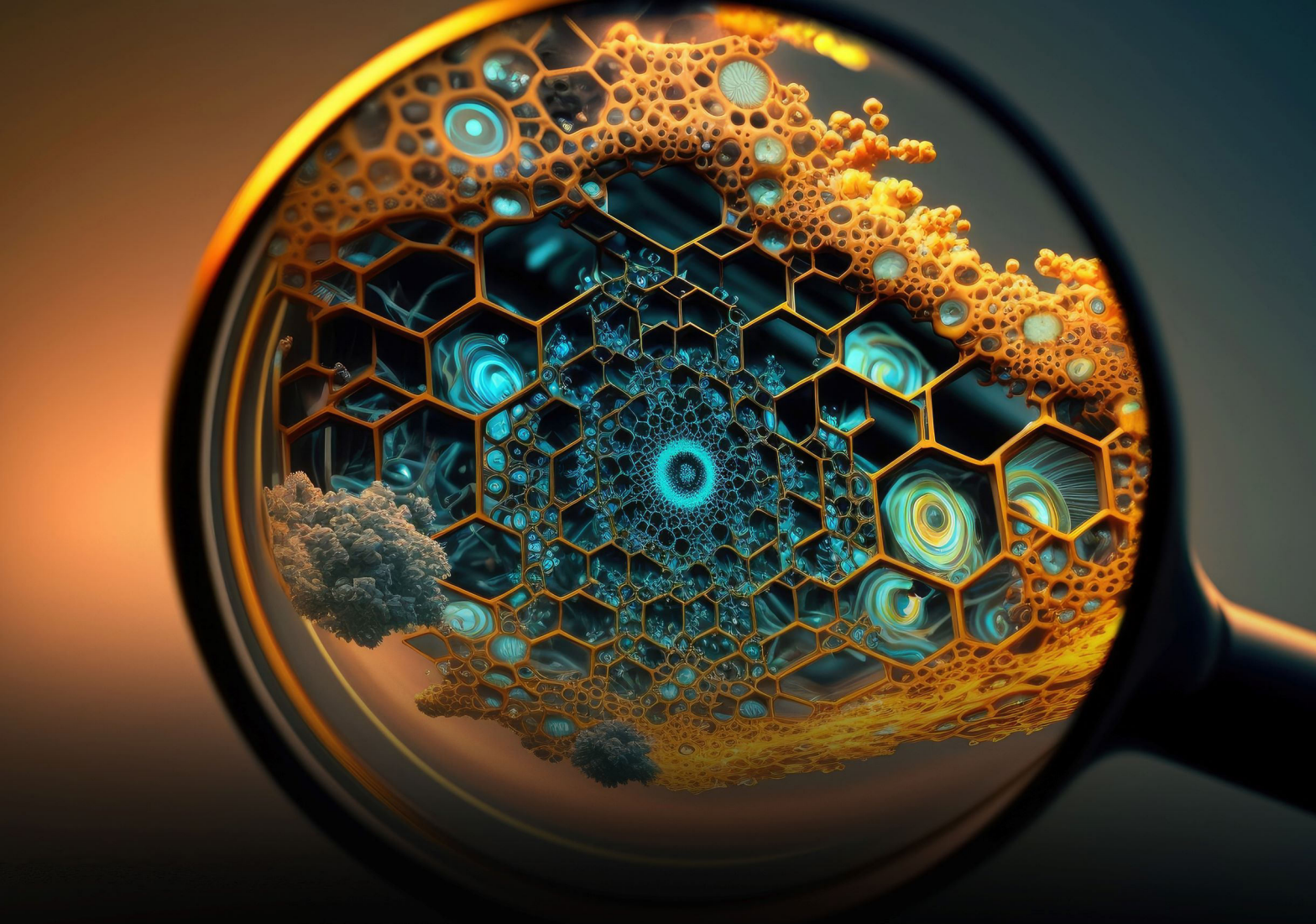

VOLUME 4

MULTIDISCIPLINARY RECENT TRENDS IN RESEARCH

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DR. R. RADHA

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DR. MANASI VYANKATESH GHAMANDE
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RESEARCH

VOLUME - 4

International Peer-Reviewed Edited Book on

MULTIDISCIPLINARY RECENT TRENDS IN RESEARCH

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CONTENTS

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MILLETS – SUPER FOOD FOR TODAY AND FUTURE

PROF. (DR.) SUNITA AGARWAL

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Millets are a group of small-seeded grasses that have been cultivated as staple crops for thousands of years. They are known for their hardy nature, nutritional value, and versatility in various culinary applications. Millets are widely grown and consumed in many parts of the world, particularly in Asia and Africa . Millets includes Sorghum (Jowar), Pearl Millet (Bajra), Finger Millet (Ragi), Foxtail Millet (Kakun), Little Millet (Kutki), Proso Millet (Cheena), Kodo Millet (Kodon).

India is the largest producer of millets and the fifth largest exporter of millets in the world. India produces all nine major types commonly known as millets. In India, most states grow one or more millet crop species. Millets require less water and are grown in regions with low rainfall so resume more importance for sustained agriculture and food security. Based on the area grown and its grain size the millets are classified as major millet and minor millets.

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❖ WHAT ARE MILLETS:

Millets are among the oldest foods known to humans. The importance of millet was reduced due to the large-scale cultivation of rice and wheat because of urbanization and industrialization. With hypertension, diabetes, and cardiovascular disease becoming more prevalent, due to newly acquired lifestyles and food habits, millets have returned as a viable option to live a healthy life and can reduce the incidence of these lifestyle diseases. Millets have many nutritional, nutraceutical, and health-promoting properties especially the high fiber content, nature of starch has a major role in reducing the risk of diabetes and other related diseases. Millets act as prebiotic-feeding microflora in our inner ecosystem. Millet does hydrate our colon to keep us from being constipated. The high-level Presence of tryptophan in millet produces serotonin, which is calming to our moods. Niacin in millet helps lower cholesterol. Millet consumption decreases C-reactive protein and triglycerides, thereby preventing cardiovascular disease. Millets are gluten-free and non-allergenic. All millet varieties show high antioxidant activity. The beneficial effects of millet on human health are reported in many kinds of literature and are available online In India, millets were traditionally consumed, but in the 1960s push given to food security through Green Revolution, millets were less consumed and almost forgotten. Before the Green Revolution, millets made up around 40% of all cultivated grains, which now dropped to around 20% over the years. The area under production has been replaced with commercial crops, pulses, oilseeds, and maize. These commercial crops are more profitable as their production is supported by several policies through subsidized inputs, inclusion in the Public Distribution System, and incentivized procurement. This has resulted in changes in dietary patterns with preferential consumption of fine-calorie-rich cereals. (6,7)

Millets are not only comparable to major cereals with respect to their nutritional values but are very good sources of carbohydrates, micronutrients, and phytochemicals with nutraceutical properties. The millets contain 7-12% protein, 2-5% fat, 65-75% carbohydrates and 15-20% dietary fibre. Among them, pearl millet contains a considerably high proportion of proteins (12-16%) as well as lipids (4-6%) whereas; finger millet contains lower levels of protein (6-8%) and fat (1.5-2%). The essential amino acid profiles of the millet protein is better than maize. Finger millet proteins are unique due to the presence of sulfur-rich rich amino acid contents and niacin content in pearl millet is higher than all other cereals. Millet proteins are poor sources of lysine, but they complement well with lysine-rich vegetable (leguminous) and animal proteins to form nutritionally balanced composites of high biological value. Compare to fine cereals, small millets are more nutritious. Finger millet is the richest source of calcium, and other small millets are good sources of phosphorous and iron

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❖ GLOBAL PRODUCTION:

Global Cultivation: Millets are cultivated in various regions around the world, with significant production in countries such as India, Nigeria, Niger, China, and Mali.

Millets Regions	Area (lakh hectares)	Production (lakh tonne)
Africa	489 (68%)	423 (49%)
Americas	53 (7%)	193 (23%)
Asia	162 (23%)	215 (25%)
Europe	8 (1%)	20 (~2%)
Australia & New Zealand	6 (~1%)	12 (~1%)
India	138 (20%)	173 (20%)
World	718	863

Global production of pearl millets has come down from 32.8 million tonnes in 2010 to 28.4 million tonnes in 2014. Asia and Africa are the major contributors to the world's total pearl millet production contributing more than 98%.of global production. The share of African countries in global millet production has come down from 49.22% in 2010 to 43.72% in 2014, whereas the contribution from Asian countries has increased to 52.25% from 48.72% in 2010. Sorghum (Sorghum bicolor (L.) Moench) is the fifth major cereal of the world after maize, paddy, wheat, and barley as per FAO production data of 2016. The World sorghum production increased significantly in 2014 to 68.9 million tonnes from 60 million tonnes in 2010, after a drastic reduction in 2011 to 57 million tonnes. Africa stood to be the largest producer of sorghum in 2014 contributing about 42% of global production followed by the Americas (39.75%) and Asia (14.04%).

❖ PRODUCTION DISTRIBUTION OF MILLETS IN INDIA:

India is the top most producers of millets followed by Nigeria for the years 2000 and 2009. In India, eight millet species (Sorghum, Pearl millet, Finger millet, Foxtail millet, Proso millet, Kodo millet, Barnyard millet, and Little millet) are commonly cultivated under low rain conditions. In each of the millet growing areas, another 4 to 5 species are cultivated either as primary or allied crops in combination with pulses, oilseeds, spices, and condiments. For example, while pearl millet and sorghum are primary and allied crops in the desert regions of Rajasthan, in Gujarat it is the opposite. Similarly, sorghum is sown as a major crop in Telangana, Andhra Pradesh, Maharashtra, and parts of Central India, while it is considered a fodder crop in some of the Southern regions.

❖ BOTANY OF MILLETS:

Understanding the botany of millets provides insights into their growth patterns, reproductive strategies, and adaptations. This knowledge is crucial for cultivation practices, breeding programs, and conservation efforts aimed at promoting the sustainable production and utilization of millets.

❖ THE BOTANICAL CLASSIFICATION OF MILLETS:

Millets belong to the family Poaceae (grass family) and the subfamily Panicoideae. They are classified under the tribe Paniceae. The scientific name of the most commonly cultivated millet is Pennisetum glaucum, also known as pearl millet or Bajra. Other millet species include Eleusine coracana (finger millet or Ragi), Setaria italica (foxtail millet), Panicum miliaceum (proso millet), Echinochloa frumentacea (barnyard millet), and Panicum sumatrense (little millet), among others.

ISBN: 978-91-89764-27-9

Growth Habit: Millets are warm-season annual grasses, which means they complete their life cycle within a single growing season. They are known for their rapid growth and can reach maturity within 60 to 120 days, depending on the species and environmental conditions

- **Ecological Adaptations**: Different millet species have evolved specific adaptations to various ecological conditions. For instance, pearl millet is well-suited to arid and semi-arid regions with its deep root system, which enables it to access water from deeper soil layers. Foxtail millet, on the other hand, is more adapted to temperate and subtropical regions.

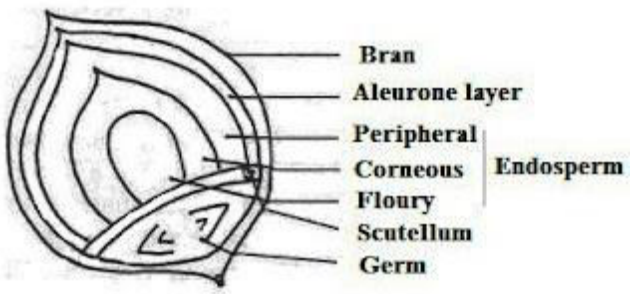
Millets are annual grasses that can grow between 2 to 6 feet tall, depending on the species. They have long, narrow leaves that grow alternately along the stem. The leaves are typically flat and have parallel venation, which is a characteristic feature of grasses.

The flowers of millets are arranged in inflorescences called panicles. Panicles are branched clusters of flowers that are borne at the top of the plant. Each flower consists of male and female reproductive organs. The male reproductive organs, called stamens, produce pollen, while the female reproductive organ, called the pistil, contains the ovary, style, and stigma.Millets are wind-pollinated plants, which means that the pollen is dispersed by the wind to reach the female flowers for fertilization. They do not rely on animal pollinators like bees or butterflies for pollination.

After successful pollination and fertilization, the flowers develop into grains or seeds, which are the edible part of millets. Millet grains are small and usually have a hard outer layer, called the husk or hull. The grains vary in shape, size, and color depending on the millet species.

Photosynthesis: Millets exhibit a type of photosynthesis known as C4 photosynthesis. This photosynthetic pathway enables them to efficiently utilize carbon dioxide, even under high-temperature and water-limited conditions. It contributes to their ability to thrive in hot and arid regions.

- **Morphological Variation**: Different millet species exhibit variations in their morphological features. For example, pearl millet (Pennisetum glaucum) has tall and robust stems, while finger millet (Eleusine coracana) has slender stems. Foxtail millet has distinctive bristled inflorescences, resembling the tail of a fox, from which it derives its name.
- **Seed Structure**: Millet seeds have characteristic structures. They consist of three main parts: the outer hull or husk, the bran or pericarp layer, and the endosperm. The endosperm is the starchy part of the seed that provides the main source of nutrition.



