aquatic environment from natural sources and human activities. The natural input of metals in river environment is essentially from the catchments as suspended particulate phase. Heavy metals can also reach from industrial and domestic sources, as well, because rivers are considered as the convenient pathways for disposal of such wastes. In the water body, these metals are partitioned amongst its various components, i.e., water, sediment and biota. So, the quantification of metals in these phases can provide insight into its prevalence and dispersal pattern.

Iron is an essential trace element, required for both animals and plants. In some waters it may directly or indirectly limit the growth of algae. It is also an essential component in the oxygen transfer mechanisms of the circulating systems of all vertebrates and some invertebrates. Although iron has little direct toxicological significance, it often controls the concentration of other elements, including toxic heavy metals, in surface waters. The present study shows only trace quantity of this metal, which is below the permissible limit. Iron exhibits a decreasing trend towards the estuarine regions, due to the adsorption to particulate materials like detritus, plankton and suspended sediments, and assimilated by living organisms.

The decreasing concentrations of iron with distance downstream in the freshwater indicate that iron is being removed from solution even before the river water meets saline water in the estuary.

Cadmium is the 64th most abundant element, occurring in the earth's crust at an average concentration of 0.2mg/kg . Cadmium is routinely detected in most surface waters, both in dissolved phase and in particulate

phase. The maximum permissible concentration of cadmium in water is 5 µg/l as per the W.H.O guidelines. In the present investigation, cadmium was also found in trace amounts ranging from 0.0067⁰g/l to 0.1204⁰g/l. Chromium occurs in the earth's crust at an average concentration of 100mg/kg. The primary sources include domestic wastewater, manufacturing processes involving metals, and the dumping of sewage sludge. Chromium is generally detected at low concentration in freshwaters. In the present study, the concentration of chromium was found below detectable level in all the stations studied.

Copper occurs in the earth's crust at an average concentration of 50mg/kg, principally as sulphides. Effluents from electroplating plants constitute one of the important sources of heavy metal pollution and normally contain objectionable quantities of copper, lead, zinc, cadmium, chromium, cyanides, oils, grease and BOD (Ramaswamy and Somasekhar, 1982). Stations I and V shows a marked decrease in the content of copper, in the present investigation.

This may be due to the mixing of saline water with fresh water. Generally speaking, the concentration of copper was found below the standard permissible levels. Lead is the 36th most abundant element in the earth's crust, with an average concentration of 15mg/kg. In the present study, lead is also found below the standard permissible levels in all the stations studied.

Zinc is an essential micronutrient, which is the 24th most abundant element. There are several major sources of zinc discharge including the discharge of domestic waste water, manufacturing processes involving metals and atmospheric fall outs. A relatively higher concentration of zinc may be toxic to aquatic life (Kothandaraman and Viswanathan, 1986). Estuarine regions where salt water mixes with the freshwater are

markedly showing lower values of Zn. Nickel constitutes about 0.008% of the earth's crust. It is shown to be essential for some microorganisms and animals but not to plants. The concentration of nickel was found to be below detectable limit in all the stations except Station III. In this station also, the concentration was observed below the standard permissible limit.

Zinc, copper, cadmium, lead and chromium are of particular relevance in freshwaters. The increased circulation of toxic metals in recent times resulted in the inevitable build up of such toxic substances in the human food chain (Moore, 1991). The effects of heavy metals on air, water and soil were well documented. Since metals are rapidly adsorbed to particulate materials (e.g. detritus, plankton, suspended sediments) and assimilated by living organisms, the concentration of metals dissolved in the water may give a highly vague picture of the degree of metal pollution. The present observation clearly indicates that the water is not polluted by heavy metals.

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Figure1. Location Map Of The Study Area

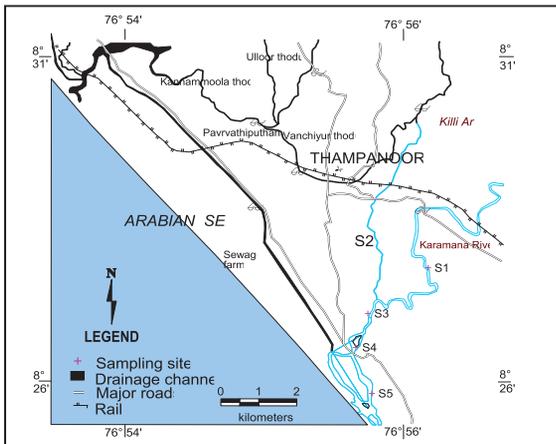
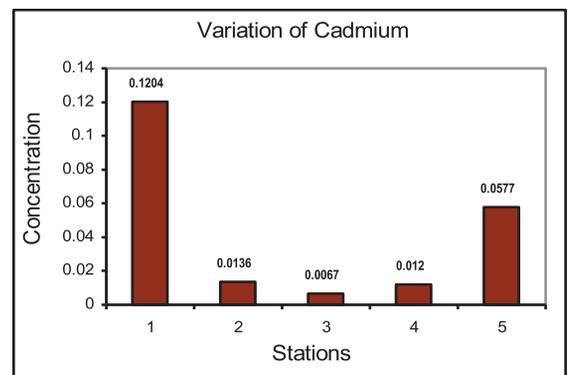
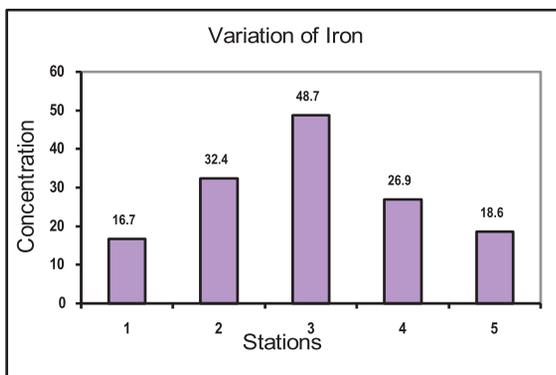
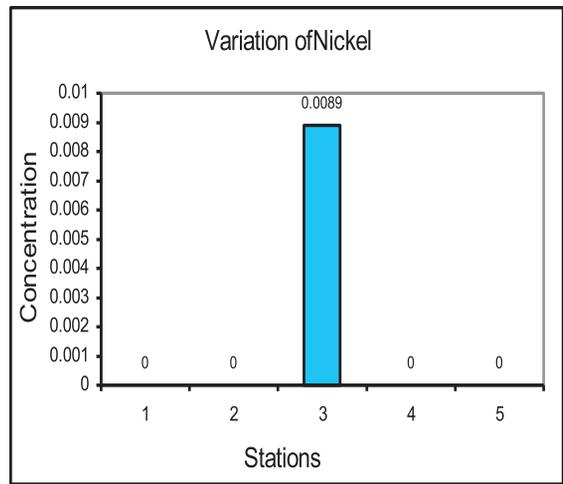
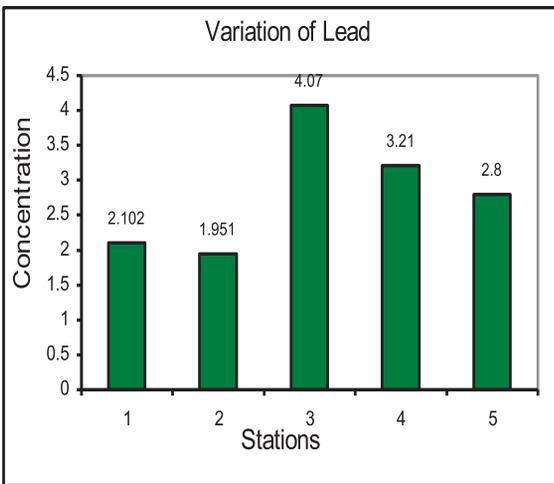
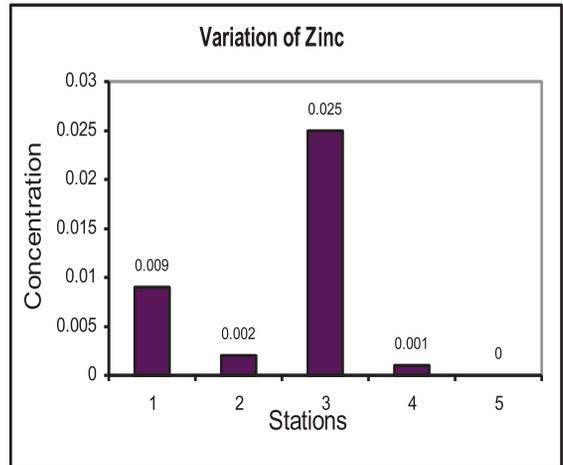
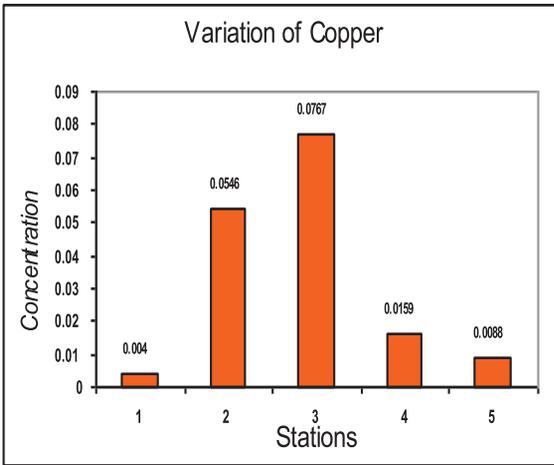


Table. 1. Variations in heavy metal Concentrations at Stations I, II, III, IV & V

Heavy metal	Station I	Station II	Station III	Station IV	Station V
Iron (µg/l)	16.7	32.4	48.7	26.9	18.6
Cadmium (µg/l)	0.1204	0.0136	0.0067	0.012	0.0577
Chromium (µg/l)	BDL	BDL	BDL	BDL	BDL
Copper (µg/l)	0.004	0.0546	0.0767	0.0159	0.0088
Lead (µg/l)	2.102	1.951	4.07	3.21	2.8
Zinc (µg/l)	0.009	0.002	0.025	0.001	BDL
Nickel (µg/l)	BDL	BDL	0.0089	BDL	BDL

Fig. 2. Variations in heavy metal concentrations at Stations I,II,III, IV and V.





“IDENTIFICATION & CHARACTERIZATION OF PIGMENT PRODUCING BACTERIA FROM SOIL & STUDIES ON SOME INDUSTRIAL APPLICATIONS OF PIGMENT”

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ABSTRACT

The present study includes the extraction of pigment using ethyl acetate as solvent from bacteria isolated from soil collected from college campus. Three bacterial strains tentatively identified as red pigment producer as *Serratia* spp., lime yellow pigment producing organism as *Micrococcus* spp. and dark yellow pigment producing belongs to *Staphylococcus* spp. The absorption spectra of these three pigments showed absorption maxima 540 nm for red pigment, for lime yellow and dark yellow, maximum absorbance was 400nm and 440 nm respectively. The extracted pigments had antibacterial activity against *Staphylococcus aureus* and *Proteus* spp. The radical scavenging activity for the pigment was determined through DPPH which showed the maximum antioxidant activity at least concentrations. These pigments were also used for dyeing of textile and bioplastic material and in lip balm production with better outputs. Further, it is necessary to conduct purification and toxicology studies of these microbial pigments before their use as natural colorants in food and pharmaceutical products.

Keywords: Pigments, Antibacterial activity, Antioxidant, Lip balm, Textile dyeing

INTRODUCTION

Natural pigments are obtained from ores, insects, plants and microbes. Among microbes, bacteria have great potential to produce diverse bioproducts and one such product is pigments. The production and application of bacterial pigments as natural

colorants has been investigated by various researchers¹. Bacterial pigment production is now one of the emerging fields of research in microbiology and biotechnology to prove its potential for various industrial applications. Microorganism's like bacteria, algae and fungi have an ability to produce variety of pigments. These pigments from microbial sources have desirable properties like stability to light, temperature and pH. Microbial pigments also possesses anti-cancer properties and are a source of pro-Vitamin A. Microbial production has various benefits as their production is independent to weather condition, easy and fast growth of bacteria on different wastes, easy extraction of pigment. Hence, microbial production of pigments has many advantages over the other as they can be produced under controlled condition in a very less time².

However, most of the research conducted at bacterial pigment production level is still at its beginning stage. Hence, more work on the bacterial pigments should be carried out to enhance its applicability for industry. There are many studies in the literature on bacterial pigments which focus mainly on production and application of specific pigment³. Pigment producing bacteria are ubiquitous and present in various ecological niches, such as rhizospheric soil, desert sand, fresh water and marine samples. They were reported in low and high temperature regions, can persist in salt regions and even as endophytes⁴. The use of bacteria for pigment production has several advantages

over fungi, such as short life cycle and ease for genetic modification. However, compared with fungal pigments, most of bacterial pigments are still at the research and development stage⁵.

The pigment production is more likely to be present in actinobacteria. Various genera such as *Streptomyces*, *Nocardia*, *Micromonospora*, *Thermomonospora*, *Actinoplanes*, *Microbispora*, *Streptosporangium*, *Actinomadura*, *Rhodococcus*, and *Kitasatospora* produce a wide variety of pigments⁶.

Red colored pigment from *Comamonas testosteroni* growing on naphthalene was isolated from petroleum contaminated soil⁷.

Before the invention of synthetic pigments, natural pigments were widely used for many purposes such as the coloring of natural fibers (wool, cotton, silk), fur and leather, to color cosmetic products and to produce inks, watercolors and artist's paints. Since the introduction of synthetic dyes, many convenient and cheap synthetic pigments have appeared in the market and the use of natural dyes has decreased due to the relatively cheaper synthetic pigments⁸.

The bacterial pigments will offer good opportunities due to their enhanced environmental acceptability and superior performance characteristics, classical or conventional grades are expected to continue to dominate the organic market. Hence, in this study focus was made on isolation and characterization of pigment producing bacteria and evaluation of them for some industrial application.

MATERIALS AND METHODS

COLLECTION OF SOIL SAMPLE

SOIL SAMPLES

Soil samples were collected from two places near waste dumping site and from Botanical garden of Yashwantrao Chavan

College of Science Karad, Vidyanagar, Karad. Collected soil samples were serially diluted up to 10⁻⁹. 0.1 ml of each dilution were plated on sterile sterile 2% glycerol nutrient Agar plates and kept for incubation at 37°C for 48 hrs. The plates were observed for growth and pigment production after 48 hrs of incubation. The isolated pigment producing organisms were further streaked on sterile same plate to obtain pure culture and were further characterized for identification. Media and chemicals used in the present study were from HIMEDIA Biosciences.

Identification of the Pigment producing Strain

The preliminary identification of the strain was confirmed by Morphological characteristics such as Gram Staining, Cell size, shape, arrangement etc., Cultural characteristics and biochemical properties.

Studies on pigment production

Biomass production for pigment

Mass cultivation was carried out in 500 ml broth taken in 1 liter capacity Erlenmeyer flask inoculated with inoculum with cell density adjusted by hemocytometer to 10⁶ cells / ml and incubated on Rotary Shaker for 48 - 72 hours.

Extraction of Pigments

The Ethyl Acetate was used for extraction of pigment but a modified procedure for the isolation of pigment was carried out where 72 hour old culture of broth mixed with Ethyl Acetate and vortexed vigorously and then centrifuged at 10,000 rpm 0°C for 10 minute. The resulting supernatant was collected and filtered through Whatman filter paper. The water layer is discarded and pigment extract was then reconcentrated using evaporating dish until minimal volume was obtained. Cell pellet were used for obtain intracellular pigments. Intracellular pigments obtained by using ultrasonicator and ethyl acetate and allowed to evaporate water. This ethyl acetate extract was used to check the applications of pigment.

This dried pigment was also suspended in DMSO (Dimethyl sulfoxide) solvent to evaluate its antimicrobial activity against laboratory pathogens⁹.

UV-Vis. Spectral analysis

Spectral analysis of extracted pigment was done by using UV-Visible spectrophotometer (Systronics model 119). The extract was scanned in the range of 300 to 700 nm to find out the maximum absorption wavelength. Ethyl acetate was used as a blank.

Studies on Applications of bacterial pigments

Antimicrobial activity of pigment

Antibacterial activity of pigment was studied by agar well diffusion method. Test organism was inoculated into sterile cooled molten nutrient agar plates, test organism used were *Escherichia coli*, *Salmonella typhi*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Bacillus sp.*, *Proteus sp.*

Nutrient agar plates were used for well diffusion method. The plate was inoculated with pure culture and wells were bored in the plates. Then the wells were filled with appropriate amount of pigment and it was kept in refrigerator for half an hour for diffusion. After that it was incubated at 37°C for 24hrs and the result was observed by measuring zone of inhibition. DMSO was taken as a control.