❖ STRUCTURE OF MILLET:

Millets can be divided into two types of seeds:

1) **Utricles**-In the utricle type of seeds, the pericarp surrounds the seed like a sac but is attached to the seed at only one point. Examples of Utricles are Finger millet, proso, and Foxtail millet. In these millets, the pericarp usually breaks away from the seed coat or testa, which is well developed, thick and forms a strong barrier over the endosperm

2) **Caryopsis**-. In a caryopsis, the pericarp is completely fused to the seeds. Example of Caryopsis are Pearl millet, fonio and teff. For pearl millet, the kernels are composed of the pericarp, endosperm, and germ.

The endosperm comprises the majority of the kernel weight for all millets. There are four structural parts of the endosperm: the aleurone layer and the peripheral, corneous and floury endosperm areas . All millets have a single layer aleurone that completely encircles the endosperm. The aleurone cells are rectangular with thick cell walls, and they contain protein, oil, minerals and enzymes. The peripheral corneous and floury endosperm areas are beneath the aleurone, in that order.

- **Germination and Seedling Development**: Millet seeds germinate under favorable conditions, with adequate moisture and temperature. Once germinated, millet seedlings develop root systems that help them absorb water and nutrients from the soil, supporting their growth and development.
- **Tillering**: Millet plants have the ability to produce multiple shoots from the base of the main stem, a process known as tillering. This helps in the formation of additional panicles and increases the overall grain yield.
- **Reproduction**: Millets reproduce through sexual reproduction, where the pollen from the stamens of one flower fertilizes the pistil of another flower. They can also reproduce through vegetative means, such as stem cuttings, although this method is less common in millets.
- **Wild Relatives**: Millets have wild relatives that grow in natural habitats, contributing to the genetic diversity of the species. These wild relatives are important genetic resources for crop improvement and conservation efforts.
- **Crop Rotation**: Millets are often included in crop rotation systems to improve soil health and break pest and disease cycles. Their fibrous root systems help in soil structure improvement and nutrient cycling. They have the ability to fix atmospheric nitrogen and enrich the soil, reducing the reliance on synthetic fertilizers and promoting sustainable farming practices

Genetic Diversity: Millets exhibit a wide range of genetic diversity within and among species. This genetic diversity is valuable for breeding programs aimed at developing improved millet varieties with enhanced traits such as disease resistance, drought tolerance, and higher nutritional content

- **Harvesting and Processing**: Millet crops are harvested when the grains reach maturity. The panicles are usually cut and threshed to separate the grains from the rest of the plant material. The harvested grains undergo further processing steps, such as cleaning, drying, and milling, to prepare them for consumption or storage.
- **Agronomic Practices**: Millets are typically grown as rainfed crops, relying on natural rainfall for irrigation. However, in areas with adequate water availability, they can also be cultivated under irrigated conditions. Millets are generally grown using direct sowing or transplanting methods, depending on the specific species and local farming practices. Weed Competitiveness: Millets have the ability to compete with weeds and suppress their growth. They exhibit vigorous growth and efficient resource utilization, which helps them outcompete unwanted plant species and reduce the need for herbicide application.

❖ ETHNOBOTANY OF MILLETS:

Nutritional Value: Millets are highly nutritious and offer a range of health benefits. They are rich in dietary fiber, protein, vitamins (such as niacin, thiamin, and riboflavin), and minerals (such as iron, calcium, and magnesium). Millets are also gluten-free, making them a suitable grain alternative for individuals with gluten intolerance or celiac disease. Millets are nutritionally superior to rice and wheat

owing to their more balanced amino acid profile and higher levels of protein. Similarly, the dietary fiber content of millet is also higher compared to some of the staple cereals. Millets also contain various phytochemicals which exert therapeutic properties owing to their anti-inflammatory and anti-oxidative properties. **Secondary Metabolites:** Millets produce various secondary metabolites, including phenolic compounds, flavonoids, and antioxidants. These compounds contribute to the nutritional and health-promoting properties of millets and may play a role in their resistance to pests and diseases. (1,2)

Nutrient content of various raw millets with comparison to quinoa, teff, fonio, rice and wheat					
Crop/nutrient	Protein (g)	Fiber (g)	Minerals (g)	Iron (mg)	Calcium (mg)
Sorghum	10	4	1.6	2.6	54
Pearl millet	10.6	1.3	2.3	16.9	38
Finger millet	7.3	3.6	2.7	3.9	344
Foxtail millet	12.3	8	3.3	2.8	31
Proso millet	12.5	2.2	1.9	0.8	14
Kodo millet	8.3	9	2.6	0.5	27
Little millet	7.7	7.6	1.5	9.3	17
Barnyard millet	11.2	10.1	4.4	15.2	11
Brown top millet	11.5	12.5	4.2	0.65	0.01
Quinoa	14.1	7	*	4.6	47
Teff	13	8	0.85	7.6	180
Fonio	11	11.3	5.31	84.8	18
Rice	6.8	0.2	0.6	0.7	10
Wheat	11.8	1.2	1.5	5.3	41

1) Millets can be cooked and prepared in various ways. They can be boiled, steamed, roasted, or even popped like popcorn. Different types of millet have distinct flavors and textures, ranging from nutty to mild and from fluffy to sticky. This versatility allows for a wide range of culinary creations, including savory dishes, desserts, and snacks.

Millets are naturally gluten-free, which makes them a suitable grain alternative for individuals with gluten sensitivities or those following a gluten-free diet. They can be used to make gluten-free flour, enabling people with conditions like celiac disease to enjoy a variety of baked goods

Animal Feed: Apart from human consumption, millets are also used as animal feed, particularly for poultry and livestock. Millet grains are highly nutritious for animals and can be a valuable component of their diet.

2) **Health Benefits**: Regular consumption of millet has been associated with various health benefits. They have a low glycemic index, which means they cause a slower rise in blood sugar levels compared to refined grains. This property makes millet beneficial for managing diabetes and maintaining stable blood sugar levels. Millets are also known to aid in digestion, promote cardiovascular health, and support weight management. Millet have substantially higher amounts of minerals like calcium, potassium, magnesium, iron, manganese, zinc and B complex vitamins, making them a preferable choice over cereal grains. Millets can also help tackle health challenges such as obesity, diabetes, and lifestyle problems as they are gluten-free, have a low glycemic index, and are high in dietary fiber and antioxidants.
3) **Gluten-Free Alternative Food**: Millets are naturally gluten-free, which makes them a suitable grain alternative for individuals with gluten sensitivities or those following a gluten-free diet.

They can be used to make gluten-free flour, enabling people with conditions like celiac disease to enjoy a variety of baked goods

4) **Millets in Traditional Medicine**: Millets have been used in traditional medicine systems like Ayurveda and traditional Chinese medicine for their various health benefits. They are believed to have cooling properties, aid digestion, improve energy levels, and promote overall well-being.(3,4)
5) **Environmental Sustainability**: Millets are known for their resilience to harsh growing conditions, requiring fewer inputs like water and fertilizers compared to other grains. They are often considered a sustainable crop choice due to their low water requirements and ability to grow well in dry and semi-arid regions. Additionally, millets are generally pest-resistant, reducing the need for chemical pesticides.
6) **Climate Resilient**: Millets are hardy, resilient crops that have a low carbon and water footprint, can withstand high temperatures, grow with little or no external inputs, and are thus termed *'crops of the future*'. In times of climate change, they are the most secure crops to farmers as they are the most resilient, hardiest, and climate-adaptable crops in harsh, hot, and drought environments.
7) **Ecologically Sustainable**: The use of chemical fertilizers is not required in the production of millets. Millet crops do not attract pests, and a majority of the millets are not affected by storage pests, so the use of pesticides is also not mandated.
8) **Drought-Tolerant Crops**: Millets are known for their ability to thrive in dry and arid conditions, making them suitable for regions with limited water availability. They have deep root systems that help them access water from deeper soil layers, allowing them to withstand droughts better than many other crops.
9) **Conservation of Genetic Diversity**: Millets contribute to the conservation of genetic diversity in agriculture. They have adapted to diverse ecosystems and come in a variety of shapes, sizes, and colors. Preserving and cultivating different millet varieties helps maintain biodiversity and safeguard against the loss of valuable genetic resources.
10) **Biodiversity Conservation**: Cultivating millets supports biodiversity conservation efforts. By promoting the cultivation of diverse millet varieties, farmers contribute to preserving traditional seed varieties and maintaining genetic diversity in agricultural systems.

❖ MAJOR INITIATIVES BY THE GOVERNMENT OF INDIA TO PROMOTE MILLETS:

The Government is promoting Nutri-cereals through Research & Development support. Support is also given to start-ups and entrepreneurs for developing recipes & value-added products that promote the consumption of millet.

Union Budget 2022-23 highlighted that support would be provided for post-harvest value addition, enhancing domestic consumption, and for branding millet products nationally and internationally.

In the launch ceremony of the International Year of Nutri-cereals which was organized by the Food and Agriculture Organization of the United Nations (FAO), Prime Minister Narendra Modi emphasized making millet a food choice for the future. He also mentioned how climate change is affecting food availability. The Prime Minister said, "Millets are good for the consumer, cultivator, and climate."

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AI FOR SOCIAL GOOD: ADVANCING THE SDGS THROUGH TECHNOLOGY

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❖ ABSTRACT:

This book chapter looks into the revolutionary potential of Artificial Intelligence (AI) in promoting the SDGs and boosting social good on a global basis. It investigates the various applications, moral challenges, and potential repercussions of AI-driven technologies in addressing important societal issues, with a focus on the junction of AI and the SDGs. The chapter explains how AI might help achieve these goals by examining the function of AI in specific fields related to each SDG and emphasising the importance of responsible AI development. It emphasises the positive effects of AI in areas such as sustainable development, healthcare, poverty reduction, education and gender equality. Prejudice, transparency, privacy, and responsibility have been addressed, emphasising the importance of human-centered design and inclusion in AI systems. The chapter concludes by supporting collaborative efforts, ethical frameworks, and public-private cooperation in order to fully use AI for social benefit and assure a sustainable and equitable future.

Keywords: *Artificial Intelligence (AI), Emerging Technologies, Sustainable Accounting, Impact Assessment.*

1. INTRODUCTION:

Artificial intelligence (AI) has emerged as a formidable instrument with the potential to expedite the achievement of the SDGs and produce social good. This chapter analyses the relationship between AI and the SDGs, focusing on how AI-powered solutions might address significant societal challenges while also contributing to long-term development. By utilising AI's capabilities, we may discover innovative solutions and accelerate progress towards a more fair and affluent society.

1.1 Background on the Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs), which were adopted by the UN in 2015, present an exhaustive global strategy for addressing poverty, inequality, environmental degradation, and other vital

challenges. The SDGs, which consist of 17 goals and 169 objectives, lay out a plan for collective action towards sustainable development by 2030. These goals span a wide range of themes, including poverty eradication, high-quality education, gender equality, climate action, and others.

1.2 The Role of Artificial Intelligence in Advancing the SDGs

Artificial intelligence has the potential to substantially advance the SDGs by revisiting traditional problem-solving and decision-making methodologies. AI technologies such as machine learning, natural language processing, and computer vision enable massive data analysis, pattern recognition, and intelligent automation. These skills can contribute to better service delivery, more efficient resource allocation, and sector-wide revolutionary change. (Acemoglu & Restrepo, n.d.).

1.3 Objectives

- To research how artificial intelligence (AI) can be used to achieve certain SDGs and promote social good.
- To emphasise AI's potential impacts and advantages in several domains aligned with the SDGs.
- To investigate the importance of ethical principles, stakeholder involvement, and inclusiveness in responsible AI development.

2. AI APPLICATIONS FOR SUSTAINABLE DEVELOPMENT:

Artificial intelligence (AI) applications have the ability to make a significant contribution to the achievement of the Sustainable Development Goals (SDGs), solving global concerns, and supporting sustainable development across different domains. Using AI's abilities, innovative solutions to support each SDG can be developed. The application of AI for several of the SDGs are briefly explained below:

2.1 SDG 1: No Poverty

AI-powered data analytics can help identify and target underserved communities. Predictive algorithms can assess the efficacy of poverty-relief programmes and optimise social safety nets to reach the most vulnerable populations (Aghion et al., 2017).

2.2 SDG 2: Zero Hunger

AI-enabled precision agriculture can optimise farming processes, allowing for more efficient utilisation of resources and higher crop yields. Monitoring and early- alerting systems powered by artificial intelligence can potentially assist prevent food shortages and enhance food distribution.

2.3 SDG 3: Good Health and Well-being

In healthcare, AI applications include disease surveillance, pharmaceutical development, and diagnostic and therapeutic support. Machine learning algorithms can analyse medical data to discover health issues and provide personalised treatments.

2.4 SDG 4: Quality Education

AI-powered educational institutions may provide personalised learning experiences by responding to individual students' requests and learning styles. Literacy and language acquisition can also benefit from virtual teachers and language processing tools (Greene et al., n.d.).

2.5 SDG 5: Gender Equality

AI can help identify and remove gender discrimination in a variety of circumstances, from hiring procedures to language usage. Furthermore, AI can empower women by promoting economic participation through digital literacy efforts.

2.6 SDG 6: Clean Water and Sanitation

By projecting water shortages and quality issues, AI has the ability to improve water resource management. Water infrastructure can be monitored and leaks detected using AI-powered sensors, ensuring that water is used efficiently (Adriaens et al., n.d.).

2.7 SDG 7: Affordable and Clean Energy

By regulating supply and demand for renewable energy sources, AI can optimise energy systems. Trends in energy usage can be examined in order to enhance energy efficiency and reduce carbon emissions.

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2.8 SDG 8: Decent Work and Economic Growth

AI has the ability to improve employee productivity and efficiency while also creating new job opportunities and improving labour market matching. Furthermore, artificial intelligence-powered corporate intelligence has the potential to boost economic development and innovation (Cao et al., 2014).

2.9 SDG 9: Industry, Innovation, and Infrastructure

AI could encourage innovation through self-driving cars, predictive maintenance, and smart manufacturing. AI applications can also improve urban planning and transportation for long-term infrastructure.

2.10 SDG 10: Reduced Inequalities

AI can help data-driven solutions to address inequities in healthcare, education, and social services. AI-powered social network analysis can help identify underrepresented groups and provide targeted support.

2.11 SDG 11: Sustainable Cities and Communities

Intelligent traffic management and waste management systems, for instance, can increase urban sustainability. AI-powered urban planning can assist cities in becoming more resilient and inclusive.

2.12 SDG 12: Responsible Consumption and Production

AI has the ability to improve supply networks while reducing waste and resource consumption. Artificial intelligence-driven product design and lifetime ratings can encourage ecologically sustainable behaviours.

2.13 SDG 13: Climate Action

AI can analyse climate data, model climate change scenarios, and assist in weather prediction. Climate monitoring powered by AI can aid in preparing for and responding to disasters.

2.14 SDG 14: Life Below Water

AI solutions that use underwater robotics and computer vision may aid marine conservation initiatives by monitoring marine ecosystems, detecting illicit fishing activity, and detecting illegal fishing methods (Sao & Kim, n.d.).

2.15 SDG 15: Life on Land

By emphasising the conservation, restoration, and development of sustainable use of terrestrial ecosystems, we can put an end to deforestation, combat desertification, land degradation, and preserve biodiversity.

2.16 SDG 16: Peace, Justice, and Strong Institutions

AI can aid with early warning systems for conflict prevention and judicial systems by using predictive analytics. AI can also help fight corruption and increase government service efficiency.

2.17 SDG 17: Partnerships for the Goals

AI can encourage data exchange and engagement among stakeholders, allowing for cross-sectoral collaboration to handle complex global issues.

These are merely a few examples of how AI applications might help with the SDGs. To fully realise AI's promise for social good and long-term growth, governments, businesses, and individuals must collaborate to develop ethical AI.

3. IMPACTS AND BENEFITS OF AI FOR SOCIAL GOOD:

As illustrated in Fig. 1, AI has demonstrated significant impacts and benefits in enhancing social good and encouraging sustainable development across a wide range of sectors. By embracing AI technology, societies can deal with complex issues and generate new opportunities for positive change.

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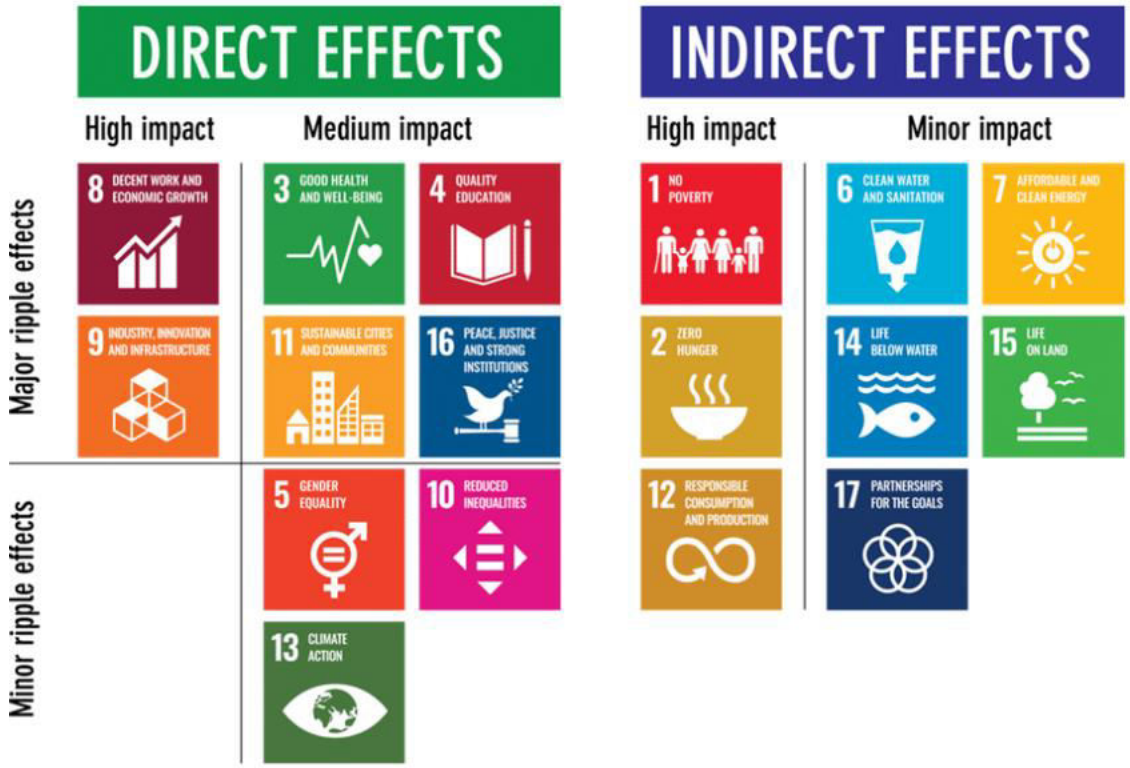

Fig. 1 A paradigm for classifying the SDGs based on its AI effect(Sætra, 2021).

3.1 Improved Decision-Making and Resource Allocation

Predictive modelling and data analytics enabled by AI enable evidence-based decision-making. AI can detect patterns and trends in vast datasets, allowing decision-makers to allocate resources more effectively. Such comprehension enables targeted interventions and optimal resource allocation.

3.2 Enhanced Healthcare and Disease Prevention

The application of artificial intelligence in healthcare has influenced patient care, drug research, and diagnostics. AI-powered medical imaging and diagnostic systems have showed higher precision and effectiveness in diagnosing ailments, ultimately leading to better health outcomes (Cockburn et al., n.d.).

3.3 Smart Agriculture and Food Security

AI-enabled precision agriculture enhances farming processes, increasing food yields while using less resources. By monitoring environmental conditions and crop health, artificial intelligence-driven systems contribute to food security and sustainable agriculture practises.

3.4 Quality Education and Personalized Learning

AI-powered education platforms provide personalised learning experiences tailored to the needs of each individual learner. To improve learning outcomes and address knowledge gaps, AI may adapt instructional tactics and materials (Shenkoya & Kim, n.d.).

3.5 Gender Equality and Women's Empowerment

By emphasising the importance of ethical AI development to combat gender bias in algorithms and ensure fairness and inclusion, AI may play a significant role in furthering gender equality by removing bias and enhancing gender parity.

4. IMPORTANCE OF RESPONSIBLE AI DEVELOPMENT:

Responsible AI development is vital if the potential of Artificial Intelligence (AI) for societal good is to be realised. The purpose of the following section is to shed light on the critical variables that contribute to the appropriate and ethical application of AI technology.

4.1 Ethical Guidelines

For responsible AI development, precise ethical criteria and principles must be established. These ideas should address concerns about fairness, openness, accountability, and privacy in AI algorithms and decision-making processes. AI programmers can ensure that their work is fair, impartial, and consistent with social standards by adhering to moral principles (Greene et al., n.d.).

4.2 Stakeholder Engagement

Responsible AI development involves collaboration with a wide range of stakeholders. Understanding the potential implications and challenges of AI applications demands collaboration among governments, academia, non-profits, industry professionals, and affected communities. Participation of stakeholders in decision-making ensures that AI technology meet genuine demands and issues (Francescato, n.d.).

4.3 Inclusivity

Responsible AI development strives for inclusion and accessibility for all people and communities. To avoid exacerbating already-existing gaps, developers must consider the needs of a wide range of user groups, particularly impoverished and vulnerable communities. AI advancements benefit everyone because of inclusive AI design, which also avoids prejudices from being reinforced.

4.4 Risk Mitigation

A thorough risk assessment and risk-mitigation strategies are required for responsible AI development. AI initiatives should go through extensive testing, validation, and continual monitoring to identify and manage any risks and unforeseen consequences. By implementing risk mitigation techniques, you may reduce the likelihood of negative things happening and ensure the security of your AI solutions (Makridakis, 2017).

4.5 Human-Centric Approach

In responsible AI development, human well-being and interests are to be prioritised. Rather than replacing or circumventing human judgement, AI technology should enhance human talents and decision-making. Keeping a human-centric perspective guarantees that AI remains a tool to help humans rather than an autonomous entity.

5. CONCLUSION:

AI has the ability to generate positive change and help accomplish the SDGs for societal benefit. By utilising AI technology, we can overcome several challenges and work towards a more promising tomorrow. AI can help us make better decisions, improve healthcare, improve education, promote gender equality, properly manage resources, and safeguard the environment. Collaboration and inclusivity are crucial to realising AI's societal benefit potential. Governments, organisations, communities, and individuals must work together to trade information and build coalitions. By working together, we can develop ethical AI practises and ensure that the benefits of AI reach everyone, putting no one behind. However, it is critical to consider the ethical consequences of AI. To build trust and ensure that AI is utilised responsibly, issues such as bias, privacy, and transparency must be addressed. Responsible AI development will allow us to create a future in which AI improves human welfare globally and contributes to long-term development. To summarise, AI offers immense potential for achieving the SDGs and positively influencing society. By embracing AI for social good, we can create a more welcoming, fair, and sustainable future for all.

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INTELLECTUAL PROPERTY RIGHTS AND YOUTH INNOVATION

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❖ ABSTRACT:

Intellectual property is the wealth that a person acquires due to his intellectual quality and diligence, as well as his creativity. Just as every individual benefits from intellectual property, so should society benefit from his talents. Talents in a person, e.g., drawing, singing, scientific research, etc., once presented, are easily subject to theft due to technological advances. E.g., copying a CD, doing someone else's research in one's own name, etc. In this way, other people can take advantage of the intellectual property of others. In such cases, it is necessary to protect this intellectual property right. The efforts of the World Intellectual Property Organisation and the World Trade Organisation resulted in various intellectual property rights laws. It includes the laws of ownership rights (patent), trade marks (trademark), trade names (tradename), publishing rights (copyright), etc. In this article, we are going to study Intellectual Property Law.

Keywords: *public awareness by government, worldwide market, protected by laws, intellectual activity, innovation by innovators*

❖ INTRODUCTION:

The World Intellectual Property Organisation was created in 1967 to deal with matters of global importance such as patents, trademarks, copyrights, and geographical indications. The World Intellectual Property Organisation has 193 member states. Since India has also been a member of this organisation since the very beginning, India has developed its intellectual property laws in accordance with the agreements of this organisation. These laws came into special force during the period of COVID. If a COVID vaccine developed by one member state is patented, that vaccine cannot be manufactured in another member state without permission. That is, the coordination between the member countries of the World Intellectual Property Organisation regarding the protection of each other's intellectual property has been determined. Considering this, the World Intellectual Property Organisation has gained great importance in recent times. From India's point of view, India is providing a large number of research, development, and intellectual property-based tax incentives, and its expected effect is visible. Due to public awareness by the government, imitation or production of fake products is decreasing. Importantly, the Government of India is also providing concessions to those using intellectual property in small and medium enterprises. A total of 1,115 Indians and 7,133 foreign nationals or entities were granted intellectual property rights in 2016. In the year 2017, a total of 1,712 Indians and 10,675 foreign nationals or entities were granted intellectual property rights. That is, there are more intellectual property rights granted to foreign nationals or entities than to Indian nationals.

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Intellectual property rights include patents, copyrights, industrial design rights, trademarks, rights to crop varieties, commercially visible geographical indications, and trade secrets. Currently, many issues like employment, energy, and pollution are raising their heads all over the world. All these questions should be answered through brainstorming. And the said answer will be registered as the intellectual property of that person, which will certainly benefit that person as well as their country. As a result, it will have access to a worldwide market for its intellectual property by addressing important world issues.

❖ BRIEF HISTORY:

Laws and administrative procedures related to IPRs have their origins in Europe. The patenting trend started in the fourteenth century. England was technologically advanced in some respects compared to other European countries and used to attract artisans from elsewhere on special terms. The first known copyrights appeared in Italy. Venice can be considered the cradle of the IP system, as most of the legal thinking in this area was done here. Laws and systems were made here for the first time in the world, and other countries followed suit in due course. Patent law in India is more than 150 years old. The first is the 1856 Act, which is based on the British patent system and provides for a patent term of 14 years. It has been followed by several laws and amendments.