Antioxidant activity

The 2, 2-diphenyl-1-picrylhydrazyl radical scavenging activity (DPPH) was carried out by the method¹⁰. For the examination of DPPH radical scavenging activity, crude extracts were prepared at different concentrations.

Percentage scavenging = $[(Ac-At)/Ac] \times 100$. Where At is absorbance of sample and Ac absorbance of control.

Preparation of lip balm

The bio lip balm was prepared using shaded Bee wax along with coconut oil and glycerol as source of lanolin. All the contents were mixed in the ratio 2:4:1 (w/v/w) in bowl.

The container was kept in water bath and heated until the wax melts completely and all the ingredients are homogeneously mixed. The 0.1 gm pigment was added to it to color the mixture. Then the mixture was poured into container and allowed to cool.

The formulation was developed and evaluated for color, odor, appearance and spread ability over a minimum of two days at room temperature (28°C) and oven temperature (55 °C).

Textile Application

The extracted pigment was used for dyeing the absorbent cotton, and thread. The samples were pre-mordant with 5% of ferrous sulphate and copper sulphate separately. Finally the absorbent cotton and thread were dyed in 50 ml of colored filtrate. Dyeing time was 45 min and incubated at 70-80°C. The samples were washed with cold water after dyeing.

Biocoloration of Bio-Plastic

15 gram of cornstarch was taken into the 100 ml water in conical flask. 10 ml of vinegar and glycerin were added into it followed by 1 ml of extracted pigment. Mixture was heated with constant stirring until it become clear, gel-like. Solution was then poured in to metal pan and dried for a couple of days.

Results and Discussion

Two Soil samples were collected from campus of Yashwantrao Chavan College of Science Karad, Maharashtra, India. Soil was used for isolation of pigment producing bacteria on 2% glycerol nutrient agar medium. Total three pigment producing bacteria were identified and characterized which were red, lime yellow and dark yellow (Fig. 1, 2, 3).

These bacteria were then identified and characterized with the help of morphological characteristics and biochemical tests (Table 1, Table 2 and Table 3). Their identification at genus level was done with the help of Bergey's Manual of Determinative Bacteriology.

Extraction of Pigments

Initially the pigment was extracted by

different solvents with their different concentrations. Acetone, Ethyl acetate and Chloroform were used. There was no pigment extraction observed in Chloroform and acetone solvent. The ethyl acetate solvent has capacity to extract the pigment from the cell. The pigments extracted were red, lime yellow and dark yellow in color.

In UV-Vis spectroscopy, maximum absorbance of Red pigment was obtained as 540 nm, for lime yellow and dark yellow maximum absorbance was 400 and 440 nm respectively (Figure 4) which was close to the absorption spectrum of beta carotene (450 nm) studied by Kaiser¹¹.

Similar studies have been carried out in *Serratia marcescens* where the maximum absorbance of red pigment was found to be at 534.76 nm using UV-Vis analysis spectra². Studies carried by Hines¹², showed the maximum absorbance for prodigiosin pigment at 535 nm.

Antimicrobial activity of pigment

The extracted pigments were dissolved with solvent DMSO to evaluate the antimicrobial activity against laboratory isolates of pathogen by well diffusion method. The zone of inhibition was measured to evaluate antimicrobial activity. All the pigments isolated showed antibacterial activity against the test pathogens with yellow pigment being less effective as compare to red pigment. For red pigment, maximum zone of inhibition was observed against *Staphylococcus aureus* (35mm) and minimum against *Salmonella typhi* (18mm). However lime yellow pigment fails to inhibit any of isolate whereas dark yellow pigment found most effective against *Proteus sp.* (32mm) and least effective against *E. coli* (16mm).

Based on the results, it was obvious that red pigment extract showed excellent antibacterial activity against *Staphylococcus aureus* while dark yellow effective against *Proteus sp*

Yellow colored pigment was found to become very faint after 2 to 3 days and hence was not used for further applications.

Antioxidant Activity

Antioxidant potential is the capability of a substance to scavenge free radicals available in its surroundings. The free radical-scavenging activity of pigment along with standard ascorbic acid was determined by the DPPH assay. Ethyl acetate extract of red pigment of isolate IS 1 showed 85% DPPH activity which was considerable good when compared with the standard ascorbic acid showing 95% activity at same concentration (Figure 4). In addition, radical scavenging activity performed with different concentration of ethyl acetate extract showed concentration dependent scavenging activity. Similar results were reported by Mani¹³, while more antioxidant activity when compared with results of Srinivasan¹⁴.

Preparation Of Lip Balm

Red lip balm was formulated have suitable characteristics such as color, odor, and uniformity. It was noticed that there were no water formation, cracks or bleeding of color and blooming even after 15 days of observation at room temperature 28°C (Figure 5).

Textile Application

The pigment extracted from biological source was used as an alternative to the synthetic colorants and also are safe and cost effective. A piece of cotton and cotton thread were used as textile materials to observe the coloring capacity of Ethyl Acetate extracted red pigment (Figure 6). Usually any sort of dye required fixative which helps in the attachment of dye to the material.

In our study we observe that extracted pigment did not require any fixative to incorporate the color texture to the textile material. The pink color was retentive enough to withstand a consecutive 3 normal water wash treatment.

Biocoloration Of Bio-plastic

The coloration of bioplastic is becoming increasingly important and is achieved today almost exclusively with the help of polymeric carrier materials and suitable colorants. However there is a problem of the biodegradability of the colorant so the only option is to search for microbial pigment having ability to color bioplastic material. In the present study red pigment was used to color bioplastic. However further studies on its stability and strength, need for additives and proper dispersion need to be done. This study opens new area of preparing ecofriendly biocolor for coloring biodegradable materials to improve its market value.

Conclusion

The organisms in the soil are an important source for the search of novel bioactive molecules with biotechnological importance such as microbial pigments. With this view the present study was undertaken. In this present study, from 2 soil samples 3 pigment producing isolates namely IS1, IS2 and IS3 with red, lime yellow and dark yellow were collected. Then according to Bergey's Manual of Systematic bacteriology, red pigment producing bacterium IS1 was tentatively identified as *Serratia* spp., lime yellow pigment producing organism IS2 was *Micrococcus* spp. and dark yellow pigment producing IS3 belongs to *Staphylococcus* spp. Furthermore pigments were tested for antimicrobial activity which showed that extracted red pigment inhibited growth of *Staphylococcus aureus* and dark yellow pigment showed activity against *Proteus* sp. Also present study focused on its antioxidant activity in which the red pigment was used in the DPPH radical scavenging activity showed better activity when compare to standard. Thus pigment can be taken as source of natural colorant in medicinal, food and pharmaceutical fields.

These pigments were tested for textile

dyeing applications and lip balm production which showed good results. Therefore the study concludes that pigments have excellent antimicrobial activity which could be very useful for pharmaceuticals and natural pigments could be manipulated as a prominent source to replace the synthetic chemicals for the preparation of textile dyes. Additional efforts on studies on use of pigments as biocoloring agent are also in consideration.

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Fig. 1 IS 1



Fig. 2 IS 2

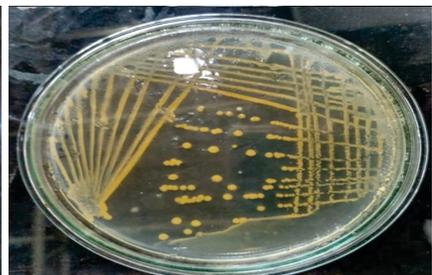


Fig. 3 IS

Table 1: Morphological, Biochemical & Physiological Characterization of the Pigment Producing Microorganism **Colony Morphology**

Code of Isolate	Size	Shape	Color	Opacity	Margin	Elevation	Consistency	Gram Nature	Motility
IS1	3mm	Circular	Red	Opaque	Entire	Convex	Sticky	Gram negative short rod	Motile
IS2	<1mm	Circular	Lime yellow	Opaque	Entire	Dome shape	Moist	Gram positive cocci	Non Motile
IS3	2mm	Circular	Dark yellow	Opaque	Entire	Low convex	Moist	Gram positive cocci	Non Motile

Table 2: Biochemical Test of Sugar Fermentation

Code of Isolate	Glucose	Mannitol	Raffinose	Fructose	Sucrose	Arabinose	Cellobiose	Lactose
IS1	+	+	+	-	-	+	+	+
IS2	+	-	-	+	-	-	+	+
IS3	+	-	-	+	-	-	+	+

Key, + = Acid Production, - = No Acid Production,

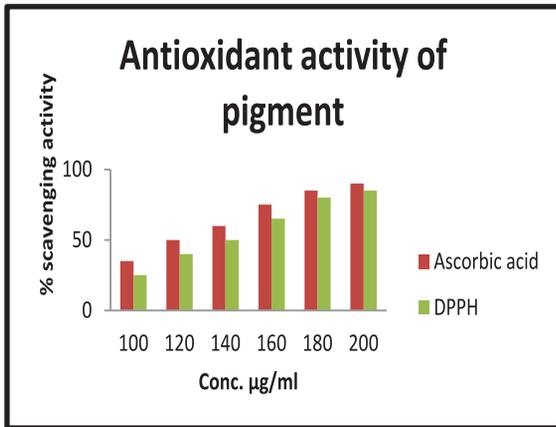


Figure 4 Determination of antioxidant potential of Pigment

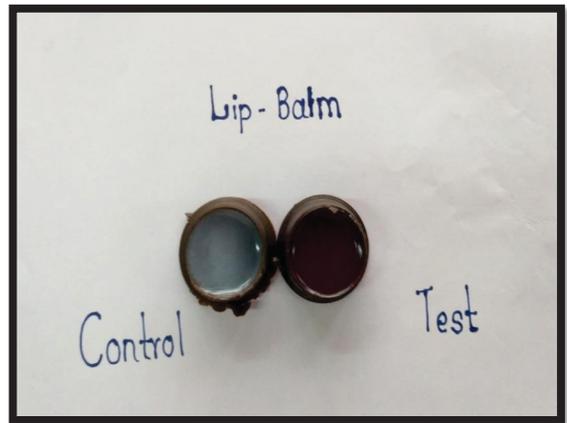


Fig. 5. Natural lip balm produced from extracted red pigment

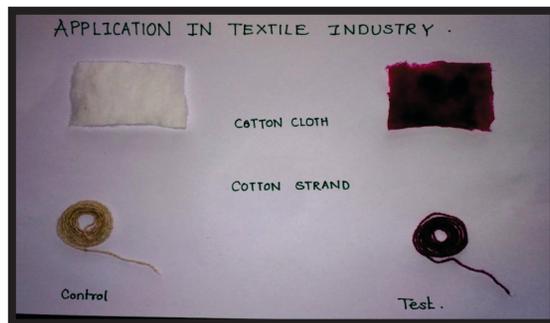


Fig. 6. Textile dyeing from extracted red pigment.

“FROM PREDICTIVE TO PERSONALIZED : ARTIFICIAL INTELLIGENCE & SHIFTS IN CONSUMER BEHAVIOR & EXPECTATIONS”

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Abstract

The rapid integration of Artificial Intelligence (AI) into the retail and digital service sectors has fundamentally altered the traditional consumer decision-making process.¹ This paper explores how AI-driven tools—including generative AI, predictive analytics, and autonomous agents—have shifted consumer expectations toward hyper-personalization, instantaneity, and proactive engagement. Utilizing a systematic literature review and synthesis of recent empirical data, the study identifies a "trust-convenience paradox," where consumers demand the efficiency of AI while maintaining high skepticism regarding data privacy. The paper concludes with strategic recommendations for businesses to navigate this evolving landscape.

1. Introduction

The global marketplace is currently undergoing a paradigm shift that rivals the invention of the internet itself. As we navigate 2026, Artificial Intelligence (AI) has evolved from an experimental backend technology into the primary architect of the consumer experience. What was once a tool for simple automation has transformed into a sophisticated engine of "Agentic Commerce," where AI models do not just suggest products—they predict needs, negotiate prices, and curate entire lifestyles.

1.1 The Context of the AI Revolution

For decades, the consumer journey followed a linear path: **Awareness--Consideration--Conversion -- Loyalty**. However, the integration of Large Language Models (LLMs)

and predictive algorithms has collapsed this funnel. In the contemporary digital landscape, consumers are increasingly interacting with "invisible interfaces." Whether through voice-activated home assistants, generative search engines, or autonomous shopping agents, the traditional "search and click" behavior is being replaced by a dialogue-based interaction model.

1.2 The Evolution of Consumer Expectations

The impact of AI is perhaps most visible in the radical escalation of consumer expectations. In a world where AI can generate personalized workout plans or suggest outfits based on a user's calendar events, "generic" marketing is increasingly perceived as obsolete or even intrusive. We have entered the era of Hyper-Personalization, characterized by three core demands:

- Predictive Proactivity: Consumers no longer want to search for solutions; they expect AI to anticipate their problems before they arise (e.g., an AI suggesting a grocery restock based on consumption patterns).

- Instantaneity: The "Amazon Effect" has evolved into the "AI Effect," where wait times for customer service or data processing are expected to be near-zero.

- Contextual Intelligence: Consumers expect platforms to remember their preferences across different devices and environments, creating a seamless "omnichannel" identity.

1.3 Problem Statement

Despite the efficiency gains provided by AI, a

significant tension has emerged—the "Trust-Convenience Paradox." While consumers gravitate toward the ease of AI-driven recommendations, there is a growing psychological resistance rooted in data privacy concerns, algorithmic bias, and the "uncanny valley" of AI-human interactions. Brands are struggling to balance the mechanical efficiency of AI with the emotional resonance required for long-term brand loyalty.

1.4 Purpose of the Study

This research seeks to dissect the psychological and behavioral changes in consumers triggered by pervasive AI. By analyzing the shift from manual search to curated discovery, this paper explores how AI influences decision-making speed, the erosion of traditional brand loyalty, and the emerging ethical standards that consumers now demand from AI-integrated corporations.

2. Review of Literature

The scholarly and industry discourse surrounding Artificial Intelligence in 2024–2026 identifies a radical restructuring of the consumer-brand relationship. The literature can be categorized into four primary thematic pillars: the transformation of the decision-making process, the rise of hyper-personalization, the emergence of agentic commerce, and the "Trust-Convenience Paradox."

2.1 The AI-Augmented Purchase Journey

Traditional marketing models, such as the five-stage consumer decision process, have been re-evaluated in light of AI integration. Meddah (2024) posits that AI influences every phase, particularly Need Recognition and Information Search. By leveraging predictive analytics and big data, AI can now trigger "anticipatory needs" before a consumer consciously identifies them (Mowade, 2025). Empirical research from the *Journal of Marketing & Social Research* (2025) demonstrates that AI tools explain

approximately 68.5% of the variance in consumer purchase decisions. Among these, interactive virtual assistance (chatbots and voice agents) exhibits the strongest influence, providing the real-time assurance necessary to move consumers from consideration to conversion (Patil, 2024).

2.2 Hyper-Personalization and Customer Engagement

By 2026, personalization has transitioned from a competitive advantage to a baseline expectation. A 2024 McKinsey study (cited in Celestin, 2024) found that **71% of consumers expect personalized interactions, while 76% report frustration** when these are absent. AI-driven personalization engines—utilizing deep learning and collaborative filtering—have been shown to increase engagement by roughly **45%** and conversion rates by **38%** (Parab, 2024).

Further research highlights that **Generative AI** adds a layer of "uniqueness" to brand communication, enabling retailers to create dedicated, real-time landing pages and "empathetic" content tailored to individual personas (Bain & Company, 2025; Trisetianto & Ali, 2025).

2.3 The Transition to Agentic Commerce

A defining trend of 2025–2026 is the rise of Agentic AI—autonomous systems that act on behalf of the user. Industry analysts predict that by 2026, a significant portion of online transactions will be handled by AI-to-AI interactions, where a consumer's personal AI agent negotiates prices and fulfillment terms with a brand's sales agent (WebProNews, 2026). This shift marks a move from a "browse-heavy" model to a "speed-optimized" model, reducing search friction and allowing humans to focus on high-level decision-making (Lemkin, 2026).

2.4 Ethical Challenges and the Trust-Convenience Paradox

While the benefits of AI are documented, the literature also reveals a significant "dark side."

Consumers increasingly engage in a "privacy calculus," weighing the extreme convenience of AI against the risks of data misuse, algorithmic bias, and misinformation (MDPI, 2025; Durham University, 2026).

- **Transparency as a Mediator:**

Research by MDPI (2025) indicates that perceived transparency is the single most important factor in enhancing trust in AI.