❖ INTELLECTUAL PROPERTY CONCEPT:

IP is the result of intellectual activity, which is protected by regulatory laws (Article 1125 of the Civil Code of the Russian Federation). Intellectual property is characterised by the following characteristics:

- *Intangibility*: IP is different from tangible assets. The latter can be transferred to other people and used at work. In most cases, the same physical object cannot be used by two people at the same time. Simultaneous use is possible for multiple users located at different locations with respect to IP.
- *Exclusivity*: All rights to intellectual property belong to the copyright holder.
- *Embodiment of IP in physical objects:* for example, a person buys a disc with an album by a music group. The person owns the disc, but the person has no rights to the music itself.

Not all tangible assets can be considered intellectual property. IP objects are listed in Article 1225 of the Civil Code of the Russian Federation. If the property is not included in the list established by law, it cannot be considered IP. That means any person can use this property.

Objects representing IP can be completely different. However, they are characterised by several common features:

- It is the result of creative or intellectual activity.
- In relation to the subject matter, a complex of property and non-property rights applies.
- Long-term use: An important feature of intellectual property subject to accounting is the ability to derive profit from it.

A right to an IP object is understood as a complete set of rights. For example, a copyright holder may reproduce, sell, publicly display, modify, or rent a work. Accordingly, if a person does not have property rights, he cannot perform these actions.

❖ PROPERTY OWNERSHIP:

No matter what position a man holds or not, he wants rights. Rich or poor, everyone wants to own something. like a house, car, computer, mobile, etc. In simple words, documents to prove your ownership, e.g., house documents, car registration, mobile receipt, etc. All these prove your ownership of your property. All these material things happened.

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❖ WHAT IS INTELLECTUAL PROPERTY?

But if society has an invention or an idea, how will it prove its ownership? Intellectual Property Rights (I.P.R.) originate from this question.

This includes intellectual property rights, i.e., I.P.R., which give us the legal right to claim that an invention we have made, a mark we have created and are using, or an idea we have brought to the world is ours.

❖ OBJECTIVES:

1) Adherence to intellectual property laws in cooperation with all countries,
2) Establishing new agreements and tools for the economic, social, and cultural development of the participating countries.
3) Encouraging human intellectual creativity.

❖ RESEARCH METHODOLOGY:

All the information in this article has been collected by the researcher from the website. Because in due time from various sources, viz., it is very difficult to collect data from all 7 sources like books, journal newspapers, reports, etc., researchers have collected data online using the theoretical method.

❖ LITERATURE REVIEW:

A careful examination of the available sources for the research work of the said article and the collected data shows that there is a lot of information on the topic "Intellectual Property Rights and Youth Energy Needed for Innovation". No supplementary information was used.

❖ TYPES OF INTELLECTUAL ATTRIBUTES AND THEIR DESCRIPTIONS:

Originally only patents, trademarks, and industrial designs were protected as 'industrial property', but now the term 'intellectual property' has a wider meaning. IPRs have enhanced technological progress in the following ways:

(a) It provides a mechanism to deal with infringement, piracy, and unauthorised use.

(b) It provides a pool of information to the general public as all types of IP except trade secrets are published. IP protection can be sought for various intellectual endeavours, including this

(i) Patents

(ii) Industrial designs of any shape, configuration, surface pattern, 2-D, e.g., textile, or 3D, toothbrush,

(iii) Trademarks refer to any mark, name, or logo under which any product or service is traded and by which the manufacturer or service provider is identified. Trademarks can be bought, sold, and licenced. A trademark has no existence apart from the goodwill of the product or service it symbolises.

(iv) Copyright relates to the expression of ideas in physical form and includes literary, musical, theatrical, artistic, cinematographic works, audio tapes, and computer software.

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(v) Geographical indications are indications that identify the good as originating in the territory of a country or in a region or locality within a territory where a given quality, prestige, or other characteristic of the good is essentially attributable to its geographical origin.

A patent is granted for an invention that meets the criteria of global novelty, non-obviousness, and industrial or commercial application. Patents can be granted for products and processes. According to the Indian Patents Act 1970, the patent term was 14 years from the date of filing, except for the process of manufacturing drugs and foodstuffs, for which the term was 7 years or 5 years from the date of filing. Patent, whichever is earlier. No product patent has been granted for drugs or food. Copyright generated in a member country of the Berne Convention is automatically protected in all member countries. India is a signatory to the Berne Convention with no registration required and has one of the best copyright laws of any country. However, copyright is not automatically available in countries that are not members of the Berne Convention. Therefore, copyright cannot be considered a territorial right in the strict sense. IPR can be transferred, sold, or gifted like any other property.

❖ INTELLECTUAL PROPERTY RIGHTS AND INNOVATION:

Today's age is one of research and innovation. The industry is focused on making every product more innovative and customer oriented. It is the plan of every industry to make it as efficient and attractive as possible. Therefore, new technologies are used. Due legal care should be taken to ensure that the same technology is not used by a competing industry. That is intellectual property right

❖ INTELLECTUAL PROPERTY RIGHTS (PATENTS):

An inventor's registration of his innovation at the government level means he has intellectual property rights. These rights give the inventor the exclusive right to protect his invention. Any other person or organisation cannot use his product as an invention or anything else and must obtain permission to use it. If someone uses it without permission, it is considered an offence under the law. Anyone with an intellectual property right can use the inventor's technology with prior permission for a specified period of time by paying appropriate financial compensation. Therefore, intellectual property rights are complementary to improving the economy. The Indian Intellectual Property Rights Act came into being in 1856 and granted these rights for fourteen years. The present Act came into force in 2005. Earlier, it was amended, enhanced, or updated in 1859, 1872, 1883, 1888, 1991, 1999, and 2002. In India, the Joint Controller/Deputy Controller for Intellectual Property Rights and Design has four offices located in Delhi, Mumbai, Chennai, and Kolkata.

❖ COPYRIGHT:

A copyright allows the assignee to apply his design to any intangible object that is partly artificial or partly natural, or to spare parts of such objects that can be separately manufactured and sold. Composition is the shape, form, style, placement, cut, pattern of colours or lines, and two-dimensional or three-dimensional appearance of an abstract object. Presently, India has the Designation Act 2000, under which ownership rights are granted to the applicant for 10 years.

❖ TRADEMARK:

Trade mark registration started in India in 1940 and is currently done under the Trade Marks Registration Act of 1999. A trade mark certificate distinguishes goods or services based on their origin, raw material production method, performance, or quality, as claimed by the manufacturer. These offices are present in Mumbai, Ahmedabad, Chennai, Kolkata, and Delhi. International trade marks are assigned according to the Madrid Protocol.

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❖ GEOGRAPHICAL INDICATION:

A geographical mark is an industrial property of goods based on a specific geographical location, such as a country, state, city, or place of origin, that conveys the quality or distinctiveness of the goods. The goods are classified into 34 categories. It includes chemicals, paints, bleaching powders, lubricants, pharmaceuticals, metals, machine tools, hand tools, surgical instruments, vehicles, musical instruments, furniture, clothing, etc. All innovators need to be aware of these rights so that they can take proper care of their innovations.

❖ CONCLUSION:

Intellectual property is still taught as an optional subject in many countries, such as India, while in China and Japan the subject has been given a permanent place in the school curriculum. Since this is a component of primary education in Japan, children's attitudes are formed at an early age. At the 10th–11th grade stage, children carry out research projects. Not only this, but they also get patents. We need to remove the apathy and ignorance regarding the subject as a whole. We should go to the root of this apathy. India's record of intellectual property is minimal, as school curricula do not include patents or similar intellectual property, or intellectual property is not a subject in college curricula. India is now considered to be the youngest country in the world. But if they do not know that the element or object created by the minds of these young people can be protected by intellectual property rights, they will not create intellectual property. Efforts are also needed on this front to reap the dividends of the young population. Advanced nations have achieved great success in channelling the energy of the youth towards innovation, and if India follows suit, Indian intellectual property will surely grow.

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PUBLIC SERVICE GUARANTEE ACT 2011: FEATURES, PROVISIONS AND IMPACT

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❖ ABSTRCT:

We have discussed about the concept of good governance in of this Course. In this Unit, we shall orient you with some of the initiatives taken in India such as Public Service Guarantee Act, Right to Information, Citizen's Charters, and Corporate Social Responsibility.

❖ INTRODUCTION:

Administration is an integral part of citizens and vice versa; the two are completely intertwined. The basic aim of administration is the welfare of the people that is, providing them the basic amenities of life. The success of any administrative system depends on the efficient and effective delivery of these services to the citizens. The administration on its own cannot provide effective goods and services to its citizen. It needs their support and cooperation. In other words, citizens should become active participants in the process of service delivery and should cooperate with administration. Since we talk of governance, citizen-centric administration is a key aspect.

In fact, in the contemporary context, the powers and functions of the State have increased manifold and the scope of administration has widened. In this process, it has acquired immense discretionary powers and prerogatives. It is generally felt that in the exercise of vast administrative powers, there is always scope for malpractices, corruption and harassment of the citizens. It is being increasingly realized that the existing mechanism for the redressal of the citizens' grievances is inadequate to safeguard the citizens against the arbitrary use and misuse of power by the administrators and public authorities. In addition, citizens interact with administration every day for getting basic

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services such as water, electricity and so on. Bhattacharya (2008) categorizes citizens' interactions with administration into five forms- clients, regulates, litigants, participants and cutting-edge encounters. Many a times it makes them dissatisfied with the provision of services. This realization has given rise to the need to bring administration closer to citizens and regain their trust in the former. The good governance initiatives are steps in this direction.

❖ 1.2 PUBLIC SERVICE: MEANING:

Public service is associated with government and it is offered and guaranteed by the administrative bodies to its citizens. Public services offer the most common interface between the citizens and the State. Their functioning and delivery shape peoples' sense of trust in and expectations of government. The government through its various tiers –central, state and local – aims to provide equitable standards of living by opening up schools and hospitals, running an efficient public delivery system, and improving the standard of living of the people. These services are provided by the government to its citizens, either directly or by financing the private players.

Public service means all the goods and services, including functions, obligations, responsibility or duty, to be provided by a public authority (Citizen's Charter Bill 2011). Public services are those services which are mainly, or completely, funded by taxation. These services do not normally operate for financial profit or require an immediate payment for goods and services prior to delivery (Flynn, 1990). They are primarily of non- commercial character and are free of market competition. These services are provided on equitable basis and the resources are allocated according to need. Public service to a large extent caters to the consumers who do not have much choice in the market.

A public service is associated with the government and it is offered by the administrative bodies to the citizens living within its area of jurisdiction. It provides a medium of common interface between people and the government. These services are to be provided within a stipulated time frame under the Public Service Guarantee Act/ Right to Services Act in India. Some of the common public services which are to be provided as per the Act are the issuing of birth, caste, marriage and domicile certificates, electric connections, voters identity card, ration card, copies of land records and so on. The nature of these services is monopolistic, oligopolistic and mandatory.

❖ FACTORS PROMOTING EFFECTIVE PUBLIC SERVICE DELIVERY IN INDIA:

Public service delivery, in a developing country like India, is an important and integral part of the governance process. Without a proper delivery mechanism in place, we cannot deliver public services to the citizens. Since independence, many efforts have been made in this area, but desired results could not be achieved for some reason or the other. The public service delivery has been plagued with shortcomings in the bureaucratic system as also the political malpractices. Corruption in public distribution system and fair price shops has been very alarming. According to a data, an estimated 58 per cent of the subsidized food grains issued from the central pool do not reach the target groups i.e., the below poverty line families, and around 36 per cent is siphoned off in the supply chain (Planning Commission, 2009).

In such a scenario, the public service delivery was bound to suffer and the worst victims of this were the marginalized people living in the rural areas. During the nineties, with the reform era in place, efforts to make public service delivery gathered momentum. Since then a number measures were adopted to enhance and promote the public service delivery in India. Some of these factors are discussed below:

There has been a global wave of efforts to reform the State especially since late eighties and early nineties. The concept of good governance with emphasis on adherence to rule of law, accountability, responsiveness, transparency triggered various initiatives.

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- **Decentralization:** It is one such reform effort advocated throughout the globe. Accordingly, many countries decentralized State powers to the subnational governments and shifted some of its powers to the periphery. India was no exception to this. It formalized decentralization by establishing local governments through 73rd and 74th Constitutional Amendments in 1992. Though decentralization of finances and functions started way back in the 19th century, it was the 73rd and 74th Amendments that brought decentralization to the forefront.

Decentralization has become one of the most politically correct ideals for better governance in today's time. It was seen as a means to reform the State in order to improve effectiveness of development programs and schemes, public service delivery and thereby speeding up the process of development. It was also seen as a means for widening and deepening the roots of democracy, bringing government closer to the people, thereby fostering greater people's participation, civic virtue, protection of civil liberties and government accountability (Mullen, 2012).

Decentralization has been looked at as a singularly useful mode of administration to deliver the public services from convenient local centers close to the clients' locality and thus more responsive to local needs. The developing world has undergone some form of decentralized governance in line to meet peoples' demands (Islam, 2007). Bringing administration to the doorsteps of the citizens and establishing a direct relationship between the citizens and the administration have been the driving force behind decentralization in most of the countries.

- **Citizen's Awareness and Demand for Better Public Services:** The contemporary times is witnessing information upsurge and people demanding better public services.
- **Community Mobilization:** This is one of the key factors impacting effective public service delivery. People mobilizing in form of self-help groups, community-based organizations and so on, assert their rights in demanding effective public services.
- **Technology**

Technology in current scenario influences public service delivery. It impacts governmental functioning, sharing of information and delivery of services to the internal and external clients. It also ensures transparency and accountability in the delivery of public services as also in the governance process. The information and communication technology brings government services to the beneficiaries in a transparent, speedy, easy and efficient way. The ICT-based governance opened new economic opportunities, brought transparency in public-private transactions, insights into outsourcing processes and an accountable administration. It introduced a minimum guarantee against arbitrary exchanges and government procurements and some form of standardisation of procedures (Nath, 2016).

The application of electronic means in the interaction between government and citizens (G2C) and government and business (G2B) as well as in internal government operations (G2G) has simplified and improved democratic government and business aspects of governance (Saxena, 2005). By providing online access and information to the citizens with regard to land records, caste and income certificates and various other government services, things have become very simple and easy for the citizens. Just by a click of the mouse, they get things readily available at their doorstep.

E-governance and digitalization is changing the way governments are addressing the problems of the citizens and delivering them. Digitalization will go a long way in making the system accountable and transparent and also ensure better and efficient delivery of public services.

The State level e-governance projects like Akshaya in Kerala, Gyandoot in Madhya Pradesh, Digital Saksharta Abhiyan in Haryana, SWAGAT in Gujarat, APSWAN and TWINS in Andhra Pradesh, Bhoomi in Karnataka, E-Mitra and Rajasthan Sam park in Rajasthan, etc., are a proof that ICT

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is extensively being used in the various government departments for enhancing efficiency, transparency, accountability and providing better quality and time bound services to the people. We have discussed this in detail of this Course.

On the whole, the impact of technology on governance has been encouraging. It represents a win- win situation for all the stake holders – the private sector, market, government; increases efficiency and effectiveness, citizens get more convenient services with greater transparency and less corruption. The innovative E-government applications have been already been implemented in isolated pockets. However, the real challenge is to have wide scale impact. Making E-government wide spread involves bridging the digital divide, enabling access to internet to rural areas and setting up into kiosks. A major task is to build institutional capacity for government reforms.

❖ PUBLIC SERVICE GUARANTEE ACT:

The public services law in India owes its origin from the Citizen's Charter of UK, which was promulgated in 1991. It is not a legal document in the strict sense of law. It is an agreement of contract entered into between the citizens and the public servants, which provides for competent and time bound delivery of services. It sought to add consumer rights to the list of citizens' rights, and thereby equipping them with the means of seeking personal redress if the services which they received were inadequate and not as promised. The main idea behind the charter was to make public services accountable, i.e., if the public service which people have paid for is not of good quality, then why should they not get their money back? This way they would have the right to purchase it from any shop or service provider in the private sector which is providing them better services.

The public service guarantee act is also known as Right to Public Services Act in some states. It provides for legislation and statutory laws that guarantee time bound delivery of services by the government to the citizen and provides mechanism for punishing the errant public servant who fails to provide the service stipulated under the statute, within stipulated time.

The introduction of Right to Services Act in India has given a powerful weapon in the hands of citizens of India. The era before its inception witnessed tormenting state of government departments where citizens had to go through unspoken hassles, corruption, delayed services with lack of transparency by some errant public servants with a sense of impunity in their government departments. In consideration for growing incidents, complaints and to introduce a statutory mechanism that could control such activities, the Right to Public Services Legislation was enacted.

The Right to Services Act is considered to be one of the most effective ways to reduce corruption in India, enhance transparency in public sector operations and provide public accountability. It is a state legislation and the states have complete discretion to adopt, implement and limit the Act in whatever manner they deem fit. Currently, there are twenty states that have implemented this Act and it represents duty towards citizens by providing them standard, quality, transparency and timely delivery of public services, in addition to an enforceable grievance redressal mechanism. Madhya Pradesh was the first state to enact the Right to Service Act on 18th August 2010 and Bihar became the second state to implement it on 25th July 2011. The other states which followed the suit are Delhi, Punjab, Rajasthan, Kerala, Uttar Pradesh, Uttarakhand, Himachal Pradesh, Odisha, Jharkhand, Haryana, West Bengal, Gujarat, Jammu & Kashmir, Goa, Maharashtra, Karnataka, Chhattisgarh and Assam.

❖ MAIN PROVISIONS OF THE ACT:

The main provisions of the legislations in various states provide for granting of "right to public services", to the public by the designated official within the stipulated time-frame. Under the legislation,

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the public services are to be granted as a right and are generally notified separately through gazette notification. Some of the common public services

which are to be provided within the fixed time frame as a right under the Acts, include issuing caste, birth, marriage and domicile certificates, electric connections, voter's card, ration cards, copies of land records, etc. If the designated officer fails to provide the public services within the stipulated time or rejects to provide the service, the aggrieved person can approach the First Appellate Authority. The First Appellate Authority, after making a hearing, can accept or reject the appeal by making a written order stating the reasons for the order and intimate the same to the applicant, and can order the public servant to provide the service to the applicant. An appeal can be made from the order of the First Appellate Authority to the Second Appellate Authority, who can either accept or reject the application, by making a written order stating the reasons

for the order and intimate the same to the applicant, and can order the public servant to provide the service to the applicant or can impose penalty on the designated officer for deficiency of service without any reasonable cause, which can range from Rs. 500 to Rs. 5000 or may recommend disciplinary proceedings. The applicant may be compensated out of the penalty imposed on the officer. So far as the general procedure under Public Service Guarantee Act is concerned, once they submit an application to the public officer for the preferred service, citizens receive an acknowledgement. After that, the officer is ideally supposed to render the

preferred service within the stipulated time from the date of the acknowledgement. As per the prescribed rules of government offices, acts and provisions as applicable on any respective government office, every service should be provided to the applicant within the fixed time frame unless there is some genuine reason. But, if the said officer fails to render the services within the given time-frame, the applicant is empowered by the Act to approach the First and Second Appellate Officers. The Appellate Officer shall instruct and bind the officer to provide the service to the applicant as they have the power and authorities to impose the penalty, summon designated officers and instruct them to produce related documents. Any delay after the given instructions by the Appellate Officer shall attract fine on the delaying officer as per the State Provisions of the Act. Even the Appellate Officer can be penalised under this Act if he/she fails to perform his/ her service or fails to give the substantial reason for non-performance or delivery of his/ her service.

❖ IMPACT OF THE ACT:

With around twenty states adopting the Act, it exhibits actual efforts made to curb corruption and foster transparency in government departments, which can help the citizen to avail public services without any hassle. However, the question that arises after the adoption of Right to Public Service Act is how well its implementation has transformed the existing system? The answer is right here! It is evident that there are variations in the Public Service Acts of the state with regard to the services they provide and the penalty mechanism for the failure to provide the public services. Each state has laid down penalty on failure to deliver the service within the set time and amount of penalty provided by states differ. The impact of the Act depends on every state's implementation order. If the implementation is strong, the legislation can play an instrumental role in curbing corruption and tracking the workflow in each government department. Amongst all the states mentioned above, Karnataka has won accolades. The past figures revealed that in a month-long pilot study, one lakh applications were filed and out of them, 87,000 have been successfully disposed of. It is true that some of the participating states have had poor implementation and some have the good implementation.

So far as the central level is concerned, the Central Government proposed Citizen's Charter and Grievance Redressal Bill, 2011 or Right of Citizens for Time Bound Delivery of Goods and Services

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and Redressal of their Grievances Bill, 2011 on the same lines as that of Right to Services Act. It still has to be passed in the Parliament. It shall apply to central government departments, constitutional bodies, statutory authorities, Public- Private Partnerships and NGOs mainly funded by central government.

❖ RIGHT TO PUBLIC SERVICE – NEED:

- Citizens had to suffer through unstated difficulties, corruption, delayed services, and a lack of transparency by certain wayward public officials with a sense of impunity in their Government Departments in the years leading up to its start.
- The Right to Public Services legislation was enacted in response to an increase in incidents and complaints, as well as to establish a statutory system to regulate such activities.
- The Right to Public Services legislation is widely regarded as one of the most successful tools for reducing corruption, increasing transparency in government processes, and increasing public accountability in India.
- The fight against corruption has already begun, and this Act focuses on enacting efficient methods for redressing public grievances against misguided public officials.

❖ FEATURES AND SIGNIFICANCE:

- The Right to Service Act incorporates legislative legislation and procedures that ensure citizens of India receive timely public services.
- It also establishes the legal framework for punishing delinquent public servants who fail to provide requested services within a specified time frame.
- One of the most successful ways to decrease corruption in India is through the Right to Service Act, enhancing transparency in public sector operations and providing public accountability.
- It is a state law, and states have complete authority in adopting, implementing, and limiting the Act as they see fit.
- Currently, about 20 states are implementing this Act, which represents the state's responsibility to people by ensuring standard, quality, transparency, and timely delivery of public services, as well as an enforceable Grievance Redressal Mechanism.
- On August 18, 2010, Madhya Pradesh became the first state to enact the Right to Service Act, and on July 25, 2011, Bihar became the second to put it into effect.
- The Manipur government has announced the opening of a single-window services centre in Imphal, which will feature door-to-door delivery of government services beginning in November.

❖ CHALLENGES:

- Bribery delays in services, a lack of transparency,and clarity on the list of documents required for application.
- Lack of transparency about officials accountable were the most significant issues they faced.
- According to a survey conducted by Transparency International in 2020, India ranks first in Asia for bribery.
- In India, people are mostly unaware of their rights and responsibilities.

❖ WAY FORWARD:

- Even before the Act was enacted, many states spent a significant amount of time and effort preparing their government systems to handle the increased workload and produce the desired results.

- In terms of streamlining procedures, standardising application forms, establishing a precise list of supporting papers, addressing accountability, and so on, a speedy re-engineering of essential processes was conducted.
- In most of the states that have implemented a real-time payment system (RTPS), the citizen interface points for receiving applications and delivering services were also separated from the back office.
- Certain states, such as Madhya Pradesh's Lokseva Kendras, Bihar's Vasudha Kendras, and Jharkhand's Pragya Kendras, have either taken personnel- or performance-based contracts or facilitated innovative fee-based private participation to strengthen this front-end, citizen-facing counters.
- Field-level personnel from the block and district offices were also briefed on the importance of the Act, and needed to deliver services on time.
- Most crucially, these states conducted frequent mass awareness efforts via newspapers, television, and radio to build demand-side pull.

❖ CONCLUSION:

The Right to Service Act is widely regarded as one of the most successful tools for reducing corruption, increasing transparency in government processes, and increasing public accountability in India. The fight against corruption has already begun, and this Act focuses on enacting efficient methods for redressing public grievances against misguided public officials. Some states have already enacted a package of reforms to ensure government service delivery.

Citizens' expectations of government departments were diminishing, but the passage of legislation such as the Right to Information Act, the Right to Service Act, and the Lokpal Bills, among others, restored their faith in governance.

❖ ACKNOWLEDGEMENT:

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DIGITAL IDENTITY CRISIS: VOICES OF TEACHERS IN HIGHER EDUCATION

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❖ ABSTRACT:

The integration of technology in higher education has revolutionized the teaching landscape, ushering in a new era of digital engagement and interaction. However, this digital transformation has not been without its challenges, particularly for educators. The digital identity crisis among teachers in higher education encompasses concerns about privacy, online presence, digital competencies, and the balance between personal and professional lives. This study tries to explore the lived experiences and struggles of teachers as they navigate the complexities of their digital identities. Drawing upon personal narratives and professional reflections, this study highlights the multifaceted nature of the digital identity crisis, shedding light on the impact of technology on the teaching profession.

Keywords: *digital identity, identity crisis, higher education*

❖ INTRODUCTION:

Identity crisis is a psychological concept that refers to a period of uncertainty and confusion in an individual's life regarding their self-concept, values, roles, and overall sense of identity. This term was first introduced by psychoanalyst Erik Erikson in his theory of psychosocial development. It is typically experienced during adolescence but can occur at any stage of life when significant life changes or challenges arise. Several theories help explain the concept of identity crisis and its impact on human development.

1) Erik Erikson's Psychosocial Theory:

Erikson proposed a series of psychosocial stages, and the fifth stage, occurring during adolescence, is identity versus role confusion. This stage involves adolescents seeking to establish a sense of identity and may explore different roles and values to find their place in society. Failure to resolve this crisis may lead to role confusion and a weaker sense of self.

2) James Marcia's Identity Status Theory:

Building upon Erikson's work, James Marcia identified four identity statuses based on the presence or absence of crisis and commitment. These are:

a. Identity Diffusion: No crisis or commitment; a lack of direction and purpose.
b. Identity Foreclosure: Commitment without crisis; adopting roles and beliefs without exploration.
c. Identity Moratorium: Crisis without commitment; actively exploring different possibilities.
d. Identity Achievement: Crisis followed by commitment; a clear sense of identity after exploration.

3) Social Identity Theory:

Social identity theory, proposed by Henri Tajfel, suggests that individuals define their identity based on group affiliations. This theory highlights the importance of social categorization and social comparison. During an identity crisis, individuals may reassess their social group memberships and seek new ones that align better with their evolving self-concept.

4) Cognitive Development Theory:

Developed by Jean Piaget, this theory focuses on the cognitive changes that occur during adolescence. In the formal operational stage, individuals gain the ability to think abstractly and engage in hypothetical reasoning. This cognitive shift enables them to explore different identities and evaluate potential roles and beliefs during an identity crisis.