- **The Credibility Gap:** Despite a growing trust in AI-generated advice—with **73%** of consumers trusting AI for financial or healthcare planning (Capgemini, 2023)—concerns regarding the "authenticity" of AI-curated social proof (like "bestseller" tags) remain a critical barrier to full adoption (Pizzi et al., 2021).

2.5 Summary Table: Key Theoretical Shifts (2020 vs. 2026)

Feature	2020 Baseline (Pre-GenerativeAI)	2026 Standard (Agentic/GenAI)
Search Model	Manual, keyword-based search	Natural language, intent-based dialogue
Personalization	Reactive (based on past history)	Proactive (predictive & context-aware)
Customer Service	Scripted bots / Limited hours	24/7 Generative agents with empathy
Trust Source	Brand reputation & human reviews	Algorithmic transparency & AI social proof
Decision	Filter-based comparison	AI-curated "Best Fit" summaries
Feature	2020 Baseline (Pre-GenerativeAI)	2026 Standard (Agentic/GenAI)
Support		

3. Research Objectives

To systematically evaluate the impact of AI on the 2026 consumer landscape, this study establishes four primary objectives:

1. **To analyze the shift in consumer decision-making speed:** Investigate how AI-curated summaries and "Agentic" assistants compress the time spent in the information search and evaluation phases.

2. **To identify the key drivers of the "Trust-Convenience Paradox":** Determine which factors (e.g., transparency, data security, accuracy) most significantly influence a consumer's willingness to delegate purchasing decisions to AI.

3. **To evaluate the effect of AI on brand loyalty:** Assess whether hyper-personalization fosters genuine emotional connection or merely a transactional dependence on "frictionless" interfaces.

4. **To map the evolution of service expectations:** Categorize the new baseline for "instantaneity" and "proactivity" in customer support as defined by 2026 standards.

4. Methodology

This research employs a Mixed-Methods Exploratory Design, integrating qualitative insights from recent literature with quantitative analysis of market behavior data available through 2025.

4.1 Data Collection Strategy

- **Systematic Literature Review (SLR):** An analysis of over 100 academic papers and industry reports (2023–2026) from databases like Scopus, IEEE Xplore, and Gartner.

- **Secondary Quantitative Analysis:** Examination of existing consumer sentiment datasets, focusing on Chi-square tests to establish correlations between AI-driven personalization and purchase intent (Kumar & Singh, 2025).

- **Case Study Analysis:** Detailed review of "pioneer" organizations (e.g., Amazon's anticipatory shipping, Netflix's content curation) to observe real-world behavioral outcomes.

4.2 Analytical Framework: The S-O-R Model

The study utilizes the Stimulus-Organism-Response (S-O-R) framework to interpret data:

- **Stimulus (S):** AI-driven interventions (Chatbots, Predictive Offers, Generative Search).

- **Organism (O):** Internal consumer states (Trust, Perceived Usefulness, Emotional Comfort, Technology Readiness).

- **Response (R):** Behavioral outcomes (Purchase intention, Brand loyalty, Platform engagement).

4.3 Key Variables Measured

Variable Category	Primary Metrics
Cognitive	Perceived Ease of Use (PEOU), Perceived Usefulness (PU).
Affective	Emotional trust in AI advice, Brand authenticity perceptions.
Behavioral	Conversion rates, Average Order Value (AOV), Retention rates.
Ethical	Privacy calculus scores, Algorithmic transparency ratings.

5. Discussion

5.1 The Compression of the Purchase Funnel

The discussion reveals that the "Discovery" and "Evaluation" phases of the consumer journey are being subsumed by AI. In 2026, consumers are moving away from browsing multiple websites toward receiving a "Single Best Answer" from AI agents. This "Frictionless Fallacy" suggests that while efficiency is high, the opportunity for brands to build emotional resonance is decreasing, as the consumer interacts more with the interface than the brand identity.

5.2 The Rise of Proactive Expectation

We are witnessing the death of Reactive Service. Consumers now judge a brand's quality by its ability to resolve issues before the consumer is aware of them. For instance, AI-driven logistics that rebook a flight before the traveler receives a delay notification have set a new psychological standard: If you aren't anticipating my needs, you are behind.

5.3 Navigating the Trust Gap

The "Trust-Convenience Paradox" remains the greatest barrier. Data indicates that while 73% of consumers trust AI for technical advice, only 32% feel comfortable with AI making autonomous financial commitments on their behalf without a "human-in-the-loop" verification step.

6. Conclusion

AI has fundamentally rewired the consumer psyche, trading the "joy of

discovery" for the "luxury of efficiency." By 2026, the successful brand is one that masters Transparent Personalization—using AI to provide extreme convenience while remaining radically open about data usage. The transition to agentic commerce means brands must now market not just to humans, but to the algorithms that represent them.

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“AI AND ROBOTICS IN INDIA: THE URGENT NEED FOR COMPREHENSIVE REGULATION.”

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Abstract

The rapid advancement of Artificial Intelligence (AI) and Robotics has revolutionized industries, governance, and daily life. However, the Information Technology Act of 2000 and the Digital Personal Data Protection Act of 2023, which dominate India's legal system, are unable to handle the moral, legal, and accountability issues raised by these technologies. This paper critically examines the gaps in India's regulatory landscape concerning AI and robotics, emphasizing risks such as autonomous decision-making, algorithmic bias, data privacy concerns, cyber security threats, and ethical dilemmas. The paper also analyzes India's National Strategy on Robotics¹ and proposes a comprehensive regulatory framework inspired by international best practices, including the European Union's AI Act² and the United States' AI Risk Management Framework.³ The study suggests the establishment of a centralized regulatory authority, incorporation of ethical safeguards, and adoption of a risk-based model to ensure responsible AI and robotics development while fostering innovation.

¹Ministry of Electronics and Information Technology, “National Strategy on Robotics: A Vision for India.”

<https://www.meity.gov.in/writereaddata/files/Draft-National-Strategy-Robotics.pdf> (last visited: February 11, 2025).

²EU AI Regulation - EU - 2024/1689 - EN-EUR-LEX., Available at: <https://eur-lex.europa.eu/legalcontent/EN/TXT/?uri=CELEX:32024R1689> (last visited: February 11, 2025).

³ U.S. Department of Commerce, “Artificial Intelligence Risk Management Framework:

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KEYWORDS

AI Regulation in India, Artificial Intelligence and Robotics, Legal Framework for AI, Ethical Challenges in AI, National Strategy on Robotics, Algorithmic Bias and Accountability

Introduction

The swift progress of Artificial Intelligence (AI) and Robotics has marked the new era of technological innovation, transforming industries, economies, and societal structures. The term artificial intelligence refers to a field of study that focuses on simulating how the human brain functions in order to complete challenging tasks that people execute. ⁴ From healthcare and education to defense and transportation, AI and Robotics are reshaping the way we live and work. However, these advancements also bring forth complex legal, ethical, and regulatory challenges. In India, the existing legal framework, primarily governed by the Information Technology Act, 2000 (IT Act), is ill-equipped to address the unique issues posed by AI and Robotics. While the IT Act was groundbreaking at the time of its enactment, it was designed for a pre-AI era and does not account for the autonomous decision-making capabilities of modern AI systems or the integration of robotics into everyday life.

The amalgamation of AI and robotics presents a particularly potent combination, capable of both tremendous benefits and significant risks. From autonomous drones to AI-driven healthcare robots, the potential for harm, whether through algorithmic bias, data breaches, or even physical harm caused by malfunctioning robots is substantial. Yet, India lacks a dedicated regulatory framework to govern this amalgamation, leaving a dangerous vacuum in the legal landscape. 4 Yadav N. "Ethics of Artificial Intelligence and Robotics: Key Issues and Modern Ways to Solve Them." - "Journal of Digital Technologies and Law." 2023; 1(4): 955-972. <https://doi.org/10.21202/jdtl.2023.41> (last visited on February 11, 2025).

This paper explores the limitations of the current legal framework in India, examines the risks associated with the unregulated growth of AI and robotics, and proposes a comprehensive regulatory approach to address these challenges. By drawing parallels with international frameworks and incorporating insights from other Indian legislations, this paper aims to provide a roadmap for India to navigate the complexities of AI and robotics regulation.

The Current Legal Framework: A Pre-AI Era Legislation

1. The IT Act, 2000: Outdated and Inadequate

The Information Technology Act of 2000 (IT Act) was passed in order to combat cybercrimes and provide electronic transactions a legal status. However, it was drafted at a time when AI and robotics were not mainstream concerns. As a result, the Act lacks provisions to address the unique challenges posed by AI-driven systems, such as autonomous decision-making, algorithmic bias, and the ethical implications of robotics.

For instance, Section 43A of the IT Act mandates compensation for negligence in handling sensitive personal data, but it does not

address the complexities of AI-driven data processing, such as real-time data collection by autonomous systems or the use of predictive analytics.⁵ Similarly, Section 66 of the Act, which deals with computer related offenses, does not account for AI-specific harms like deep fake frauds or autonomous cyber attacks.⁶ The IT Act also fails to address the issue of algorithmic accountability. If an AI system makes a decision which results in damage or harm, then it is unclear that who should be held responsible. Is it the Developer, the Manufacturer, or the User? This lack of clarity

5 Information Technology Act, 2000, No. 21, Acts of Parliament, 2000 (India), Section 43A.

6 Information Technology Act, 2000, No. 21, Acts of Parliament, 2000 (India), Section 66.

could lead to prolonged legal battles and undermine public trust in AI-driven technologies.

2. The Digital Personal Data Protection Act, 2023: A Step Forward, But Not Enough

The recent legislation, Digital Personal Data Protection Act, 2023 (DPDP Act) ushered a significant step towards strengthening the data protection in India. However, it falls short of addressing the specific challenges posed by AI and robotics. While the DPDP Act introduces concepts like data minimization and accountability, it does not provide a comprehensive framework for regulating AI-driven decision-making or the ethical use of robotics.

For example, the DPDP Act does not explicitly address the issue of Algorithmic Bias. In Algorithmic Bias, AI systems may inadvertently discriminate against certain groups based on biased data sets. This is a critical gap, especially in sectors like healthcare and finance, where AI-driven decisions can have far-reaching consequences.

3. Other Relevant Legislations: Gaps and Limitations

In addition to the IT Act 2000 and the DPDP Act 2023, other Indian legislations, such as the Consumer Protection Act, 2019 and the Competition Act, 2002, also play a role in regulating AI and robotics. However, these laws were not designed with AI in mind and fails to address the unique challenges posed by these technologies.

For instance, the Consumer Protection Act, 2019 provides safeguards against unfair trade practices, but it does not specifically address the risks posed by AI-driven consumer

7 Digital Personal Data Protection Act, 2023, No. 30, Acts of Parliament, 2023 (India).; Cyber Law Consulting, available at: https://www.cyberlawconsulting.com/ai_and_data_privacy_in_india.php (last visited on Feb 15, 2025).

8 Digital Personal Data Protection Act, 2023;Rajiv Malik. "Privacy Paradox :A digital dilemma ." available at : <https://law.asia/digital-personal-data-protection-act-compliance-india/> (last visited on February 11, 2025).

products, such as autonomous vehicles or AI-powered home assistants.⁹ Similarly, the Competition Act, 2002 aims to prevent monopolistic practices, but it does not account for the potential for AI-driven platforms to engage in anti-competitive behavior, such as algorithmic collusion or predatory pricing.¹⁰

The Risks of Unregulated AI and Robotics Amalgamation

1. Autonomous Decision-Making and Accountability

Amongst other challenges posed by AI and robotics, the most pressing challenge is the issue of accountability. Unlike traditional systems, AI-driven robots can operate autonomously, making decisions without human intervention. This raises critical questions: Who is responsible when an AI-

driven robot causes harm? Is it the programmer, the manufacturer, or the user? The current legal framework in India does not provide clear answers to these questions, leaving a significant gap in accountability.¹¹

For instance, in the case of an autonomous vehicle causing an accident, neither IT Act nor DPDP Act provides a mechanism to determine liability. This lack of clarity could lead to prolonged legal battles and undermine public trust in AI-driven technologies.¹²

2.Data Privacy and Surveillance Risks

The integration of AI and robotics also poses significant risks to data privacy. AI systems is dependent on a vast amount of personal data in order to function effectively. This also raises concerns about data misuse and surveillance. While the DPDP Act provides some safeguards, it does not address the unique privacy risks associated with

9 Consumer Protection Act, 2019, No. 35, Acts of Parliament, 2019 (India).

10 Competition Act, 2002, No. 12, Acts of Parliament, 2002 (India).

11 NITI Aayog, "National Strategy for Artificial Intelligence,2021"

<https://www.niti.gov.in/sites/default/files/2023-03/National-Strategy-for-Artificial-Intelligence.pdf> (last visited on February 11, 2025).

12 Ana Taveira da Fonseca, Elsa Vaz de Sequeira, and Luís Barreto Xavier "Liability for AI Driven Systems "p.No. 302. Available at; file:///C:/Users/LAB1/Downloads/Liability_for_AI_Driven_Systems.pdf (last visited on February 11, 2025).

AI-driven robotics, such as real-time data collection by surveillance robots (one equipped with CCTV) in public spaces.¹³

For example, AI-powered surveillance robots could infringe on individual privacy rights by continuously monitoring and analyzing public behavior without explicit consent. This could lead to a surveillance state,

where individuals' every move is tracked and recorded, and raising serious ethical and legal concerns.¹⁴

3. Cyber security Threats

AI and robotics also introduce new cyber security threats. Adversarial attacks, where malicious actors manipulate AI systems by feeding them misleading data, are a growing concern. Similarly, autonomous robots could be hacked and used to carry out cyber attacks or physical harm. The IT Act's cyber security provisions, such as Section 70B, which designates the Indian Computer Emergency Response Team (CERT-In) for cyber security incident responses, are inadequate to address these AI-specific threats.¹⁵

For instance, an AI-driven robot in a healthcare setting could be hacked to leak sensitive patient data. The current legal framework does not provide a mechanism to prevent or respond to such incidents effectively.¹⁶

4. Ethical Concerns: Bias, Discrimination, & Transparency

¹³ Anamika Kundu, Digvijay S. Chaudhary "CCTVs in Public Spaces and the Data Protection Bill, 2021" available at: <https://www.rsrr.in/post/cctvs-in-public-spaces-and-the-data-protection-bill-2021> (last visited on January 11, 2025).

¹⁴ John Cater, "The Battle for Privacy in the Age of AI-Powered Surveillance: What's at Stake in 2024?" available at:

<https://www.tlciscreative.com/the-battle-for-privacy-in-the-age-of-ai-powered-surveillance-whats-at-stake-in-2024/> (last visited on January 11, 2025).

¹⁵ Information Technology Act, 2000, No. 21, Acts of Parliament, 2000 (India), Section 70B.

¹⁶ Gunther Eysenbach, "Security Implications of AI Chatbots in Health Care", Vol 25, Journal of Medical Internet Research, 2023, available at:

<https://www.jmir.org/2023/1/e47551/>

(last visited on January 25, 2025).

The data that AI systems are trained on determines their results. The AI system is likely to generate biased results if the training data is biased. This is especially troubling in fields like criminal justice, healthcare, and finance, because prejudiced AI systems may result in the unequal treatment of particular groups.¹⁷

For example, an AI system used in hiring processes might discriminate against candidates based on gender, race, or socioeconomic background if the training data reflects historical biases.¹⁸ Similarly, AI-driven predictive policing systems could disproportionately target marginalized communities, exacerbating existing social inequalities.¹⁹

The lack of algorithmic transparency further compounds these ethical concerns. Many AI systems operate as "black boxes," meaning that even its developers are not entirely aware of the reasoning behind some of their choices. This lack of transparency makes it difficult to challenge or correct biased outcomes, undermining trust in AI-driven systems.²⁰ When this AI amalgamates or converges itself with Robot, it becomes an Intelligent self-dependent as well as independent entity capable of taking decisions as well as capable of executing the same decisions. Looking at the challenges posed by the Robotics advancements, the Ministry of Electronics and Information Technology (MeitY) came up with a Roadmap for National Strategy on Robotics.

National Strategy on Robotics: A Roadmap for India²¹

¹⁷ IBM Data and AI Team, "Shedding light on AI bias with real world examples", available at:

<https://www.ibm.com/think/topics/shedding-light-on-ai-bias-with-real-world-example>

¹⁸ Chen, Z. "Ethics and discrimination in artificial intelligence-enabled recruitment practices." - Humanit Soc Sci Commun 10, 567

(2023). <https://doi.org/10.1057/s41599-023-02079-x> (last visited on January 25, 2025).