5) Identity Processing Styles:

Kroger's identity processing styles outline how individuals approach identity-related information. These styles include information-oriented, normative, and diffuse-avoidant. During an identity crisis, individuals may shift between these styles as they gather and process information about themselves and their potential identities.

6) Social Support and Attachment Theory:

Attachment theory, pioneered by John Bowlby, emphasizes the importance of secure relationships during development. A supportive social network can provide a safe base for exploration during an identity crisis. Positive attachments can foster a stronger sense of self and the confidence to navigate this challenging phase.

7) Cultural and Environmental Influences:

Identity development is also influenced by cultural, societal, and environmental factors. Cultural norms, values, and expectations can shape how individuals perceive themselves and their roles in society. Immigrants and individuals from marginalized groups may experience unique identity challenges due to cultural conflicts or discrimination.

Identity crisis is a complex phenomenon influenced by various psychological, social, and cultural factors. The theories mentioned above provide valuable insights into how individuals navigate this critical period of self-discovery and identity formation. From Erikson's psychosocial stages to social identity theory, these frameworks shed light on the challenges and opportunities presented by the identity crisis and its profound impact on human development. Understanding these theories can help individuals, families, and professionals support and facilitate healthy identity development during times of uncertainty and change.

❖ DIGITAL IDENTITY:

Digital identity refers to the online representation of an individual or entity's unique characteristics, attributes, and interactions in the digital world. It encompasses a wide range of information, including personal data, online activities, preferences, and behaviours that are associated with a specific user or entity across various online platforms and services. In the digital age, people leave digital footprints as they engage in online activities such as social media interactions, online shopping, accessing financial services, or using digital communication tools. These activities contribute to the creation of a digital identity, which may include usernames, email addresses, IP addresses, browsing history, social media profiles, and more.

Digital identity plays a crucial role in online interactions, authentication, and authorization processes. It is the basis for various online services that require verification of a user's identity, ensuring security, privacy, and personalization. Digital identity management systems and technologies help organizations verify the identities of users to grant appropriate access rights and permissions. However, the growing prevalence of digital identity also raises concerns about privacy and data security. Mishandling or unauthorized access to digital identities can lead to identity theft, fraud, and other

cybercrimes. Therefore, ensuring the protection of digital identities is a significant challenge that requires robust security measures and privacy safeguards.

Furthermore, with the increasing reliance on digital services and the Internet of Things (IoT), the concept of digital identity is expanding beyond individuals to include devices and objects (e.g., smart home devices, wearable technology). These entities also have digital identities that enable them to communicate, interact, and share data with other connected devices and system. Digital identity is a fundamental aspect of our online presence and interactions. It encompasses the information and activities associated with individuals, entities, and even devices in the digital realm. As the digital landscape continues to evolve, ensuring the security and privacy of digital identities will remain a critical challenge for individuals, businesses, and policymakers alike.

The digital identity crisis refers to the challenges and complexities surrounding the management, security, and privacy of individuals' online identities in the digital age. As technology advances and more aspects of our lives move into the digital realm, people are generating vast amounts of digital data and leaving digital footprints across various online platforms and services. This digital trail often comprises personal information, online behaviours, preferences, and interactions, collectively forming an individual's digital identity. This study aims to find out how digital identity crisis is influencing the process of socialization in the digital era.

❖ PURPOSE OF THE STUDY:

The purpose of the study was to investigate and understand the challenges, experiences, and implications of teachers' digital identities in the context of the evolving digital landscape. The study aims to explore the multifaceted nature of the crisis and its impact on teachers' personal and professional lives, as well as the broader implications for the educational community.

❖ OBJECTIVES:

1. To Identify the Digital Identity Challenges Faced by Teachers
2. To Explore Teachers' Perceptions and Attitudes Towards Technology Integration
3. To Examine the Impact of the Digital Identity Crisis on Teachers' Well-being and Job Satisfaction

❖ MATERIALS AND METHODS:

To study about the challenges faced by higher education teachers in maintaining a digital identity that is always up to the mark a representative sample of 10 teachers from different facets in higher education was selected and an open-ended interview was conducted taking into consideration the objectives put forward for the study. The interview gave ideas about many broader aspects in the case of the digital divide existing among teachers.

❖ DATA ANALYSIS:

Once the data was collected it was prepared into codes and from the opinions of teachers a thematic analysis was conducted

❖ THEMATIC ANALYSIS:

The digital identity crisis has become a prominent concern as technology integrates further into academic settings. This thematic analysis aims to explore the experiences, challenges, and reflections of teachers as they navigate the complexities of their digital identities. Drawing from interviews and

surveys conducted with teachers from diverse backgrounds, this analysis sheds light on the multifaceted nature of the crisis and its impact on educators.

Theme 1: Balancing Personal and Professional Boundaries

"I feel torn between being myself and maintaining a professional image online. Sharing personal interests and experiences humanizes me as a teacher, but I worry about how it may be perceived by students and colleagues."

"I try to keep my personal life private, but it's challenging when students find and add me on social media. I want to connect with them, but I'm always conscious of maintaining appropriate boundaries."

Theme 2: Data Privacy Concerns and Online Vulnerability

"With the increasing use of online platforms, I fear my personal data might be at risk. I often wonder who has access to my information and how it might be used."

"I once experienced online harassment from an anonymous account, and it really shook me. It made me cautious about sharing too much online, even if it's related to my professional life."

Theme 3: Embracing Technology and Digital Competency

"At first, I was hesitant to integrate technology into my teaching, but I realized it's necessary to engage students. However, I sometimes feel overwhelmed by the constant need to learn new tools."

"I attended a workshop on digital competency, and it was eye-opening. Now, I feel more confident using digital tools, but there's still so much more to explore and learn."

Theme 4: Impact of Online Harassment and Cyberbullying

"I once received a hurtful comment on my blog, and it affected my confidence as a teacher. I didn't expect such negativity from the online community."

"Online harassment has made me more cautious about sharing my opinions online. I try to stay positive, but I feel like I have to tiptoe around certain topics."

Theme 5: Unequal Access to Technology and the Digital Divide

"Some of my students don't have access to reliable internet or devices, and it's disheartening. I want to provide equitable learning experiences, but it's challenging with the digital divide."

"It's frustrating to see how some schools have state-of-the-art technology while others struggle to provide basic resources. We need to address this disparity to ensure all students and teachers have equal opportunities."

❖ CONCLUSION:

The thematic analysis reveals that the digital identity crisis among teachers in higher education is a multifaceted issue with significant implications for educators. Teachers grapple with the challenge of balancing personal and professional boundaries in the digital space while being mindful of data privacy concerns and online vulnerability. They strive to embrace technology and develop digital competencies, but the experience is not without challenges. Online harassment and cyberbullying have a profound impact on teachers' confidence and behaviour in the digital realm. Additionally, the digital divide remains a significant barrier, affecting both teachers and students' access to technology and educational resources. Addressing these concerns requires proactive measures from both educators and policymakers to create a safer, more equitable digital landscape for teachers in higher education.

❖ RECOMMENDATIONS FOR TEACHERS:

1. Continuous Professional Development: Teachers should actively engage in continuous professional development to enhance their digital competencies. Participating in workshops, online courses, and conferences focused on educational technology will enable teachers to stay updated with the latest trends and best practices.

2. Responsible Digital Citizenship: Educate students about responsible digital citizenship and model appropriate online behaviour. Teachers should emphasize the importance of respecting others' privacy, citing reliable sources, and engaging in constructive online discussions.
3. Copyright Compliance: Familiarize themselves with copyright laws and intellectual property rights to ensure ethical use of digital resources. Teachers should encourage students to create and share original content while respecting copyright regulations.
4. Digital Equity Advocacy: Advocate for digital equity and access to technology for all students, particularly those from underserved communities. Teachers can collaborate with policymakers and community leaders to address the digital divide and ensure equitable opportunities for learning.
5. Personalize Learning: Leverage technology to personalize learning experiences based on students' individual needs and learning styles. Utilize digital tools that provide adaptive content and immediate feedback to support student progress.
6. Engage in Collaborative Learning: Encourage collaborative learning experiences among students, using digital platforms to facilitate group projects and peer-to-peer interactions. This fosters a sense of community and active engagement in the learning process.
7. Secure Online Spaces: Be proactive in securing online spaces and protecting personal information. Teachers should regularly review privacy settings on social media and other platforms to maintain a professional online presence.
8. Cultivate Lifelong Learning: Embrace a growth mindset and be open to learning from both successes and challenges in integrating technology. A willingness to continuously learn and adapt to new digital tools is crucial in the rapidly evolving digital landscape.

By implementing these recommendations, teachers and policymakers can collectively address the challenges posed by the digital identity crisis in higher education. Embracing technology responsibly, promoting digital equity, and fostering a culture of lifelong learning will empower educators to navigate the digital landscape successfully while providing students with equitable and engaging learning experiences.

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DIGITAL METAMORPHOSIS IN SUPPLY CHAIN MANAGEMENT: INSIGHTS FROM A MULTIDISCIPLINARY LENS

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❖ ABSTRACT:

This chapter takes a profound plunge into the topic of digital transformation within the realm of supply chain management (SCM), offering a perspective shaped by multiple disciplines. We navigate through the labyrinth of digital technologies and their profound impact on SCM, delineating a transition from conventional methods to more effective, technology-infused strategies. A comprehensive analysis of pre-existing literature paves the way for a discourse on the multifaceted nature of digital transformation, investigated through diverse disciplinary viewpoints - Business, Computer Science, Economics, and Human Factors, to name a few.

Keywords*: Supply Chain Management, Digital Transformation, Multidisciplinary Approach, Big Data Analytics, Artificial Intelligence, Blockchain Technology, Internet of Things, Cyber-Physical Systems, Economic Models, Human-machine Interaction.*

1. INTRODUCTION:

As we have entered the new era of digitalisation, Supply Chain Management (SCM) has found itself at the crossroads of a radical transformation. Inundated with cutting-edge digital technologies, the traditional contours of SCM have been redrawn, leading to improved operational efficacy, enhanced resilience, and heightened transparency. While such digital upheaval is predominantly deliberated within the confines of Business and Computer Science, this chapter aims to broaden the discourse, acknowledging the convergence of an array of disciplines instrumental in shaping the digital metamorphosis of SCM.

2. LITERATURE REVIEW:

The wealth of literature on digital transformation in SCM is wide-ranging, illuminating numerous facets like operational efficiency, cost-effectiveness, data-guided decision-making, and customer satisfaction.

2.1 Business Perspective

Within the business sphere, scholars have been cognisant of the profound influence of digital technologies on SCM. Seminal works such as that by Bowersox, Closs, and Cooper (2013) and Gunasekaran, Subramanian, and Papadopoulos (2017) champion the digital transformation in enhancing strategic and competitive advantage, fostering operational efficiency, and augmenting customer satisfaction.

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2.2 Computer Science Perspective

From the viewpoint of computer science, emphasis has been placed on the application and advancement of particular technologies in SCM. Technologies like Blockchain, Artificial Intelligence (AI), Internet of Things (IoT), and Cyber-Physical Systems (CPS) have particularly dominated the discourse (Kamble, Gunasekaran, & Sharma, 2018; Queiroz, Telles, & Bonilla, 2020).

2.3 Economic Perspective

Economists, in their quest, have sought to unearth the economic implications of digital transformation in SCM. Their primary focus has been on cost efficiencies, market dynamics, and the emergence of new economic paradigms as a result of the digital revolution (Tapscott & Tapscott, 2016).

2.4 Human Factors Perspective

In an often-neglected area, the human factors in SCM have recently garnered attention. Scholars have started to unravel the impact of digital transformation on workforce capabilities, job satisfaction, and the intricate dynamics of human-machine interaction (Brynjolfsson & McAfee, 2014).

Though the literature is replete with insights, it predominantly exists in disciplinary isolation. The aim of this chapter is to bridge this chasm, facilitating a holistic comprehension of digital transformation in SCM.

3. DIGITAL TRANSFORMATION IN SCM: A COMPREHENSIVE MULTIDISCIPLINARY APPROACH:

In this part of our discussion, we will dissect digital transformation in SCM through a multidisciplinary lens. By bridging the perspectives of the aforementioned disciplines—business, computer science, economics, and human factors—we present a holistic view of how they interact and contribute to the narrative of digital transformation in SCM. We aim to illustrate that digital transformation, while rooted in technology application, extends its tendrils into broader economic and societal spheres, affecting each in unique ways.