19 Ibrahim Raji, Damilola Bartholomew Sholademi, Predictive Policing: The Role of AI in Crime Prevention, Volume 13 “International Journal of Computer Applications Technology and Research”,—Issue

10, p.No.76 ,available at:

<https://ijcat.com/archieve/volume13/issue10/ijcatr13101006.pdf>

20 Majsja Storbeck, Artificial intelligence and predictive policing: risks and challenges EUCPN (2022), p.No.10. Available at: <https://eucpn.org/sites/default/files/document/files/PP%20%282%29.pdf>

21 Draft National Strategy on Robotics, Ministry of Electronics and Information Technology (MeitY), July 2023, available at: <https://www.meity.gov.in/static/uploads/2024/02/Draft-National-Strategy-Robotics.pdf>

The Draft National Strategy on Robotics, published in July 2023 by the Ministry of and Information Technology (MeitY), outlines a comprehensive roadmap for India to emerge as a global leader in robotics by 2030. The strategy emphasizes the integration of robotics with artificial intelligence (AI) and other emerging technologies to drive socio-economic transformation across key sectors such as manufacturing, healthcare, agriculture, and national security. This section analyzes the key components of the strategy, its objectives, and its implications for India’s regulatory and technological landscape.

1. Vision and Objectives

The National Strategy on Robotics aligns with India’s AI for All and Atmanirbhar Bharat vision, aiming to make India a global hub for robotics research, development, and manufacturing while fostering innovation and entrepreneurship.

Key objectives include:

1. Establishing India as a global robotics leader by 2030, focusing on manufacturing, healthcare, agriculture, and

national security.

2. Enhancing domestic value addition to reduce import dependency.

3. Driving research and innovation through targeted investments and global collaborations.

4. Expanding robotics adoption by creating new markets and applications. These objectives are essential for leveraging robotics’ transformative potential while addressing technological challenges.

2. Focus Areas for Robotics Adoption

The strategy prioritizes four key sectors for robotics adoption, each with significant socio-economic impact:

1. Manufacturing: Robotics can enhance logistics, warehousing, and production automation, with companies like Flipkart and Bajaj Auto already leveraging them for efficiency.

2. Healthcare: Robotics can address workforce shortages and infrastructure gaps through surgical robots, telemedicine, and disinfection systems. According to GlobalData’s report, India’s market is expected to account for approximately 6% of the Asia-Pacific market in 2024, driven by government efforts to promote the adoption of surgical robotics.²²

3. Agriculture: Robotics can improve productivity and safety through precision farming, crop scouting, and automated spraying, addressing labor shortages.

4. National Security: Indigenous robotics development is crucial for mine detection, surveillance, and remotely operated vehicles (ROVs), reducing dependence on imports.

3. Strategic Recommendations

The strategy adopts a four-pillar approach to strengthen India’s robotics ecosystem:

1. Research and Development (R&D): Establishing Centers of Excellence (CoEs) to drive foundational and applied research,

enhance robot functionality, and develop indigenous hardware and software. Moonshot Projects aim to advance robotics through ambitious, mission-driven research.

2. Demonstration and Testing: Setting up innovation testbeds and demonstration centers to validate robotic technologies and build public trust. Regulatory sandboxes will ensure ethical and safety compliance in a controlled environment.

3. Commercialization and Supply Chain Development: Implementing fiscal incentives like PLIs, trade benefits, and ease of doing business reforms to attract investment and boost domestic manufacturing. Robotics industrial zones will enhance supply chain efficiency.

4. Adoption and Awareness: Encouraging market expansion through public procurement, financial incentives, and technology adoption plans. Capacitybuilding initiatives and awareness campaigns will educate stakeholders and address ethical concerns.

4. Challenges and Ethical Considerations While the strategy outlines a comprehensive roadmap, it also acknowledges several challenges that need to be addressed:

22 Express Healthcare. "Robotic Surgical Systems Market Size by Segments, Share, Regulatory, Reimbursement, Installed Base and Forecast to 2036,"

<https://www.expresshealthcare.in/news/india-robotic-surgical-systems-market-to-record-10-percent-cagr-during-2024-36-driven-by-increasing-adoption/448103/>

Skilled Workforce: The Indian robotics ecosystem faces a shortage of skilled professionals, particularly in areas like robot maintenance and integration. The strategy emphasizes the need for dedicated robotics education programs and up skilling initiatives to bridge this gap.

High Costs and Import Dependency: The high cost of robotics components and reliance on imports are significant barriers to

adoption. The strategy proposes measures to localize the supply chain and reduce costs through economies of scale.

Ethical and Regulatory Concerns: The strategy highlights the need for ethical frameworks and governance mechanisms to ensure the responsible use of robotics. This includes addressing issues like algorithmic bias, data privacy, and job displacement due to automation.

The **Draft National Strategy on Robotics** aims to harness robotics and AI for socioeconomic transformation, focusing on manufacturing, healthcare, agriculture, and national security. Its success hinges on effective implementation, stakeholder collaboration, and a strong regulatory framework for ethical use.

By promoting indigenous innovation, skill development, and ethical governance, the strategy aligns with India's AI vision. To achieve global leadership, India must also address the ethical and societal impacts of robotics for sustainable and inclusive growth.

Critical Gaps in the Draft National Strategy on Robotics

Lack of Concrete Implementation Roadmap

While the strategy lays down broad recommendations, it lacks a detailed timeline for execution. The absence of phased implementation plans raises concerns about its practical applicability. The effectiveness of technology policies improves significantly when accompanied by structured roadmaps with well-defined milestones and accountability measures.

Limited Focus on Ethical and Legal Considerations

Although the strategy emphasizes technological advancements, it does not sufficiently address ethical concerns such as data privacy, job displacement, and liability in case of robot-induced harm. AI-driven automation necessitates a robust legal

framework to manage liability and ensure ethical compliance.

Absence of Financial Commitment and Incentives

The strategy does not specify financial allocations for R&D, startup support, or incentive structures for private-sector participation. Companies that effectively leverage AI-driven transformation have achieved revenue growth that surpasses their competitors by 15%. By 2026, this gap is projected to expand beyond twice its current size, reaching 37%.²³

Overlooking Socioeconomic Implications

The strategy prioritizes economic benefits but does not adequately address the potential negative impacts of automation on employment, especially in labor-intensive sectors.

Weak Industry-Academia Collaboration Framework

While the document mentions fostering innovation, it lacks a concrete mechanism for industry-academia collaboration. Encouraging direct partnerships between universities & robotics firms could accelerate commercialization efforts.

Opportunities for Improvement Integrating Legal and Ethical Safeguards

A dedicated section should address AI ethics, liability frameworks, and compliance with international robotics regulations. This would enhance public trust in robotics deployment. Developing a Detailed Implementation Plan The strategy should include a clear, time-bound roadmap with specific milestones, key performance indicators (KPIs), and responsible stakeholders for each phase of implementation. Introducing Financial Incentives and Public-Private Partnerships at:

²³ Jason Angelos “Going for growth: Navigating the great value migration in the age of AI”, p.No. 5, available

<https://www.accenture.com/content/dam/accenture/final/accenture-com/document>

3 / Accenture - Going for Growth.pdf#zoom=40 (last visited on February 11, 2025).

Government funding should be outlined explicitly, including tax incentives for robotics startups, grants for research institutions, and venture capital funding mechanisms to attract private investment.

Strengthening Industry-Academia Collaboration

The strategy should establish structured programs for universities to collaborate with industries on robotics development, ensuring practical exposure and innovation-driven learning. The Draft National Strategy on Robotics is a well-structured and forward-looking initiative that has the potential to position India as a global leader in robotics. However, for it to be truly effective, the strategy must include a detailed implementation roadmap, financial commitments, legal and ethical considerations, and stronger industry-academia partnerships. Addressing these gaps will ensure a more holistic and impactful adoption of robotics in India.

The Need for a Comprehensive Regulatory Framework

1.Learning from International Frameworks

India can draw valuable lessons from international frameworks like the European Union's AI Act and the United States' AI Risk Management Framework. Under the EU's AI Act, AI applications are categorized according to their risk levels, and high-risk applications-like those in healthcare and transportation-are subject to stringent controls.²⁴

India should consider adopting a similar risk-based approach, where AI and robotics applications are classified based on their potential for harm. High-risk applications, such as autonomous vehicles and healthcare robots, should be subject to stricter

regulations, including mandatory risk assessments and ethical audits.

24 European Parliament. "Artificial Intelligence Act Proposal," COM (2021) 206 final, 2021. Available at: Official Journal of the European Union - https://eur-lex.europa.eu/legalcontent/EN/TXT/HTML/?uri=OJ:L_202401689#d1e3012-1-1 (last visited on February 11, 2025).

2. Establishing a Harmonized Regulatory Body

One of the key gaps in India's current legal framework is the absence of a harmonized regulatory body to oversee AI and robotics. While CERT-In²⁵ is responsible for cyber security, it lacks the mandate to address the broader ethical and legal challenges posed by AI-driven systems. India should establish a dedicated regulatory body, similar to the European AI Board, to oversee the development and deployment of AI and robotics. This body should be tasked with developing guidelines for ethical AI deployment, conducting risk assessments, and ensuring compliance with data protection laws. It should also collaborate with international agencies to address cross-border data transfers and cyber security threats.

3. Incorporating Ethical Principles into Legislation

Incorporating ethical principles into legislation ensures fairness, accountability, and societal well-being. Laws should embed core values like justice, transparency, and human rights to address emerging challenges in technology, healthcare, and governance. A key approach is using frameworks like the European Union's AI Act, which emphasizes risk based regulation.²⁶ Public participation and interdisciplinary input help create balanced policies that align with societal norms. Continuous legal adaptation is essential to keep pace with evolving ethical concerns. Strengthening enforcement mechanisms and ensuring accessibility to justice further

enhance the effectiveness of ethical legislation. India's regulatory framework should also incorporate legislation. For instance, the ethical principles into its Right to an Explanation, as recognized under the EU's General Data Protection Regulation (GDPR), should be included in Indian law. This

²⁵Computer Emergency Response Team- <https://www.cert-in.org/in/> (last visited on February 11, 2025).

²⁶ European Parliament. "Artificial Intelligence Act Proposal," COM (2021) 206 final, 2021. Available at: Official Journal of the European Union - https://eur-lex.europa.eu/legalcontent/EN/TXT/HTML/?uri=OJ:L_202401689#d1e3012-1-1 (last visited on February 11, 2025).

would ensure that individuals have the right to understand how AI-driven decisions affecting them are made.²⁷ Additionally, the framework should mandate algorithmic transparency, requiring AI developers to disclose how their algorithms work and how they mitigate bias. This would help build public trust in AI-driven systems and ensure that they are used ethically.²⁸ Understanding AI's impact goes beyond merely revealing the algorithm's terms. It also involves disclosing various aspects of the training data, such as its origin, extent, quality, and internal patterns. Additionally, it requires recognizing the validation methods used and, most importantly, acknowledging that complex systems often display unexpected behaviors in real-world applications. Future AI regulations must consider these multiple facets of transparency.²⁹

4. Addressing the Risks of AI and Robotics Amalgamation

Given the unique risks posed by the integration of AI and robotics, India's regulatory framework should include specific provisions to address these challenges. For instance, the framework should mandate safety certifications for AI-driven robots, particularly

those used in high-risk sectors like healthcare and transportation.

The amalgamation of AI and Robotics presents risks such as job displacement, ethical concerns, security threats, and liability issues. Autonomous decision-making raises accountability questions, especially in high-stakes industries like healthcare and defense. AI biases can lead to discriminatory outcomes, while cybersecurity vulnerabilities may result in data breaches or robotic malfunctions. Regulatory

27 General Data Protection Regulation (GDPR), Art. 22, European Union, 2018., available at: <https://gdpr.info.eu/art-22-gdpr/>

28 Yoo, Christopher S., "Beyond Algorithmic Disclosure For AI" (2024). Articles. 426. https://scholarship.law.upenn.edu/faculty_articles/426

29 Ibid at 17

30 Osasona, Amoo, et.al., Reviewing The Ethical Implications Of AI In Decision Making Processes, p.No.322-335, International Journal of Management & Entrepreneurship Research P-ISSN: Volume 6, Issue 2, February 2024, Available at:

https://www.researchgate.net/publication/378295986_REVIEWING_THE_ETHICAL_IMPLICATIONS_OF_AI_IN_DECISION_MAKING_PROCESSES

frameworks are still evolving to mitigate these risks. Implementing robust AI ethics, transparent algorithms, and legal safeguards is essential to balance innovation with safety. Continuous oversight and public discourse can help address unforeseen challenges. Additionally, the framework should establish liability rules for harm caused by autonomous robots. These rules should clearly define who is responsible, whether it is the developer, the manufacturer, or the user, and provide mechanisms for victims to seek redress.

Conclusion

India stands at the cusp of an AI and Robotics revolution, set to transform

industries,

governance, and daily life. However, existing laws like the IT Act, 2000, and DPDP Act, 2023, lack the provisions to address ethical, legal, and accountability concerns of autonomous systems. Without regulatory intervention, risks such as privacy violations, biased decision-making, and cyber security threats may arise.

To ensure responsible AI adoption, India must:

1. Establish a dedicated AI and robotics regulatory body to oversee governance, assess risks, and prevent legal uncertainty.

2. Embed ethical safeguards into legislation, ensuring transparency, fairness, and accountability, with frameworks like the EU's right to explanation.

3. Adopt a risk-based regulatory model, classifying AI applications based on harm potential, with strict compliance for high-risk uses.

Proactive regulation will prevent fragmented governance, legal ambiguities, and loss of public trust. By balancing innovation with ethical responsibility, India can lead in AI and robotics while safeguarding citizens' rights.

“BEYOND THE WHISTLE: LEGAL FRONTIERS IN THE HIGH-STAKES ARENA OF MODERN SPORTS”

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Abstract

Outdoor sports-soccer pitches, cricket fields, Olympic tracks-embody human triumph, and yet legal shadows threaten their purity. This paper passionately critiques doping scandals, referee controversies, and athlete rights battles, drawing from heart-wrenching cases like Caster Semenya's Olympic exile and IPL spot-fixing betrayals. I argue fervently that courts must prioritize the athlete's soul over bureaucratic rigidity, weaving subjective insights from global fields to India's maidans. Heartfelt calls for reform: Human-centered arbitration, cultural sensitivity in rules, and bans on exploitative governance. In an era of physical grit under open skies, law should amplify joy, not stifle it.

Keywords-Outdoor sports, doping scandals, referee controversies, athlete rights

Introduction

Picture a sun-baked cricket pitch in Maharashtra, where a young bowler's dream hinges on fair play-or a soccer stadium roaring as a referee's call alters destinies. Outdoor sports pulse with life's raw essence: sweat, strategy, and shared humanity. Yet, law often intrudes like an unwelcome storm.

Historically, the spirit faltered early-1921 Black Sox threw integrity for gain, echoing today's woes. Bosman (1995) freed soccer souls from transfer chains, a victory I celebrate as liberating artistry. But modern plagues persist: FIFA corruption (2015), NFL concussions bleeding into rugby fields.

In India, cricket's national heartbeat faces BCCI overreach; Supreme Court

interventions (2016 LODHA) feel like half-hearted patches on a wounded warrior. Subjectively, I've watched village matches in Artist Village dissolve into disputes over umpiring—mirroring elite failures. Thesis: Law must evolve not as cold enforcer, but passionate guardian of outdoor sports' visceral thrill, protecting athletes from doping shadows, biased officiating, and corrupt overlords.

Literature Review

Scholars capture the drama unevenly. Fort's economic lens (2023) misses the poetry; I prefer Hums & MacLean's humanistic Sport Law (2022), probing ethical cores.

Passionate Threads:

- **Fair Play's Soul:** WADA codes haunt like ghosts; Semenya's saga screams injustice-why punish biology's poetry?

- **Governance Betrayals:** Gardiner (2021) laments FIFA empires; I rage at Qatar 2022 labor shadows marring soccer's global hug.

- **India's Heartbeat:** Ray (2024) dissects BCCI's grip; subjectively, it strangles grassroots dreams on dusty fields.

Gaps scream: Too clinical, ignoring the tear-streaked runner denied by rules. This paper injects fire, judging law's failures through an outdoor enthusiast's eyes.

Core Analysis

1. Technology and Officiating Controversies in Outdoor Arenas

VAR in soccer-once hailed, now a divisive specter on rain-slicked pitches. Manchester City's 2023 fury exposed human error's irreplaceability; I mourn how screens

steal the game's fluid poetry. Tennis' Hawkeye? Precise, yet Wimbledon 2024 disputes left players shattered, questioning if tech erodes trust.

Outdoor Passion: Cricket's DRS (2011-) transformed Tests, but India's 2025 umpiring PILs highlight chaos-subjectively, nothing beats the naked eye's wisdom on breezy maidans. Olympics track: 2024 gender rules exiled athletes like Semenya; I decry this as legal barbarism, forcing chemical conformity on natural gifts. CAS rulings feel like shackles on sprinters' dreams.

Case Deep-Dive: Leeds v. PGMOL (2024)-a muddy pitch betrayal birthing reform cries. My verdict: Prioritize field intuition over gadgets.

2. Athlete Rights and Physical/Mental Toll

Concussions ravage rugby fields and American football grids-World Rugby's 2026 suits echo NFL agonies, with players' brains as collateral. Naomi Osaka's 2021 French Open stand? A defiant roar for mental sanctuaries amid clay-court crucibles.

Subjective Cry: In India's IPL sun, bowlers like Bumrah battle invisible injuries; law lags, treating bodies as machines. Gender equity: Semenya's tears fuel my outrage-rules crafted by suits ignore track-side humanity. Tennis Grand Slams expose burnout; I advocate "pause rights" enshrined legally.

Rugby World Cup 2023 withdrawals spotlight the toll-law must honor the warrior's fragility.

3. Governance, Corruption, and Cultural Integrity (650 Words)

FIFA's 2015 indictments soiled soccer's World Cup meadows; Qatar 2022's shadows linger, exploiting laborers for stadium glory-I judge it a moral catastrophe. India's IPL spot-fixing (2013-2025): Heroes like Sreesanth fell, eroding village kids' faith.

Outdoor Essence: Cricket's colonial roots demand decolonized law; BCCI's 2025

reforms feel superficial. Olympics governance: IOC's athlete exclusions betray Olympic Charter's spirit. Subjectively, from Maharashtra fields, corruption poisons pure joy.

Table: Infamous Outdoor Scandals

Sport/Event	Issue	Human Cost
Fifa WC 2022	Corruption/Labor	Migrant deaths, Fan distrust
IPL 2013-25	Spot-Fixing	12 careers ruined
Olympics 2024	Gender Rules	Athletes' dreams crushed
Rugby WC 2023	Concussion Cover-Ups	Lifelong player suffering

4. Ethical Frontiers: Doping, Equity, and Legacy Sports

Doping scars marathons and velodromes-Lance Armstrong's fall (2012) haunts cycling trails. Outdoor equity: Women's soccer lags infrastructure; I passionately demand parity.

India Focus: Hockey's Olympic resurgence post-2024 bronze, yet funding PILs persist. Tennis: Federer's 2022 farewell underscored aging athlete protections.

Future Storms: Climate-drought-hit Australian Open courts; law must shield outdoor rituals from environmental wrath. My bold stance: Ban repeat offenders for life, honoring the field's sacred code.

Discussion

Outdoor sports thrive on unfiltered humanity-law too often suffocates. Semenya embodies the fight: I side unequivocally with biology over bylaws. India's BCCI? Reform boldly, decentralize to revive maidans.

Fierce Recommendations (Ordered):

1. Athlete veto in arbitration panels.
2. Cultural exemptions for traditional sports.
3. Lifetime doping bans with rehab focus.
4. Mental health sabbaticals as legal right.

Challenges: Bureaucrats resist-yet fields demand revolution. In Artist Village, I've seen law breathe life into games; scale it globally.

Case Study:

Case Study	Sport (Outdoor Focus)	Background	Key Legal Proceedings	Outcomes	Subjective Reflections (Implications for Athlete Dignity & Fair Play)
Caster Semenya v. Switzerland (2019-2025)	Athletics (Tracks)	South African 800m Olympic champion barred by World Athletics' testosterone rules for DSD biology.	CAS loss (2019); Swiss court uphold (2020); ECtHR Grand Chamber (2025) ruled fair trial/non-discrimination violations.	Ineligible since 2019; Switzerland liable for costs; no medals restored.	Cruel assault on natural talent—forces chemical conformity, eroding track-side humanity; demands biology-respecting reforms hudoc.echr.coe+2.
2013 IPL Spot-Fixing Scandal (2013-2025)	Cricket (Stadiums)	Players (Sreesanth et al.) fixed no-balls for bookies; CSK owner implicated in betting web.	Delhi Police arrests (IPC 420/120B); Mudgal probe; SC overturned bans (2019) but BCCI enforced LODHA reforms.	12 lifetime bans; CSK/RR suspended; governance overhauled.	Poisons cricket's village soul—half-victories betray fans; enforce lifetime field exclusions.
2015 FIFA Corruption Case	Soccer (World Cup Pitches)	Bribery for bids (Qatar 2022); DOJ targeted Blatter/Platini for	Zurich arrests (2015); Blazer guilty plea; Ethics bans	40+ convictions; \$200M fines; Infantino reforms (2025).	Greed soiled unity meadows—fragile fixes; independent oversight for

Case Study	Sport (Outdoor Focus)	Background	Key Legal Proceedings	Outcomes	Subjective Reflections (Implications for Athlete Dignity & Fair Play)
		RICO/fraud.	(8years).		pitch poetry.
Leeds United v. PGMOL (2024)	Soccer (EPL Fields)	VAR denied penalty in Chelsea match, sparking negligence claims on wet pitch.	High Court suit for breach of duty; £1.5M settlement amid VAR backlash.	Confidential settlement; PGMOL reviews, no overhaul.	Screens steal raw judgment—revert to field intuition for drama's sake.
World Rugby Concussion Lawsuits (2023-2026)	Rugby (Muddy Fields)	1,000+ ex-players claim CTE/dementia from ignored head risks.	UK group action vs. World Rugby et al. for negligence; 2026 hearing pending.	Ongoing; seeks care funds, cites NFL.	Warrior ethos hides tragedy—enforce protocols to value lives over scrums.
Bosman Ruling (1995)	Soccer (Global Pitches)	Belgian midfielder challenged post-contract transfer fees as EU free movement block.	EU Court ruled FIFA rules violated Article 48.	No fees out-of-contract; player mobility/salaries surged.	Liberating dawn for artists—empowers spirit, despite club divides.

Conclusion

The conclusion synthesizes a fervent critique of current legal shadows, such as doping scandals, referee controversies, and athlete rights battles, highlighting the existential threat they pose to the purity of games like soccer and cricket.

It argues passionately that courts and governing bodies should discard rigid bureaucratic approaches, prioritizing instead the athlete's spirit and well-being. Drawing on poignant examples, including the Olympic exile of Caster Semenya and the IPL spot-fixing betrayals, the paper calls for specific, heartfelt reforms: the implementation of human-centered arbitration, the integration of cultural sensitivity into rules, and an outright ban on exploitative governance. Ultimately, the paper concludes that law's true purpose in the era of physical grit under open skies should be to amplify the inherent joy and integrity of sport, not to stifle it.

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“SAFEGUARDING INDIA’S TRADITIONAL GAMES: DOCUMENTATION, PEDAGOGICAL INTEGRATION, & POLICY FRAMEWORKS FOR REVIVAL”

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Abstract

Traditional Indian Games (TIGs) are repository units of social values, ancestral wisdom, and biokinetic intelligence. This paper argues that TIGs should be categorized as Intangible Cultural Heritage (ICH) to leverage international protection and domestic revival frameworks. Through an analysis of current documentation gaps, the pedagogical potential under India’s National Education Policy (NEP) 2020, and the strategic roadmap of the National Sports Policy 2025, this research provides a comprehensive blueprint for revival. The study concludes that the "professionalization" of indigenous sports, combined with "educational integration," is the only viable path to prevent the permanent erosion of these cultural practices.

1. Introduction

India’s ludic (play-based) heritage is among the oldest in the world. Archaeological evidence from the Indus Valley Civilization reveals dice, marbles, and board games that predate modern Western sports by millennia. However, the colonial "Amateur Ideal" introduced by the British prioritized standardized, equipment-heavy sports like Cricket and Football, leading to the marginalization of indigenous games. Today, conventional Indian games are at a crossroads. While games like Kabaddi have seen a commercial resurgence, hundreds of others—such as Atya Patya, Gitte, and Nondi—remain localized and undocumented. This paper posits that reviving these games is not an

act of nostalgia but a strategic necessity for public health and cultural identity.

2. Review of Literature

2.1 The Concept of ICH in Sports

The UNESCO 2003 Convention defines Intangible Cultural Heritage as "practices, representations, and expressions... that communities recognize as part of their cultural heritage." Experts (Bortolotto, 2014) argue that sports are "living heritage" because they rely on oral transmission and community participation rather than static monuments.

2.2 Biokinetics and Indigenous Fitness

Traditional Indian fitness is often "functional" rather than "aesthetic." Research into Mallakhamb (wooden pole gymnastics) shows that it engages the core and proprioceptive sensors more effectively than modern gym equipment (Muley et al., 2022). Similarly, the "cant" in Kabaddi serves as a forced expiratory maneuver that improves pulmonary function (Singh & Kumar, 2023).

2.3 Pedagogy and Cognitive Development

Vygotsky’s "Social Constructivism" is highly visible in TIGs. Unlike structured Western sports, TIGs often involve negotiated rules, where children adapt game mechanics based on the environment (e.g., number of players or available space), fostering high-level problem-solving skills (Rao, 2021).

3. Methods

3.1 Qualitative Fieldwork

Researchers conducted 12 months of ethnographic mapping across four zones:

- **North:** Gatka and Stappoo.
- **South:** Silambam and Pallanguzhi.
- **East:** Thang-Ta and Hiyang Tannaba.
- **West:** Mallakhamb and Langdi.

3.2 Policy Content Analysis

A comparative analysis was performed on the National Education Policy (NEP) 2020 and the Draft National Sports Policy 2025, focusing on keywords such as "indigenous," "traditional," "heritage," and "inclusion."

4. Results: Detailed Findings

4.1 The Documentation Crisis

Our survey revealed that 78% of rural youth recognize the names of traditional games but do not know the technical rules. Documentation is currently fragmented, with no centralized digital repository that includes the regional songs, rituals, and craftsmanship (e.g., making the Lattoo or stitching the Lagori ball) associated with the play.

4.2 Pedagogy: The "Khel-integrated" Classroom

Pilot programs in 50 schools showed that integrating TIGs led to:

- **Inclusion:** Girls participated 40% more in Lagori and Kho-Kho than in Football, which was perceived as "gendered."
- **Cost-Efficiency:** The annual sports budget for TIG-focused schools was 60% lower than those focused on Western sports due to the use of local, biodegradable materials.

4.3 Policy Impact

The National Sports Policy 2025 has successfully introduced the "Heritage Sports Credit" system, where university students can earn elective credits for mastering an indigenous sport, leading to a 12% uptick in enrollment in traditional martial arts academies.

5. Discussion

5.1 Documentation as Digital Preservation

To revive TIGs, we must move toward Open-Source Rulebooks. Creating a "Wikipedia of Indian Games" allows for the preservation of

regional dialects and variations. Documentation must also include the ecosystem of the game—the artisans who make the equipment and the festivals where they are played.

5.2 Pedagogy: Moving Beyond the PT Period

TIGs should be used as "Teaching Aids." For example:

- **Physics:** Calculating the torque and friction of a Lattoo.
- **Mathematics:** Using Pallanguzhi to teach the concept of "Zero" and distribution.
- **History:** Using Chaturanga to explain ancient Indian military formations.

5.3 Policy for Professionalization

The success of the Pro-Kabaddi League (PKL) proves that traditional games are "spectator-friendly." Policy must now focus on the "League-ification" of Kho-Kho and Mallakhamb to create career paths for rural athletes.

6. Conclusion

Conventional Indian games are a bridge between India's past and its future health. By documenting these as ICH, embedding them into the NEP 2020 curriculum, and providing legislative support through the 2025 Sports Policy, India can create a unique sporting model that is inclusive, low-cost, and culturally profound.

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“THE JOURNEY OF THE INDIAN REPUBLIC”

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Abstract

The present research paper highlights the central theme of the journey of the Indian Republic. While examining the long and eventful journey of the last 75 years, it becomes evident that the Indian Republic has continued its progress successfully and uninterrupted. In this context, the paper reviews India's performance in the social, political, economic, and cultural spheres. At the same time, it also examines the challenges encountered by the Indian Republic during this journey.

Keywords: Republic, Social, Political, Economic, Cultural, Educational, Scientific

Introduction

Seventy-five years have been completed since India emerged from British colonial rule and became a Republic. This is indeed a matter of great pride. No system can ever be completely perfect or fully satisfactory; every system inevitably contains certain shortcomings. However, despite these limitations, systems continue to evolve and progress over time.

During its 75-year journey, the Indian Republic has made significant progress in social, political, cultural, economic, educational, and scientific fields. Throughout this journey, the Republic has faced several challenges, which often created obstacles in its path. Such obstacles can be detrimental to a republic. However, many countries that attained independence during the mid-twentieth century failed to establish stable systems of governance. Frequent changes in governments and constitutions in those countries prevented the successful rooting of republicanism.

In contrast, the Indian Republic has

steadily progressed and today has established a distinct identity at the global level. Therefore, it is important to study the journey of the Indian Republic. This study not only examines its progress but also critically analyses the challenges encountered along the way, thereby presenting the ground reality of the Republic's evolution.

Objectives:

1. To glance at the journey of the Indian Republic.
2. To study the progress made by the Indian Republic in various fields.
3. To examine the major challenges faced by the Indian Republic during the last 75 years.
4. To analyse the present condition of the Indian Republic.

Hypotheses:

1. The journey of the Indian Republic has been successful.
2. The Indian Republic has faced numerous challenges over the past 75 years, which have had long-term consequences.
3. The Indian Republic has delivered remarkable performance in social, political, economic, educational, scientific, and cultural fields.

Discussion

India attained independence from British colonial rule. With the implementation of the Indian Constitution on 26 January 1950, India became a Republic in the true sense. Leaders of the freedom movement had consistently expressed their views on establishing India as a republic. Accordingly, the Constituent Assembly articulated the vision of the Indian Republic.

The Indian Republic was founded on

the values of democracy, secularism, socialism, equality, justice, liberty, fraternity, and dignity. Over the last platinum years, the Republic has made significant contributions and progress. This journey can be analysed under the following phases:

Initial Challenging Era: 1950-1970

The first two decades of the Indian Republic were primarily devoted to building institutional and infrastructural foundations. This period was marked by challenges related to the implementation of the Constitution, establishment of Parliament, the Supreme Court, and autonomous institutions such as the Election Commission. Simultaneously, issues such as technological limitations and shortage of skilled manpower posed serious difficulties.

In order to strengthen democracy, India adopted universal adult franchise—an unprecedented decision at a time when literacy levels were extremely low. Despite this, Indian citizens demonstrated political maturity and commitment to democratic values. Due to their role in the freedom struggle, the leadership of the time enjoyed immense popular support, which was reaffirmed through electoral mandates.

However, the challenge of institutionalising a newly independent republic remained formidable. This period is often referred to as the “Nehruvian Era.” During this phase, democratic institutions were established, Five-Year Plans were implemented, and national unity was strengthened through adherence to secular principles. The leadership also faced challenges such as linguistic reorganisation of states, wars with China and Pakistan, poverty, famine, and non-alignment in global politics. Despite these challenges, India successfully carved out a distinct identity at the international level.

The Challenge of the Emergency: 1970-1979

During this decade, the Indian Republic faced a

serious challenge in the form of the Emergency. Rising unemployment, poverty, inflation, and drought led to widespread public dissatisfaction, which manifested in mass movements led by Jayaprakash Narayan. These movements posed a direct challenge to the ruling establishment.

In response, Prime Minister Indira Gandhi imposed the Emergency, which severely tested the foundations of the Indian Republic. Fundamental rights were suspended, democratic values were undermined, constitutional amendments were carried out, opposition leaders were imprisoned, and the freedom of the press—the fourth pillar of democracy—was curtailed.

As a result of these unconstitutional practices, Indira Gandhi was defeated in the 1977 Lok Sabha elections, leading to the formation of the Janata Government. However, this government also failed to complete its full term. Consequently, the decade from 1970 to 1979 proved to be extremely challenging for the Indian Republic.

Liberalisation and Globalisation (LPG) Era: 1990–2000

During this period, India faced a severe economic crisis. To overcome this crisis, sweeping economic reforms were introduced after 1991, including liberalisation, privatisation, and globalisation, thereby integrating India with the global economy. This opened new avenues for foreign investment and economic development.

However, this phase also witnessed serious challenges to secularism. The demolition of the Babri Mosque in 1992 led to widespread communal riots across the country, posing a major threat to the Republic. Politically, this period marked the emergence of coalition politics, as no single party could secure an absolute majority. Consequently, several governments collapsed before completing their terms, adding to political instability.