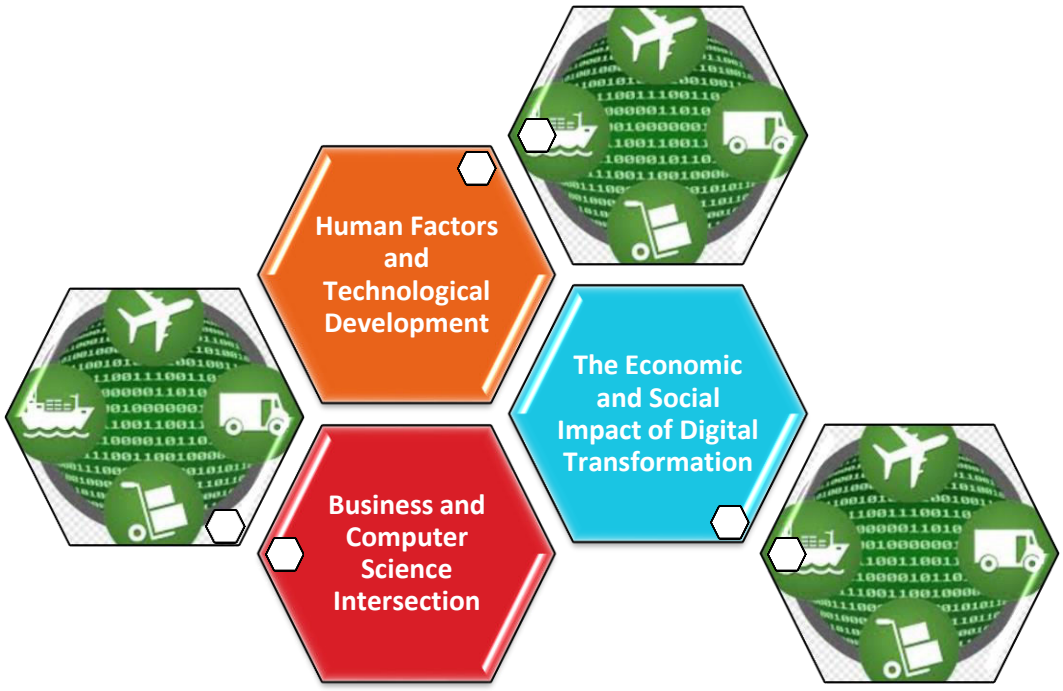

Figure 1: *Digital transformation in SCM through a multidisciplinary lens of disciplines*

3.1 Business and Computer Science Intersection

This section delves into the intricate symbiosis between business strategies and technological advancements, a junction where practical business needs meet cutting-edge technology solutions. The dynamic interplay of these fields is vividly seen in instances where technological breakthroughs have engendered new business models. For instance, the advent of Blockchain technology has given rise to decentralised and secure supply chain models, providing unprecedented levels of traceability and accountability (Tapscott & Tapscott, 2016).

On the flip side, strategic business imperatives have also acted as catalysts for the development of innovative technological solutions. For example, the rising demand for real-time data and predictive insights in SCM has accelerated advancements in Big Data analytics and Artificial Intelligence (Gunasekaran, Subramanian, & Papadopoulos, 2017). These intertwined progressions have fostered a more robust, transparent, and agile SCM environment, revolutionising the business landscape.

3.2 The Economic and Social Impact of Digital Transformation

Turning to the economic and social ramifications of digital transformation in SCM, we start by accentuating the compelling economic advantages. From streamlining operations to enhancing customer service, digital transformation has been a key driver for cost efficiencies and improved financial performance (Kamble, Gunasekaran, & Sharma, 2018).

However, there is also a cautionary tale to be told. As much as digital transformation promises considerable economic dividends, it may also foster socio-economic disparities. For example, the automation of routine tasks may lead to job displacement in the short term, causing social unrest (Brynjolfsson & McAfee, 2014). This reality underscores the importance of strategic policy interventions to ensure the equitable distribution of digital dividends and the facilitation of a just transition for all affected parties.

3.3 Human Factors and Technological Development

Finally, we delve into the sphere of human factors and their critical interplay with technological development. At the heart of digital transformation lies the human element—those who design, implement, and utilise the digital technologies permeating SCM. In this context, user-centred design becomes a crucial aspect. Technologies must be designed with the end-user in mind, ensuring ease of use, effective human-machine interaction, and ultimately, user acceptance and satisfaction (Brynjolfsson & McAfee, 2014).

Moreover, a digitally transformed SCM brings about an evolving set of skill requirements. There is a mounting need for individuals proficient in managing complex digital systems, analysing copious amounts of data, and solving intricate problems. This shift necessitates an overhaul of education and training programmes, equipping the workforce for the demands of a digital supply chain landscape.

Lastly, we examine the broader implications of digital transformation on job satisfaction and overall quality of life. With the advent of technologies such as AI and IoT, supply chain jobs are becoming more engaging, intellectually stimulating, and less tied to routine tasks, potentially leading to higher job satisfaction and improved work-life balance (Brynjolfsson & McAfee, 2014). This human-centric perspective, while often overlooked, is essential for a comprehensive understanding of digital transformation in SCM.

4. GLOBAL PERSPECTIVE: CASE STUDIES:

As the digital transformation in SCM plays out across the globe, it is vital to highlight the international nuances. Digital technologies have the power to knit together global supply chains in ways never before

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possible, but the impact varies from region to region, and between different economic sectors. In this section, we delve into a global perspective on digital transformation in SCM by examining six critical case studies, each representing a unique geographical and economic context.

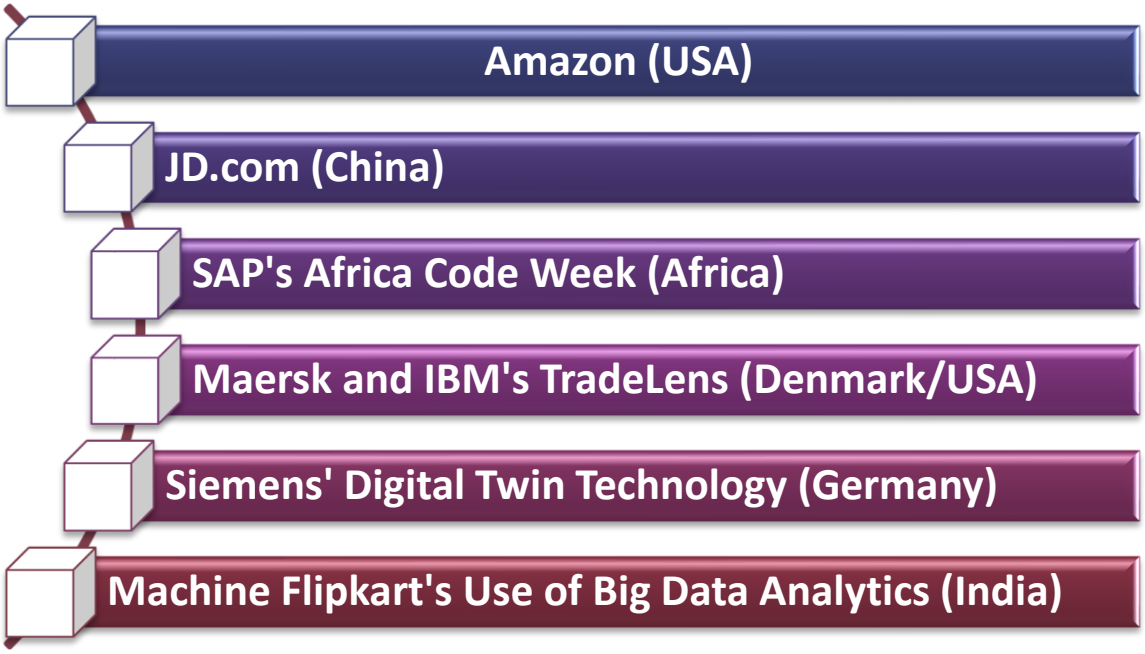

Figure: 2: *Six critical digital transformation in SCM case studies, each representing a unique geographical and economic context*

4.1 Amazon (USA)

Perhaps no single company epitomises the power of digital transformation in SCM as does Amazon, the global e-commerce behemoth. By leveraging sophisticated algorithms, AI, robotics, and IoT, Amazon has refined its SCM to near perfection, offering its customers unparalleled delivery speed and reliability. Their recent introduction of drones for delivery exemplifies their innovative spirit and technological prowess (Manyika et al., 2015).

4.2 JD.com (China)

In the Asian context, JD.com, one of China's largest e-commerce platforms, has leveraged digital technologies to build an end-to-end SCM solution. Their innovative use of AI and robotics in warehousing operations, paired with automated drones for rural deliveries, demonstrate their commitment to digital transformation. The result is a resilient, efficient and agile supply chain that spans across the diverse geographical terrain of China (Lee, 2017).

4.3 SAP's Africa Code Week (Africa)

Africa's digital transformation journey in SCM showcases the interplay between human factors and technology. Africa Code Week, an initiative launched by SAP, aims to develop digital literacy skills among African youth. The initiative aims to equip the future workforce with the digital competencies required in a digitally transformed SCM environment, providing a roadmap for a socially inclusive digital transformation (Gardner et al., 2019).

4.4 Maersk and IBM's TradeLens (Denmark/USA)

Blockchain technology is making waves in SCM, and TradeLens, a joint venture between Maersk and IBM, is a leading example. Leveraging blockchain's inherent transparency and security, TradeLens brings together disparate parties involved in a supply chain, from shippers to customs officials. This

global digital platform is revolutionising international trade by improving efficiency and reducing costs (Tapscott & Tapscott, 2016).

4.5 Siemens' Digital Twin Technology (Germany)

Siemens' adoption of digital twin technology in its SCM process is a game-changer. By creating virtual replicas of physical assets, Siemens can predict potential hiccups in its supply chain and adjust its operations proactively, mitigating risks. This German multinational corporation exemplifies how advanced digital technologies can bolster supply chain resilience and efficiency (Rosen et al., 2015).

4.6 Flipkart's Use of Big Data Analytics (India)

India's largest e-commerce platform, Flipkart, leverages big data analytics to optimise its supply chain operations. By analysing real-time customer data, Flipkart can anticipate demand trends, manage inventory more effectively, and improve their delivery timelines. This case illuminates the power of data-driven decision-making in transforming SCM (Gupta, George, & Baalen, 2020).

These case studies serve as poignant reminders of the global variance in the digital transformation journey in SCM. They underscore the myriad ways digital technologies are harnessed to enhance SCM, highlighting the unique regional and sectoral challenges that emerge along the way.

5. CONCLUSION:

This review has sought to provide a multifaceted analysis of the digital transformation in supply chain management (SCM). As evidenced throughout the discussion, the process of digitalisation in SCM is not a straightforward or homogenous one; it is rather a complex, nuanced, and multifaceted phenomenon, which intersects and interacts with numerous disciplines. It entails far more than the mere application of novel technologies, also embracing wide-ranging economic, societal, and human factors.

Global case studies further underscored the various trajectories that digital transformation can follow, dependent on regional characteristics and the sector of application. They have revealed the universal potential of digital technologies in bolstering the efficiency, agility, and resilience of supply chains, while also highlighting the unique challenges that come with such digital advancement.

6. FUTURE SCOPE AND RECOMMENDATIONS:

The landscape of digital transformation in SCM is dynamic and continually evolving, promising further avenues of exploration and development. Emerging technologies, such as quantum computing and advanced machine learning, will undoubtedly reshape SCM, presenting new opportunities and challenges. As such, further research on the impact and integration of these technologies within SCM is recommended.

There is also a dire need for more extensive exploration of the socio-economic implications of digital transformation in SCM, particularly as automation technologies continue to advance and proliferate. Policymakers, researchers, and practitioners alike should pay keen attention to ensuring that the benefits of digital transformation are equitably distributed and that potential adverse consequences are mitigated.

Education and training programmes should be aligned with the emerging skill requirements of a digitally transformed SCM landscape. These initiatives should focus on equipping the future workforce with the necessary digital competencies, ensuring a seamless transition into the digital age.

Lastly, the role of human factors in a digitally transformed SCM must be continuously assessed and reassessed. The design of digital technologies should be user-centric, considering not just operational efficiency but also the end-user's satisfaction and quality of life.

In conclusion, the digital transformation in SCM presents an exciting, yet complex landscape—one that requires a concerted, multidisciplinary approach to fully harness its potential benefits and address its concomitant challenges. As we venture further into the digital age, the importance of a comprehensive understanding of this phenomenon will only continue to grow.

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INTRODUCTION TO MULTIDISCIPLINARY RESEARCH

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❖ ABSTRACT:

This chapter provides an overview of multidisciplinary research, highlighting its significance and exploring its characteristics. Multidisciplinary research involves the integration of knowledge, theories, and methodologies from multiple disciplines to address complex research questions and solve real-world problems. It goes beyond interdisciplinary research by actively combining different disciplinary perspectives, fostering collaboration and creativity. This chapter defines multidisciplinary research and discusses its scope and applicability across various fields. The benefits of multidisciplinary research are examined, including its potential for innovation, comprehensive understanding, and relevance to real-world challenges. The chapter also addresses the challenges and barriers faced in conducting multidisciplinary research, such as communication gaps and differing methodologies. Strategies for overcoming these challenges, including effective communication channels and a collaborative culture, are explored. Case studies are presented to illustrate successful multidisciplinary projects, including examples from cancer research, sustainable urban planning, and climate change mitigation. These case studies demonstrate the power of multidisciplinary collaboration in generating holistic solutions and driving positive societal impact. The chapter concludes by emphasizing the need for effective collaboration among researchers from diverse disciplines and serves as an introduction to subsequent chapters that delve deeper into specific aspects of multidisciplinary research. By fostering interdisciplinary collaboration and integration, multidisciplinary research has the potential to address complex problems, spur innovation, and provide holistic solutions that benefit society as a whole.