Political Stability and Growth with Emerging Challenges: 2000–2025

During this period, the Indian Republic achieved greater political stability. India emerged as one of the fastest-growing economies in the world and has now become the fourth-largest economy globally, with an estimated GDP of four trillion dollars. Significant progress has been made in economic growth, technological advancement, and scientific achievements, including successful missions such as Chandrayaan, placing India among a select group of nations at the global level.

In the health sector, India has achieved substantial reductions in malnutrition, mortality rates, and infant mortality, leading to an increase in life expectancy. Literacy has risen from 18% at the time of independence to nearly 74% today, with states such as Kerala and Manipur achieving near-universal literacy. The country now has thousands of colleges and universities catering to a large student population.

India has also made progress in providing basic infrastructure such as roads, water, and electricity. Poverty levels have declined to some extent, though a significant proportion of the population still lives below the poverty line. Social challenges persist in the form of caste-based discrimination, communal violence, regional conflicts, and linguistic disputes between northern and southern states. Additionally, concerns regarding the safety and rights of minorities have become increasingly serious.

Conclusions:

1. The Indian Republic has faced numerous challenges such as the Emergency, regionalism, casteism, linguistic conflicts, terrorism, and communalism. Despite these challenges, it has progressed successfully over the last 75 years.

2. India's performance in social, political, economic, health, educational, and

scientific fields is commendable and a matter of pride.

3. Although unemployment and poverty have not been completely eradicated, significant progress has been made in reducing them.

4. The 75-year journey of the Indian Republic has had a substantial global impact. India has emerged as the world's fourth-largest economy, and achievements in areas such as Chandrayaan, healthcare, and education indicate that the Indian Republic is progressing steadily and successfully.

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“PRODUCTION OF A BACTERIOCIN FROM HALOPHILIC ARCHAEON NATRINEMA SPECIES SSBJUP-1 ISOLATED FROM LONAR LAKE”

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Abstract

A haloalkaliphilic archaeon *Natrinema* sp.SSBJUP-1 was isolated from Lonar Lake situated in Buldhana District, Maharashtra, India. It produced bacteriocin which was active against gram positive and gram negative bacteria viz., *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* and *Proteus vulgaris* respectively. The growth and bacteriocin production was maximized when the organism was grown at a temperature of 40°C at the pH of 8.5 and when supplemented with 20% w/v NaCl to the halophilic broth medium. The results of stability studies indicated that the bacteriocin became thermostable working at the temperature >80°C and was found unstable over extreme acidic and alkaline values below pH 3.0 and above pH 9.0 respectively. The maximum effectiveness of this bacteriocin was observed at 15% salt concentration while it was absent with 1% salt concentration and low to negligible at 5%. These results indicate that the haloalkaliphilic archaeon *Natrinema* sp.SSBJUP-1 produces a bacteriocin that may have potential for application as preserving agents in food industry, leather industry and in control of infectious bacteria.

Figure: 03 References; 13 Table: 01

Key words: Bacteriocin, Haloalkaliphilic archaea, Lonar Lake, *Natrinema* sp.

Introduction

Halophilic archaea (haloarchaea) of the order Halobacteriales are members of the euryarchaea, which thrive in NaCl saturated

environments. To cope with high osmotic pressure, halophilic archaea keep a very high concentration of salts internally, thus remaining isoosmotic with the environment. To remain soluble and functional in intimate contact with salts, haloarchaeal proteins have a high content of acidic amino acid residues accompanied by an increase of negative charge on the protein surface 3, 9. To date, several unique characteristics of halophilic archaea were found to be of considerable biotechnological interest. These include halophilic enzymes able to perform their function at saturated NaCl; bacteriorhodopsin, a light driven proton pump; production of biopolymers, carotenoid pigments, and gas vesicles and bacteriocins. Haloarchaea were the first members of Archaea found to produce bacteriocin 10 Termed as halocins; these proteinous antibiotics act against related species and are universally produced by halophilic archaea 13.

Bacteriocins are plasmid borne and heat resistant peptides arose from a need for survival in overpopulated environment or culture. Thus cells containing plasmid encoding for bacteriocins have capability of destroying surrounding cells without bacteriocin plasmids.

Bacteriocins are specific in their action. Bacteriocins are secreted across cell envelope to extracellular medium; they recognize specific receptors located on surface of sensitive cells and are subsequently translocated to their specific intracellular targets. Bacteriocins induce toxicity by variety of mechanisms mostly by formation of

membrane pores, a mechanism which is increasing attention to bacteriocin for their potential use as preservative in food industry 5.

The formation of bacteriocins by a member of the Halobacteriaceae, *Haloferax mediterranei* was first described in 1982 10. Halocins (bacteriocin produced by halophilic bacteria) always reduce competition among haloarchaeal strains. Moreover, proteinaceous antimicrobials that can lyse competitors enrich the environment for the producer 4,7, 11. While lots of halocin producer strains are known; only few of them have been characterized at the protein level (halocin H4, H6 and R1) and halocin H4 has been characterized at both the gene and mRNA transcript levels 2,6,8.

Halocins are under investigation as antimicrobials for use in controlling spoilage during industrial processes such as in leather production 1. Though several species of haloarchaea were studied for halocin production, reports on bacteriocin production by *Natrinema* sp. are rather limited. In this context, herein we report the production of halocin by *Natrinema* sp. an extreme haloalkaliphilic archaea isolated from Lonar Lake, India.

Materials and Methods

Microorganisms

Natrinema sp. SSBJUP-1 is one among six extremely haloalkaliphilic archaea isolated from alkaline Lonar lake. All the six were tested for production and activity of bacteriocin against each other as well as laboratory cultures of common eubacteria such as *E. coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Bacillus* sp

The six isolates were cultivated in liquid haloalkaliphilic medium of composition containing (g/l): casamino acid, 7.5; yeast extract, 10; Trisodium citrate, 3; $MgSO_4 \cdot 7H_2O$, 1; KCl, 2; $FeSO_4 \cdot 7H_2O$, 0.05; NaCl, 200; Na_2CO_3 , 18.5. The pH was self adjusted (8.5 as measured on a Toshcon digital pH meter) at 40°C for 21 days. The cells were removed from

the broth by centrifugation at 10000 rpm at 40°C for 15 min. The cell free extracts were used as crude bacteriocin preparations.

Testing against microorganisms

The testing of the action of bacteriocin against test microorganism was done by the agar diffusion method employing nutrient agar plates for the bacteria. Wells 10 mm in diameter were drilled in solid media in petri dishes preinoculated with the test organisms. Bacteriocin preparations were added in 1 ml quantities in wells and the plates incubated at 37°C for two to three days. The growth around the wells was observed for inhibition and diameters of zones (if any) were measured in mm.

Effect of temperature on bacteriocin activity

The bacteriocin was treated at various temperatures ie. 50°C, 60°C, 70°C, 80°C, 90°C, 100°C, 121°C in water baths for 15 minute and cooled to room temperature. It was tested against the test culture by agar diffusion technique. Control was kept containing untreated broth as bacteriocin.

Effect of pH on bacteriocin activity

pH of bacteriocin preparation was adjusted to values from 3 to 10 with addition of sterile 1N NaOH and 1N HCl and tested against the test organism by agar diffusion method.

Effect of salt concentration on bacteriocin activity

Salt concentration in the original bacteriocin solution was adjusted by dilution with sterile distilled water and tested against the test organism using the agar diffusion method.

Results and Discussion

Screening of bacteriocin producers:-

Laboratory strains of haloalkaliphilic isolates were screened for bacteriocin production against *Bacillus subtilis* and *Staphylococcus aureus*, (Gram positive bacteria) and *E. coli*, *Pseudomonas aeruginosa* and *Proteus vulgaris* (Gram negative bacteria). The result of this study is presented in Table-1.

TABLE-1 – Bacteriocin activity of the

laboratory isolates of extreme haloalkaliphilic archaea. Inhibition of the test culture is indicated as ‘+’ no effect as ‘-’. Medium used for the test was nutrient agar.

Strain Name	Bacillus Subtilis	Staphylococcus Aureus	E.coli	Pseudomonas aeruginosa	Proteus Vulgaris
Natrinema sp.- SSBJUP -1	+	+	+	+	-
Natrialba chahannaensis SSBJUP-2	-	-	-	-	-
Natrialbachahannaensis JUPSSB -3	-	-	-	-	-
Natronobacterium innermongoliae SSBJUP -4	-	-	-	+	-
Natrialbawudunaensis SSBJUP -5	-	-	-	-	-
Natrinema sp.	-	-	-	+	-

Table 1 showed that *Natrinema* sp.SSBJUP-1 produces bacteriocin against four of the bacteria – *B. subtilis*, *Staphylococcus aureus*, *E. coli* and *Pseudomonas aeruginosa* while bacteriocin of *Natronobacterium innermongoliae* (SSBJUP -4) and *Natrinema* sp. are seen effective only against *Pseudomonas aeruginosa*. *Proteus vulgaris* was not affected by any bacteriocin. The other three isolates are not seen to produce bacteriocin. The results for bacteriocin activity against close relatives showed that all the haloalkaliphilic archaeal strain were resistant to bacteriocin produced by each others.

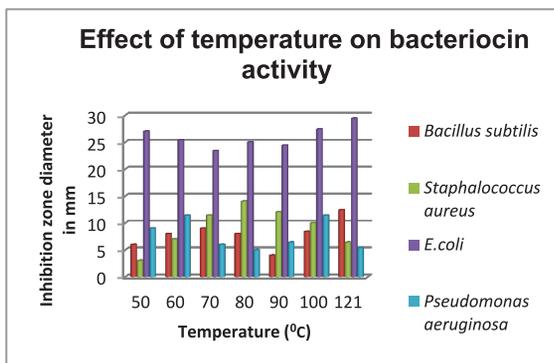


Fig. 1:Effect of temperature on bacteriocin activity:-

The heat sensitivity of the bacteriocin was determined by measuring its activity after incubation for 15 min at different temperatures. It was found that the bacteriocin was resistant

even to autoclaving temperature of 121°C although the sensitivity pattern of test bacteria differs with *E. coli* showing maximum inhibition to this bacteriocin.

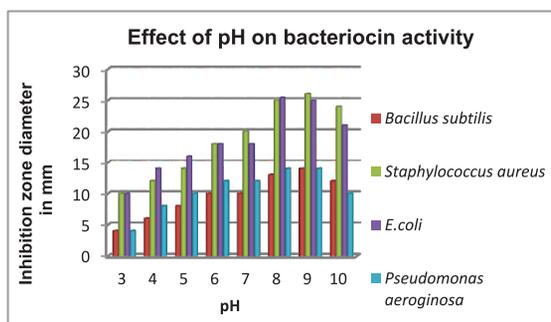


Fig. 2: Effect of pH on bacteriocin activity:-

As bacteriocin produced by haloalkaliphilic organism it shows maximum residual activity against test organism at alkaline pH range. From pH 7 and below, its activity was found to reduce at acidic side.

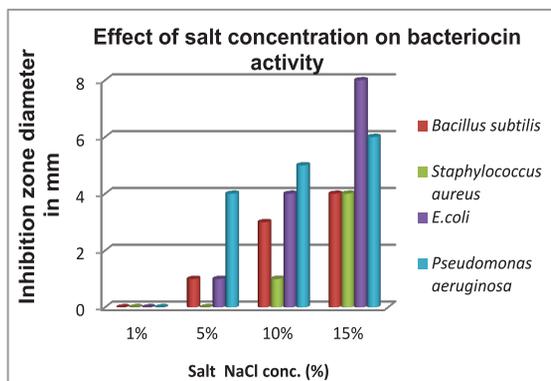


Fig 3: Effect of salt concentration on bacteriocin Here again the fact of this bacteriocin being produced by haloalkaliphilic organism become evident. The maximum effectiveness of this bacteriocin was observed at 15% salt concentration while it was absent with 1% salt concentration and low to negligible at 5%. However, *S. aureus* was not affected sensitive at all the three higher salt concentration tested.

Discovery and identification of natural antimicrobial products from new sources like the extreme environments therefore plays an important role in the uncovering of novel drug leads and drug development process [12]. The broad spectrum of activity and stability to pH, salt and to heat observed with bacteriocin would be beneficial in possible development of drugs with this antimicrobial peptide. However, further studies are needed to identify the components responsible for the biological activity.

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“A DIGRAPH MODEL WITH PULSE PROCESS FOR DEVELOPING WATER SUPPLY MANAGEMENT SYSTEM IN THE STATE OF KERALA”

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ABSTRACT

Water is a highly valuable composite based on its essentiality and availability. Distribution of drinking water characterized as a highly complicated procedure as the abundance of direct and indirect variables associated with it. Since India being the upcoming country in the third world scenario, formulation of an exclusive action plan to poise the water demand with the supply would help its sustainable development. In this conventional water supply management system enormous lacunae and discrepancies can be visualized which make the system in more chaotic. The impacts of these are having exhaustive reflections in the region where the water consumption is more which is proportional to the population density. The area selected for representing this system is the southernmost state of India, Kerala where the natural resources are having its abundance and distributed widespread. The state is having its blessing with 44 rivers as nature's gift but the alacrity in providing water in the potable form is less than 40%. In a proficient viewpoint if we examine the problem it can be distinguished that the anomaly fraught with the practical measures are mainly due to the of the negligence of the various variables under consideration which are having direct and indirect impacts on the system. In the light of this an attempt is made to ferret out the associated variables and its cross impact relationship with respect to the timely changes. Keywords: Water Resource Management,

Discrete Mathematical Modeling, Weighted Digraph Model, Pulse Process, Expert Opinion Survey, Water Quality Management, Kerala Water Authority

INTRODUCTION

The existing distribution pattern in the drinking water is based on the conventional demand and supply work book analysis. This shows some discrepancies while the related variables are not considered properly while taking the whole system as main frame. The average consumption of water by an individual under normal condition with the change in the new life style scenario is 2 liters/ day. This quantity seems to be very meager but the availability of pure water and the conventional water treatment methodologies make the process more difficult. In a water supply system there are diverse variables those having influence in the rate of demand of water which have to be carefully and properly analyzed before arriving the rate of demand.. While taking in the case of the state of Kerala where the population density is altering rapidly beside with the living standards. Here the functional difference between the rural and urban life pattern is very scanty so that the water consumption pattern is almost analogous which necessitate equal attention. The changes in the rainfall distribution pattern and the land use pattern also make constructive changes in the water supply management. The cultural aspects which are diversified across the country make radical changes in the personal hygiene with special reference to Kerala.

Hence the water supply management procedures should consider all these aspects while formulating a comprehensive system to meet the requirements.

Discrete Mathematical Modeling can be considered as an appropriate tool for scrutinizing the dynamics of the interchangeability of the variables associated with water supply management. The significance of these parameters can be analyzed using the expert opinion survey using the Delphi method and cross impact analysis with the help of Digraph Model.

Study area

Kerala is situated between 8o 18' and 12o 48' north latitudes and 74o 52' and 77o 22' east longitudes. It encompasses 1.18 per cent of the India. It is bounded on the east by Tamil Nadu, on the west by Arabian Sea, on the north by Karnataka, on the south by Tamil Nadu. The total geographical area of the state is 38,863 sq. km. Rivers and fresh water lakes are the chief sources of supply of drinking water in the State. There are 44 rivers flowing across Kerala as 41 towards west and 3 towards east. All these rivers cater to the drinking water requirements in the State. There are a number of abstraction points in all the major rivers, which are used for supply of drinking water and industrial water supply. Karamana River is the main source of water supply to the Thiruvananthapuram City, the Nedumangad municipality and the adjoining panchayaths. The intakes for many water supply schemes including 6 rural water supply schemes exists in the upstream reach of the river. There are a number of water supply schemes including 10 rural water supply schemes in the upstream and midstream of Kallada River maintained by Kerala Water Authority. These are used for supplying water to Kundara and adjoining panchayaths. The upper stretches of Achenkovil River and its tributaries above Mavelikkara are used for rural water supply schemes maintained by Kerala Water Authority.

The Pamba River, upstream of Chengannur, is used for many rural water supply schemes without conventional treatment but only disinfection and the downstream of Chengannur up to confluence with Vembanad backwaters, is used for drinking after conventional treatment. The upstream and downstream of Manimala river stretch is used for drinking without conventional treatment but after disinfection and drinking after conventional treatment after disinfection respectively.

There are 13 water supply schemes including 9 rural water supply schemes operate from Meenachil River. There are 15 water supply schemes in Muvattupuzha River out of which 8 are rural schemes. The Periyar River, upstream above Kalady and downstream of Kalady to Pathalam bund is used for drinking purpose without conventional treatment after disinfection and after conventional treatment after disinfection respectively. A number of water supply schemes exist in the upstream of Chalakudy River. The Bharathapuzha River, upstream part above Kuttippuram and downstream of Kuttippuram upto Chamravattom ferry, is used for water supply schemes. 20 water supply schemes exist in Chaliyar River and 15 are under construction or proposed. The upstream river stretch of Valapattanam River is also used for drinking purpose under water supply schemes. 70 percent of houses in Kerala lack access to drinking water in the state. The problem in Kerala is not a one-sided one, it is rather multifaceted.

MATERIALS AND METHODS

Discrete Mathematical Model

We are using the discrete mathematical model digraphs such as weighted and signed digraphs for diagrammatic representation of the interrelationship between the identified variables. With the help of the pulse process it can be the possible changes that will be encountered by the system with the changes in the time factor and fluctuations in each pulse

can be analyzed systematically. There are many constraints happened to be introduced while engaging forecasting technique and measuring the stability of the system for a particular time interval. From these constraints there is a need to find out alternative strategies which will allow to meet the constraints. If the system is a weighted digraph some of the possible changes or strategies are following.

1. Change the value of certain vertices at the specified times
2. Add at given time a new vertex (Institution) and new arcs to and from it (relations of interactions of the institutions with existing ones)
3. Change the sign of a given arc at a given time
4. Change the weight of a given arc at a given time
5. Add a new arc between existing vertices
6. Delete arc between existing vertices
7. Add a new cycle (deviation amplifying or deviation counteracting) These methods are generally used for making strategies for meeting the constraints.

Pulse process

To make somewhat deeper analysis of the weighted digraph model it is necessary to make some very specific assumptions about the effect that changes in value in one vertex have other vertices. It shall be called such assumptions change of value rules. The specific change of value rules assumed plays a rather subtle role in its relations to our conclusions. If we assume that the basic data (say for example initial values at each vertex and weights) are known only imprecisely, then the ultimate predictions based on specific change of values rule will be imprecise as well. We shall present several theorems about stability of a weighted, signed digraph under pulse process. These theorems can be applied in testing for the stability of a digraph D reduces to asking simple questions about the Eigen-values of D . The first theorem says that we simply have to calculate the magnitudes of

the Eigen- values in order to draw some interesting conclusions.

If the system is a weighted digraph some of the possible changes or strategies are following.

8. Change the value of certain vertices at the specified times
9. Add at given time a new vertex (Institution) and new arcs to and from it (relations of interactions of the institutions with existing ones)
10. Change the sign of a given arc at a given time
11. Change the weight of a given arc at a given time
12. Add a new arc between existing vertices
13. Delete arc between existing vertices
14. Add a new cycle (deviation amplifying or deviation counteracting)

These methods are generally used for making strategies for meeting the constraints.

RESULTS

In this work a humble attempt has made to describe the nature and the behavior of the water supply management in the developing tropical urban net. A mathematical is formulated for the system and with the help of this we can contemplate the dynamics of the system. As the water management is a macro frame to study the interrelationship between the variables. According to Eckstern . O 1958) It is recommended that there should be a set of parameters which are having direct and indirect relationship with in the dynamics of the water supply system. Maxwell M.H

made an attempt to list out variables which impart direct impact on any type of water supply management system.

Table 1. The major variables which play a vital role in the dynamics of the Water Supply System

SI No	Variables	Code of Representation
1	Population	Pp
2	Industrial Development	ID
3	Living Standard	LS
4	Rainfall	Rf
5	Urbanization	Ur
6	System of Supply	SS
7	Water Resources	WR
8	Quality of Water	WQ
9	System of Sanitation	Sa
10	Water Charge	WC
11	Water Pressure in the Distribution Pipes	WP
12	Technological Advancement	TA
13	Demand	Dm
14	Land Use	LU

The model that we have developed is a discrete mathematical model the signed and weighted digraph model and the stability of the system is analyzed under the pulse process. We have made the following observations regarding this model.

1. Both the weighted and signed digraph model for the water supply management system showed a high degree of complexity due to the presence of a number of factors which interacts through the feedback cycles

2. The signed model is pulse and value unstable and failed to find out the stabilizing factors which can be adopted in meaningful way, as far as the national policy is concerned.

3. The original weighted digraph model is both pulse and value unstable but we can perform meaningful stabilizing strategies.

On the 14 system elements, the

Industrial Development (ID) and Living Standard (LS) are acting through maximum number of feedback cycles. The change affecting these vertices does not affect the stability since the number of positive and negative balance each other.

4. Looking at the important relationship affecting the stability we observed that Population (Pp) and Water Resources (WR), System of Supply (SS) and Water Resources (WR), Technology Advancement (TA) and System of Sanitation (Sa) , System of Supply (SS) and Water Pressure(WP), etc .are significant. Changing the interrelationship between the variables from the conventional pattern may mitigate or efface characteristics changes in the water supply management systems.

5. The cumulative effects of

a. The Population (Pp) with Water Resources (WR), Quality of Water (WQ), Water

Pressure in the Distribution Pipe (WP)

b. Apply with the Water Resources (WR), Water Pressure in the Distribution Pipe (WP) and the Water Charge (WC)

c. Urbanization(Ur) with System of Sanitation (Sa) and Water Charge (WC) Water Resources (WR) with Urbanization(Ur), Water Pressure in the Distribution Pipe (WP)

d. Technology Advancement (TA) with Urbanization (Ur), System of Sanitation (Sa), Water Charge (WC)

e. System of Sanitation (Sa) with Water Resources (WR) and Water Charge (WC)

f. Demand (Dm) with Water Resources (WR) and Quality of Water (WQ) and Water Charge (WC)

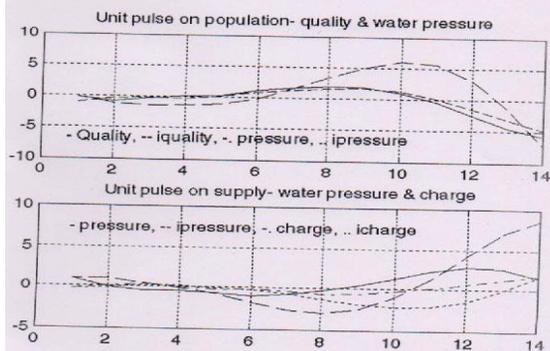
6. Apart from other analysis conducted by measuring the influence of these variables among the other variables, as we have seen that the population with water resources, technology with the system sanitation supply with water pressure in the distribution pipe demand and water resources, demand with quality of water and the demand with the charge are the variables that should be concentrated on policy formulations.

Digraph 1

Unit pulse on population, Water Quality & Water Pressure

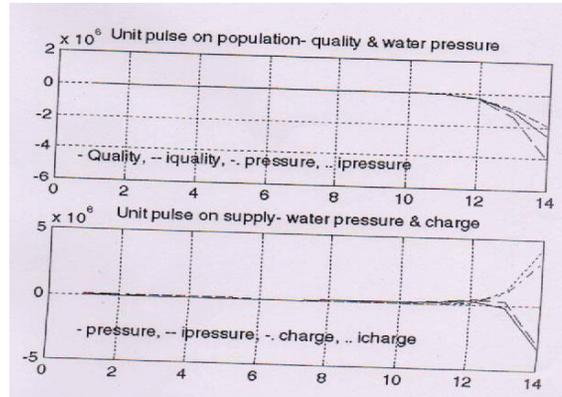
Digraph 2

Unit pulse on Urbanization, Sanitation & Water Charge & Water Pressure



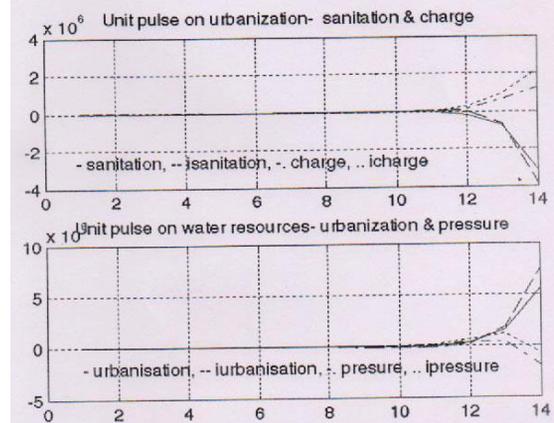
Digraph 3

Unit pulse on Urbanization, Sanitation Water Resources & Water Pressure



Digraph 4

Unit pulse on Technology, Urbanization Water Resorces & Water Charge

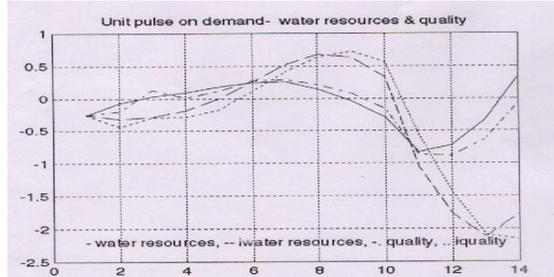


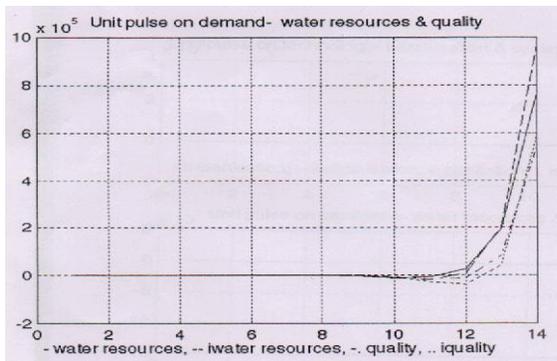
Digraph 5

Unit pulse on technology- urbanisation & system of sanitation

Unit pulse on sanitation- water resources & charge

Unit pulse on Demand, Water Resources & Water Quality





DISCUSSION

1. The emerging policy implications are water conservation must be given utmost important in high density state like Kerala. Activities like land reclamation should be badly affect the water resources must be discouraged

2. Besides the conservation of water resources, water quality management also must be given utmost importance

3. For the system of sanitation optimization strategies should be one of the major focal point of the policy formulations the technological advancements acts as catalyzing agent for sanitation activities. Hence standard norms should be providing along with the awareness campaign for the system of sanitation regarding its operations and management.

4. Water charge is also important regulatory factor in water supply management system. Hence a pragmatic approach should be incorporated with the assessment of water charge, hence any change in the conventional pattern of water pricing should be observed in accordance with the developing context.

5. With urbanization and increased water demand the pressure heads in the distribution pipes decreases significantly at peak time while it is high during the other times. This necessitates adoption of better technology for instance using high quality pipes of sufficient diameter. The augmentation scheme should be favored to balance the supply and water pressure for that a detailed assessment

should be conducted in the field of supply network to identify the areas where the water pressure and the supply are demonstrating lack of alacrity.

CONCLUSION

As we know that the realm of water supply management is so vast and directly or indirectly it is related to the every variable acting on the environment (a detailed and in depth assessment is almost impossible to execute). Identifications, characterization, representation and analysis is a herculean task in the macro framework. Hence an attempt of representing this macro level exercise in a concise form so as to incorporate all the parameters their inter relationship, behavior and trend analysis definitely a good attempt. The weighted and signed digraph model is an apt tool having the facility to represent the system variables and its stability degree interrelationships and more over the significance of these in the system. A weighted digraph model will help us to assess the weightages of impacts and signed digraph will help to specify the nature of the impact. The pulse

process will help us to examine the value stability and pulse stability of the water management system and provide us suitable strategies to implement for making the system less unstable.

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“PREDICTING MENTAL HEALTH THROUGH HAPPINESS AND ENGAGEMENT AT WORK”

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Abstract

Ample studies have shown that the majority of employees have their ups and downs in their mentality at work and it affects their mental health. Extra work, unexpected working conditions, unrealistic workload expectations, pressure from employers, poor relationships with colleagues, and overambition can create issues with anxiety, stress, depression, and mental health. It's clear that there is a link between mental health and engagement at work. Research on engagement generally suggests that engagement is a positive work-related state of mind. In the present study, the mediating role of happiness in the relationship between intellectual, social, and occupational engagement and mental health is assessed. The study involved 270, 163 females and 107 males. The Engagement Scale, Happiness Scale, and Mental Health Scale were used to collect data for the study, which was done online (via Google Form). Descriptive statistics, Pearson's product moment correlation coefficient, and multiple regression analysis were used to analysed the obtained data. The results of the study revealed that the happiness, work engagement and mental health are strongly and positively associated to each other. The happiness and the work engagement are the significant predictor of mental health in which the happiness is the best predictor of mental health. Furthermore, there is no combine contribution found of the predictor variables (The happiness and work engagement) into the mental health level.

Key Words: Happiness, Intellectual

Engagement, Social Engagement and work Engagement, Mental Health.

Over the last decade, people's mental health problems are increasing day by day. Employees are no exception. The nature of today's job market requires organizations to be productive and competitive in order to survive safely in the face of constant pressure to turn a profit as quickly as possible. As such, workers are expected to be psychologically connected to their work, to be proactive and committed to high quality standards, to cooperate with others, to be energetic, dedicated, and engaged in their work (Bakker, Albrecht, & Leiter, 2011). So it can be concluded that "Today's organizations need dedicated employees" (Bakker & Shafeli, 2008, p. 150). However, in this process, employees deal with many circumstances, including management's demands and expectations (Boakye & Ampiah, 2017; Dias-Lacy & Guirguis, 2017). All these factors undoubtedly bring psychological pressures such as anxiety, stress and depression to employees and affect their psychological health as individuals. For this reason, it is incorrect to expect professional success from employees with poor mental health.

The majority of workers have temperamental ups and downs at work that affect their mental health. This problem can become very serious and dangerous not only for our country, but also for its people and society. According to WHO, mental health is a state of well-being that enables people to reach their potential, cope with the pressures of normal life, work productively and contribute to their communities (WHO 2001b). Research on

mental health shows that her 450 million people worldwide suffer from mental or behavioral disorders. Apart from that, 1 in 4 of her will have a mental or behavioral problem at least once in her life (WHO). Wellness as “the process of self-awareness of changes in health and behavior aimed at a healthier physical, mental, emotional, psychological, occupational, and spiritual state.” Mental health can therefore be viewed as being free from mental illness and having a positive appreciation of life.

Mental health includes the ability to form relationships with others that promote health and well-being. Mentally healthy people are able to cope with life's ups and downs and are confident and resilient. Mental health is therefore more than the absence of mental illness/disorder. It represents a positive aspect of mental health and may be reached by people diagnosed with mental disorders. Researches shows that mentally healthy people are better at coping with difficult situations, which has been shown to keep you focused, flexible, and creative.

There are many factors that affect our mental health. In other words, it regulates our mental health. Happiness plays a very important role in a person's mental health and is considered one of the most important determinants of subjective well-being (Honkanen et al., 2005). The meaning of happiness is used to indicate that positive effects such as joy, interest, and pride predominate over negative effects such as sadness, fear, and anger. Happiness is the most important key factor in human daily life and has been established by the World Health Organization as a major component of health. Happy people develop self-esteem, a sense of control, optimism, and a sense of purpose by having goals. All factors are positively correlated with a person's psychological well-being. Skevington, MacArthur, and Somerset (1997) found that happiness was ranked as the most important factor in quality of life, higher

than money, health, or sex in a number of focus groups in the United Kingdom. According to Aristotle, fulfilling one's potential was a key component of happiness (Waterman, 1990). Similarly, according to other theorists, happiness occurs when some specific living conditions come together. (Ryan & Deci, 2001; Ryff, 1989).

One study found that measures of well-being defined by aspects of healthy functioning were negatively correlated with symptoms of mental illness. Studies show that happy people have fewer symptoms of mental illness (Diener & Seligman, 2002). One study found that happiness can lead to individual and community well-being and never negatively impact people or the humanities (O'Brien, 2008). Another study showed that people who were happier had better life outcomes. H. Greater coping skills, supportive relationships, superior financial performance and physical health, and longevity (Piqueras et al. 2011). Happiness is therefore an important positive factor that plays a key role in promoting a person's mental health (Saldanha et al., 2021; Bieda et al., 2019; Joo & Lee, 2017; Rahman et al. al., 2016; Mahakud & Yadav, 2015).

On the other hand, organizations formed by a large number of people, whose leadership qualities and cultural and psychological climate can influence their level of well-being by positively and negatively influencing their employees (Çetin, 2004; Juul, 2008; Harris, 2018). Expressed as well-being, this concept represents the achievement of individual and organizational goals (Bulut, 2016). As such, well-being affects the well-being of all individuals within an organization (Arslan & Polat, 2017). Research also shows that happiness is associated with work engagement (Coetzee & Rothmarm, 2005; Rothmarm & Jordaan, 2006; Money, Hillenbrand & Da Cámara, 2008; Field & Buitendach, 2011; Mather, 2015 Othman, Mahmud, Noranee & Noordin, 2018). Engagement is consistently given by

employees who can benefit the organization through commitment and dedication, advocacy, discretionary effort, full use of talent, and support of the organization's goals and values. One of the most frequently researched topics in the field of positive organizational psychology recently is employee engagement (Sonnentag, 2003; Kulophas, Ruengtrakul & Wongwanich, 2015; Khan, 2016). Work engagement is a positive and satisfying attitude towards work characterized by 'energy, dedication and receptivity' (Schaufeli, Salanova, Gonzalez Roma, & Bakker, 2002). Schaufeli, Salanova, Gonzalez-Roma, and Bakker (2002, p. 74) define engagement as "a positive, fulfilling, work-related state of mind". Engaged employees feel connected to the organization and invest in the organization as a whole, not just their role. Engaged employees are more likely to stay with the company, outperform her by 20% than her peers, and act as an advocate for the company.

Engagement can increase profits, enable organizational agility, and improve efficiency in driving transformational initiatives. Engaged individuals become fully invested in their work, which increases self-efficacy and has a positive impact on physical and mental health. Younger employees may feel positive when they first join the organization, but they can quickly become discouraged. Highly extroverted and adaptable people are easier to join the organization. Engagement is a decision that depends on what an employee is worth investing in themselves. Its levels depend on tenure within the organization, occupation and tenure, but also by sector. The higher the position, the more likely to engaged. Presidents, managers, operations staff, and operational staff tend to be the most dedicated, professional, and least supportive staff, but this varies by organization. There are seven commonly cited factors of engagement. job types, transparent purposeful work, growth opportunities, timely recognition and rewards,

building respectful and confident relationships, open two-way communication systems, and inspiring leadership.

There are various engagement measures. However, due to the lack of a clear definition of employee engagement and the different needs of different organizations, the values measured in these studies can vary widely. Job satisfaction is a weaker predictor of business outcome than engagement, lacking the two-way relationship characteristic of engagement. Both engagement and psychological contracting have cognitive and emotional components and can represent the interaction between employees and employers. Engagement can affect employee hiring, absenteeism, and turnover, and various studies have found links to productivity. This increasingly shows high correlations with individual, group and organizational performance, outcomes related to customer experience quality and measured customer loyalty.

According to Towers Perrin (2007), organizations with the highest percentage of engaged employees saw a 19% year-over-year increase in operating profit and a 28% increase in earnings per share. Looking at the association between work engagement and mental health based on this information, it is hypothesized that organizational satisfaction may also mediate this association. No literature has examined the mediation of well-being between these two variables. A study was therefore conducted to examine the mediating role of happiness in the relationship between work engagement and mental health among employees working in different sectors.

REVIEW OF LITERATURE

Çayak, (2021) arranged a correlational study and assessed the level of happiness, work engagement and life satisfaction of seven hundred and sixty-seven teachers. Their level of happiness, work engagement and life satisfaction were measured by Work Engagement Scale the Life Satisfaction Scale

and the Organisational Happiness Scale. The data was analysed by Pearson's correlation, regression analysis, and the bootstrapping method. The result revealed that workplace happiness plays a partially mediating role between life satisfaction and work engagement. Saldanha et al., (2021) have administered Psychological Well-being Questionnaire and Oxford Happiness Questionnaire on one hundred and five participants during the COVID-19 pandemic phase, in order to explore the relationship between the well-being and happiness. Participants with the age ranges between 16-25 years were selected by using continent sampling method. The obtained data were analysed by Thematic and content analysis. The results revealed that psychological well-being and happiness was positively and significantly associated with each other.

Bieda et al., (2019) revealed that there are the reciprocal associations among happiness, positive mental health and life satisfaction over time. Moreover, they disclosed that happiness compared to satisfaction of life and positive mental health may be a primary indicator for positive change in the crucial period in students' lives.

Joo and Lee, (2017) conducted a correlational study on five-hundred and fifty workers of a conglomerate in South Korea to examine the effect of perceived organizational support and psychological capital on happiness in work engagement, careers satisfaction, and subjective well-being. Factor analysis, correlation, reliability and structural equation modelling analyses were used to analyse the obtained data. Results of the study discovered highly engaged worker was gratified with their careers and perceive a greater sense of well-being when they had higher POS and PsyCap in their lives.

Rahman et al., (2016) showed from their study that happiness and mental well-being of university students were positively and

significantly associated to each other. For this, they arranged a correlational study and comprised one-hundred university students from Aligarh Muslim University (India). Mental well-being scale and Oxford Happiness Questionnaire devised by Tenant and colleague (2007) and by Argyle and Hills (1989) respectively were administered to obtain desire data and further, data was analysed by Pearson's correlation.

Mahakud & Yadav, (2015) explored from their research that happy peoples have a lesser amount of chance to predisposed to the mental disorders. They also are more sociable and adore quite good communal wellbeing. They suffer less anxiety, tension and depression.

Mather, (2015) conducted correlational study and administered Utrecht Work Engagement Scale by Schaufeli and Bakker (2003), the Survey of Perceived Organizational Support by Eisenberger et al., (1986), and Happiness Subjective Scale by Lepper & Lyubomirsky, (1997) on twenty-five thousand students affaires professionals of higher education institute of US. Results of the study revealed that the work engagement and happiness were significantly and positively associated to each other.

Ahmadigatab & Taheri, (2011) arranged a correlational study to discover the association among happiness, life quality and psychological health. One hundred and sixty-five students of Babol payam-e-noor university were included by random clustered sampling method. Adult psychological health questionnaire, life quality questionnaire and happiness questionnaire were used to assess their level of psychological health, life quality and happiness respectively. The results of the study revealed a significant psychological health, life quality and happiness were significantly and strongly correlated to each other.

Aim:

Main aim of the present study is to

discover the strength of relationship among work engagement, happiness and mental health of the people.

Objectives:

The researcher has carried out the present research with the following objectives.

1. To assess the level of work engagement, happiness and mental health of people.
2. To quantify the strength of correlation among work engagement, happiness and mental health.

Research Questions:

- 1) Will there be significant relationships between the predictor variables (work engagement and happiness) and mental health?
- 2) What are the relative contributions of the predictor variables to mental health?
- 3) What are the combined contributions of the predictor variables to mental health?

METHOD

Design for Study

The correlation design was implemented in the present study to observe the correlation among work engagement, happiness and mental health. Further, the stepwise regression analysis was used to exhibit the relative contribution of predictive variables in mental health.

Sample

A sample of 270 (163 females and 107 males) with the age ranges from 25 to 57 years were assigned for the present study using random sampling technique.

Statistical Treatment of the data:

Obtained data was analysed by Descriptive statistics namely Mean, SD and Pearson’s correlation coefficient and inferential statistics namely multiple regression analysis. However, data was initially screened for outliers and skewness.

Data collection tools

A) The ISA Engagement Scale (ISA ES)

The ISA engagement scale has been developed by Soane et al. (2012). This scale consists of 9

items and three facets of engagement viz. intellectual, social, and occupational engagement.

B) Mental Health Quotient Scale (MHQS)

This scale is developed by Jennifer Jane Newson, and Tara C Thiagarajan (2020). This is a 9-point scale with negative and positive dimensions. The scale provides sub scores of 6 categories of mental health.

C) Oxford Happiness Questionnaire (OHQ)

This questionnaire is developed by Hills and Argyle (2002). It includes 29 statements about happiness and Ss has to indicate how much they are agree or disagree on seven-point Likert’s scale. This scale is widely used throughout the world scholars.

Variables under study:

1. Predictive Variables
 - a) Happiness
 - b) Work Engagement
2. Predicted Variable
 - c) Mental Health

Procedure

The data for the study was collected online (via Google Form).

RESULTS

Table 1 shows the descriptive statistics for work engagement, happiness and mental health of people. It can be observed that work engagement has the Mean score of 53.11 with 6.91 standard deviation. Happiness has the Mean value of 134.85 (16.61 SD) and Mental health has the Mean score of 29.00 and SD value of 4.26. Overlook at these mean and SD values we can see that the mean values were three times more than their corresponding SD values. It suggests the distribution of the variables in sample is normal or near normal.

Table1: Descriptive Statistics (N = 270)

	Mean			Skewness		Kurtosis	
	Statistic	SEM	s	Statistic	Std. Error	Statistic	Std. Error
<i>W.E.</i>	53.11	0.42	6.91	-0.58	0.148	-0.17	0.295
<i>Happiness</i>	134.85	0.91	16.61	-0.39	0.148	-0.26	0.295
<i>Mental Health</i>	29.00	0.26	4.26	-0.77	0.148	0.01	0.295

W.E.= Work Engagement; SEM = Standard error of the mean; s= standard deviation

But we can't conclude that only on the basis of mean and SD values, hence in order to confirm that the distribution of these three variables are normal or near normal skewness and kurtosis values were calculated. We also observe that the skewness values of these variables are less than 01 (one) and kurtosis values are less than 02 (two) and when we divide skewness and kurtosis values by their corresponding standard error, answers came less than 1.96 which indicate the distribution of these variables in sample were normally distributed. Therefore, we can use the parametric statistics for the further calculations.

Research Question 01: Will there be significant relationships between the predictor variables (work engagement and happiness) and mental health?

Since, there is no violation of normality, hence in order to search the answer of this research question obtained data was analysed by Pearson's correlation coefficient. The findings are displayed in

Table 2. It revealed that the two sets of scores that is work engagement and happiness were correlated strongly and positively to each other [$r(268) = .47, p < 0.000$, one tailed]. Which indicate that the higher the level of work engagement more the happiness level and vice versa.

Table 2: Correlation coefficients among work engagement, happiness and mental health

	Work Engagemen	Happiness	Mental Health
Work Engagemer	1	.47**	.27**
Happines:		1	.48**
Mental Health			1

** . Correlation is significant at the 0.01 level (1-tailed)

Further, the table exhibits the correlation coefficient scores of the two sets of scores which is work engagement and mental health. Which is also strongly and positively associated to each other [$r(268) = .27, p < 0.00$, one tailed]. Indicating that the more the

level of work engagement more the level of mental health and vice versa.

Finally, table also revealed the association between happiness and mental health. The Pearson's correlation coefficients value is .48, for 268 df this correlation coefficient value is significant at 0.01 level of significance; [$r(268) = .48, p < 0.000$, one tailed]. It also indicating that the higher the happiness level more the level of mental health and vice versa. That clearly means the deviation is the scores were not by chance only.

Research Question 02: What are the relative contributions of the predictor variables to mental health?

The second aim of this study was to estimate the relative contributions of the predictor variables to the variance in scores of mental health. To this end, stepwise regression analysis and simple multiple regressions were computed with mental health as the dependent measure and work engagement and happiness being the predictors as seen in **Table 3** work engagement and happiness were entered to explore how much variability each of them could significantly account for. As can be observed in table 3, step 1, attending to happiness alone accounted for 23.00 % (R-square = 0.23) of the variance in mental health, the inclusion of work engagement accounted for 24.00% (R-square .24) which resulted in an additional 01.00% in step 2.

Table 3: Stepwise Multiple Regression Analysis predicting Mental Health

Predictors	B	β	t	R	R ²	Adj. R ²	ΔR^2	F(1, 268)
Step 1								
Happiness	0.12	0.48	9.06**	0.48	0.23	0.23	0.23	82.14**
(Constant)	12.24		6.57**					
Step 2								
Happiness	0.12	0.46	7.60**	0.49	0.24	0.23	0.24	F(2,267) = 41.42**
Work Engagement	0.03	0.05	0.88#					
(Constant)	11.36		5.36**					

** - Significant at the 0.01 level; # - Not Significant
 B = unstandardized coefficients
 β = the standardized beta coefficients, gives a measure of the contribution of each variable to the model
 R² = the square of the measure of correlation;
 ΔR^2 = R Square Change;

In table 3, step 2, indicate that the standardized β values revealed the decreasing order of the predictors: Happiness > work engagement which showing that happiness was the best predictor, ($\beta = .48$, $t = 9.06$; $p < 0.01$), while work engagement was not significantly predicts the dependent variable ($\beta = .05$, $t = .88$; $p > 0.01$). Therefore, consequently concluded that the mental health was significantly predicted by happiness. We can also predict the value of mental health on the basis of the value of happiness by using following equation; $Y = 12.24 + 0.12X$.

Table 4: Simple regression analysis predicting mental health (predictor – work engagement).

Predictor	B	β	t	R	R ²	Adj. R ²	ΔR^2	F (1,268)
Work Engagement	0.17	0.27	4.54**	0.27	0.07	0.07	0.07	20.65**
(Constant)	20.23		10.40**					

** - Significant at the 0.01 level;

However, in order not to miss out any evidence on the relative contributions of the predictor variables, a simple regression analysis was performed to find out if work engagement will contribute significantly to the variance in Mental Health. Those findings are presented in **Table 4** revealed that work engagement also contributed 0.70% (R-square = .07) to the variance in mental health and this was found to be significant [F (1, 268) = 20.65, $p < .01$]. These results indicated that work engagement is important factor in the mental health of workers.

Research Question 03: What are the combined contributions of the predictor variables to mental health?

The third aim of this study was to find out the joint contributions of the predictor variables. Using the stepwise method, a significant model emerged: as seen in **Table 3** step 2, these predictors significantly accounted for 24.00% (R-square = .24); [F (2, 267) = 41.42, $p < .01$] of the variance in mental health.

However, it also appears from Table 3 that the work engagement does not contributed into the variance of mental health in association with happiness. It simply means it cannot interactively affect with happiness to the level mental health. In other words, work engagement can contribute to the variance of

mental health separately rather than combine with happiness. Therefore, it can be concluded that there is no combine contribution found of the predictor variables into the mental health level.

DISCUSSION

The level of Happiness, work engagement, and mental health of workers were assessed and association among them were inspected in the present research. To gather the desire data psychometric scales were administered to 270 participants (163 females and 107 males) via Google Form. Furthermore, combine contribution of Happiness and work engagement into the level of mental health was explored.

Research findings have shown that there are positive and strong correlation among happiness, work engagement and mental health. There was no research has been found in literature review in which all above variables were included together. This study also supported with previous research which documented work engagement can be perceived as a concept related to happiness (Coetzee & Rothmarm, 2005; Rothmarm & Jordaan, 2006; Bakker, Albrecht & Leiter, 2011). This is also in corroborated with the findings of Bieda et al., (2019), Rahman et al., (2016) and Mahakud & Yadav, (2015), they showed that there is significant relationship among happiness, positive mental health and

life satisfaction. These results are also consisted with Mather, (2015), and Bakker & Demerouti (2009) exposed that the work engagement happiness is positively and significantly correlated to each other. Likewise, Coetzee & Rothmarm, (2005); Rothmarm & Jordaan, (2006); Bakker, et al., (2011); Bieda et al., (2019); Çayak, (2021) explored from their study that there is significant positive association between work engagement and happiness.

Likewise, Coetzee & Rothmarm, (2005); Rothmarm & Jordaan, (2006); Bakker, et al., (2011); Bieda et al., (2019); Çayak, (2021) explored from their study that there is significant positive association between work engagement and happiness. Also, Ahmadigatab & Taheri, (2011) and Bieda et al., (2019) exposed from their study a significant correlation between psychological health, life quality and happiness.

CONCLUSIONS

The following conclusions were drawn on the basis of interpretation of results and discussion:

i) The happiness, work engagement and mental health are strongly and positively associated to each other.

ii) The happiness and the work engagement are the significant predictor of mental health. The happiness is the best predictor of mental health among them.

iii) There is no combine contribution found of the predictor variables (The happiness and work engagement) into the mental health level.

RECOMMENDATIONS

In the light of the findings obtained from the study, some recommendations can be made for students, researcher scholars & practitioners.

Many factors related to happiness mental health and work-engagement. Experimental and Longitudinal studies can be conducted to explore the effect of these factors

on mental health of the person. In present research the quantitative research method was used. To gain more information about the association of these variables, Qualitative or mixed research methods can also be used.

Moreover, some recommendations can be offered to the research scholars in line with the findings attained from the study. To improve the level of mental health of workers training can be given to administrators to make persons engaged in their work and increasing their level of happiness. Professional support activities can be carried out for persons to cope with the difficulties they face in their work-lives, that cause psychological fear and reduce their mental health.

LIMITATIONS

The present study has certain limitations;

The study conducted online via google form, therefore, researcher has no proper control of on participants. Sample size is only 270. Geographical regions and gender differences were not taken in consideration. Most of participants are female. Taking in consideration these limitation in upcoming studies, it is assumed that it may be helpful to use different research designs.

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