❖ DEFINITION AND SCOPE OF MULTIDISCIPLINARY RESEARCH:

Multidisciplinary research is an approach that involves integrating knowledge, theories, and methodologies from multiple disciplines to address complex research questions and solve real-world problems. It goes beyond the traditional boundaries of single disciplines and actively combines different disciplinary perspectives, fostering collaboration and cross-pollination of ideas.

The scope of multidisciplinary research is broad and encompasses various fields such as healthcare, sustainability, technology, social sciences, and more. In healthcare, for example, multidisciplinary research brings together experts from fields such as medicine, biology, psychology, and engineering to tackle complex health challenges holistically. In sustainability, researchers from disciplines like environmental science, economics, and sociology collaborate to develop comprehensive strategies for environmental preservation and resource management. The scope of multidisciplinary research expands

as researchers recognize the interconnectedness of various disciplines and seek to address complex, multifaceted issues.

The integration of different disciplinary perspectives and methodologies is a distinguishing feature of multidisciplinary research. It requires researchers to go beyond their own disciplinary boundaries and engage in interdisciplinary dialogue, exchanging ideas and knowledge. This integration enables researchers to gain deeper insights into complex phenomena that cannot be fully understood within a single discipline. By combining diverse approaches and expertise, multidisciplinary research offers a comprehensive understanding of complex problems and facilitates the development of innovative solutions.

Moreover, the scope of multidisciplinary research extends beyond academia. It is increasingly recognized that complex real-world problems cannot be effectively addressed by a single discipline alone. Multidisciplinary research plays a vital role in bridging the gap between academic research and practical applications in industries, governments, and communities. It enables the translation of knowledge into tangible outcomes and fosters collaboration among diverse stakeholders.

In conclusion, multidisciplinary research involves integrating knowledge, theories, and methodologies from multiple disciplines to address complex problems. Its scope is broad, encompassing various fields and offering a comprehensive understanding of multifaceted challenges. By fostering collaboration and cross-disciplinary dialogue, multidisciplinary research has the potential to generate innovative solutions and drive positive societal impact.

❖ CHARACTERISTICS OF MULTIDISCIPLINARY RESEARCH:

Multidisciplinary research exhibits several key characteristics that set it apart from other research approaches. These characteristics reflect the nature of collaboration, integration of diverse perspectives, and the potential for innovation and comprehensive problem-solving [6-9]. The following are the key characteristics of multidisciplinary research:

- **Collaboration and Interaction:** Multidisciplinary research involves active collaboration and interaction among researchers from different disciplines. It brings together experts with diverse backgrounds, expertise, and perspectives, fostering a rich exchange of ideas and knowledge. Collaboration enables researchers to leverage the strengths of each discipline and work synergistically towards common goals.
- **Integration of Disciplinary Perspectives:** Multidisciplinary research integrates knowledge, theories, and methodologies from multiple disciplines to address complex research questions. It goes beyond simply connecting different disciplines and actively combines their perspectives to gain a more comprehensive understanding of complex phenomena. This integration allows researchers to approach problems from multiple angles and explore novel insights and solutions.
- **Flexibility and Adaptability:** Multidisciplinary research requires flexibility and adaptability from researchers. They must be open to exploring different disciplinary approaches, methodologies, and paradigms. Flexibility enables researchers to navigate the challenges of integrating diverse perspectives, methodologies, and terminologies. It also encourages creative thinking and the development of innovative approaches to problem-solving.
- **Holistic Problem-Solving:** Multidisciplinary research aims to address complex, multifaceted problems in a holistic manner. By integrating diverse disciplinary perspectives, researchers can examine problems from various dimensions, considering social, cultural, economic, environmental, and technological factors. This holistic approach allows for a more comprehensive understanding of the problem and the development of comprehensive solutions.

- **Innovation and Breakthroughs:** Multidisciplinary research often leads to innovation and breakthroughs. The combination of diverse perspectives and expertise can spark new ideas and novel approaches to problem-solving. The synthesis of knowledge and methodologies from different disciplines creates fertile ground for innovation, pushing the boundaries of research and fostering transformative advancements.
- **Real-World Relevance:** Multidisciplinary research strives to address real-world problems and challenges. By integrating knowledge from different disciplines, the research outcomes are often better aligned with practical applications and societal needs. This relevance enhances the potential for impactful outcomes and facilitates the translation of research findings into practical solutions.

In summary, multidisciplinary research is characterized by collaboration, integration of disciplinary perspectives, flexibility, holistic problem-solving, innovation, and real-world relevance. These characteristics enable researchers to tackle complex challenges effectively and generate comprehensive, innovative solutions that have a positive impact on society.

❖ SIGNIFICANCE AND BENEFITS OF MULTIDISCIPLINARY RESEARCH:

Multidisciplinary research holds significant importance and offers numerous benefits that contribute to advancing knowledge, addressing complex problems, and driving innovation [5, 6]. The following are the key significance and benefits of multidisciplinary research:

- **Comprehensive Understanding:** Multidisciplinary research allows for a comprehensive understanding of complex phenomena by integrating diverse perspectives, knowledge, and methodologies from multiple disciplines. It enables researchers to explore problems from various angles, considering social, cultural, economic, and technological factors. This comprehensive understanding enhances the richness and depth of research outcomes, leading to a more holistic perspective.
- **Innovation and Breakthroughs:** The integration of different disciplinary perspectives in multidisciplinary research creates a fertile ground for innovation and breakthroughs. By bringing together experts with diverse backgrounds and expertise, new ideas are generated, and novel approaches to problem-solving emerge. The synergy of different perspectives often leads to innovative solutions, pushing the boundaries of knowledge and driving transformative advancements.
- **Cross-Fertilization of Ideas:** Multidisciplinary research encourages the cross-fertilization of ideas between disciplines. When researchers from different backgrounds collaborate, they bring their unique insights and methodologies to the table. This cross-pollination of ideas stimulates creative thinking, encourages new connections, and facilitates the development of novel approaches to research problems. The exchange of knowledge and perspectives between disciplines enriches the research process and expands the realm of possibilities.
- **Enhanced Relevance and Applicability:** Multidisciplinary research emphasizes the relevance and applicability of research outcomes to real-world problems. By integrating multiple perspectives and considering various contextual factors, the research findings are better aligned with practical applications. This enhances the potential for meaningful impact and facilitates the translation of research into tangible solutions that address societal needs.
- **Collaboration and Networking:** Multidisciplinary research fosters collaboration and networking among researchers from different disciplines. It encourages the formation of interdisciplinary research teams, creating opportunities for knowledge exchange, shared expertise, and collective problem-solving. Collaboration enhances research outcomes, promotes learning across disciplines, and builds networks that can extend beyond the research project, facilitating future collaborations and interdisciplinary endeavors.

- **Addressing Complex Challenges:** Multidisciplinary research is well-suited for tackling complex challenges that require a comprehensive understanding and multifaceted solutions. Many real-world problems, such as climate change, healthcare disparities, and sustainable development, are multifaceted and require an integrated approach. Multidisciplinary research allows for the exploration of these challenges from different angles, leading to more nuanced and effective strategies for addressing them.

In conclusion, multidisciplinary research is significant in providing a comprehensive understanding of complex phenomena, driving innovation, facilitating cross-fertilization of ideas, enhancing relevance and applicability, fostering collaboration and networking, and addressing complex challenges. By integrating diverse perspectives and expertise, multidisciplinary research holds immense potential for advancing knowledge and generating impactful solutions to the multifaceted problems of our world.

❖ CHALLENGES AND BARRIERS IN CONDUCTING MULTIDISCIPLINARY RESEARCH:

Conducting multidisciplinary research presents several challenges and barriers that researchers must navigate. These challenges arise due to differences in disciplinary approaches, communication gaps, and resource constraints. Understanding and addressing these challenges are crucial for successful collaboration and fruitful outcomes. The following are key challenges and barriers in conducting multidisciplinary research:

- **Communication Gaps:** Communication barriers often arise due to differences in disciplinary jargon, methodologies, and terminologies. Researchers from different disciplines may have distinct ways of expressing ideas and concepts, leading to misunderstandings and misinterpretations. Bridging these communication gaps requires establishing effective channels of communication, fostering a shared understanding of key concepts, and promoting active listening and open dialogue among researchers.
- **Conflicting Methodologies:** Each discipline has its own research methodologies and paradigms. When integrating multiple disciplines, researchers may encounter conflicting approaches, data collection techniques, and analytical frameworks. Harmonizing methodologies and finding common ground can be complex but is essential for effective collaboration. Researchers must be willing to learn and adapt to different research methods, and identify synergies between disciplines.
- **Funding and Resource Constraints:** Traditional funding mechanisms and grant structures may not adequately support multidisciplinary research projects. Funding agencies and institutions often have discipline-specific funding streams, which may not align with the collaborative nature of multidisciplinary research. Researchers face the challenge of securing funding that supports collaborative efforts, interdisciplinary training, and infrastructure necessary for successful multidisciplinary research.
- **Disciplinary Biases and Resistance to Change:** Disciplinary biases and resistance to interdisciplinary approaches can pose challenges in conducting multidisciplinary research. Researchers may face skepticism or resistance from colleagues who are rooted in disciplinary silos. Overcoming these biases requires building awareness, promoting the value of interdisciplinary collaboration, and fostering a culture that values and rewards interdisciplinary research.
- **Time and Project Management:** Multidisciplinary research projects often involve coordinating multiple researchers, disciplines, and timelines. Managing diverse perspectives, coordinating research activities, and ensuring effective collaboration can be challenging. Researchers must develop strong project management skills, establish clear roles and responsibilities, and foster a culture of mutual respect and accountability.

- **Ethical and Regulatory Considerations:** Multidisciplinary research projects may encounter ethical and regulatory challenges due to the involvement of multiple disciplines and complex research designs. Researchers must navigate ethical review processes, obtain approvals from relevant authorities, and ensure compliance with regulations across disciplines. Coordinating ethical considerations and ensuring ethical practices throughout the research process can be demanding.

In conclusion, conducting multidisciplinary research involves navigating challenges such as communication gaps, conflicting methodologies, funding constraints, disciplinary biases, time and project management, and ethical considerations. Researchers must actively address these challenges by establishing effective communication channels, harmonizing methodologies, seeking appropriate funding, promoting interdisciplinary awareness, developing strong project management skills, and ensuring ethical compliance. By overcoming these barriers, researchers can unlock the potential of multidisciplinary collaboration and achieve impactful outcomes.

❖ CASE STUDIES: SUCCESSFUL MULTIDISCIPLINARY RESEARCH PROJECTS:

To exemplify the power and potential of multidisciplinary research, several case studies can be highlighted [7-9]:

- **Case Study: Multidisciplinary Approaches to Cancer Research**

Cancer research often requires the collaboration of researchers from diverse disciplines, including oncology, molecular biology, data science, and bioinformatics. By integrating these disciplines, researchers can gain a more comprehensive understanding of cancer biology and develop innovative approaches to diagnosis, treatment, and prevention.

In one successful multidisciplinary research project, a team of oncologists, molecular biologists, data scientists, and bioinformaticians collaborated to identify new biomarkers for a specific type of cancer. The project involved collecting clinical data, performing genomic analyses, and utilizing advanced machine learning algorithms to analyze large datasets. By integrating clinical and molecular information, the researchers identified genetic mutations associated with drug resistance, allowing for the development of targeted therapies. This collaborative effort led to improved treatment outcomes and personalized medicine approaches for patients with this type of cancer.

- **Case Study: Sustainable Urban Planning**

Sustainable urban planning requires the integration of knowledge from disciplines such as architecture, urban design, environmental science, economics, and social sciences. By combining these perspectives, researchers can develop holistic approaches to urban development that prioritize environmental sustainability, social equity, and economic viability.

In a successful multidisciplinary research project, urban planners, architects, sociologists, environmental scientists, and economists collaborated to design a sustainable urban neighborhood. The project involved assessing energy efficiency, incorporating green spaces, considering transportation systems, and analyzing social dynamics. The researchers utilized simulation models, stakeholder engagement, and interdisciplinary workshops to develop a comprehensive urban plan that promoted sustainability and improved quality of life. This multidisciplinary collaboration resulted in the creation of a vibrant, eco-friendly neighborhood that provided a blueprint for sustainable urban development.

- **Case Study: Interdisciplinary Solutions for Climate Change**

Addressing climate change requires collaboration among climate scientists, economists, policymakers, and social scientists. By integrating these disciplines, researchers can develop comprehensive strategies to mitigate climate change impacts, adapt to environmental changes, and transition to a low-carbon economy.

In a successful multidisciplinary research project, researchers from different disciplines collaborated to develop an interdisciplinary framework for climate change mitigation. The project involved integrating climate modeling, economic analysis, policy recommendations, and public engagement. By combining scientific projections, economic assessments of mitigation options, and policy analysis, the researchers proposed a comprehensive strategy that included renewable energy promotion, carbon pricing mechanisms, and community-based initiatives. This collaborative effort led to actionable recommendations for policymakers and informed decision-making processes to combat climate change effectively.

These case studies illustrate the power of multidisciplinary collaboration in generating innovative solutions and driving positive societal impact. By integrating diverse perspectives and expertise, multidisciplinary research can tackle complex challenges in fields such as healthcare, sustainable development, and climate change. These examples highlight the transformative potential of multidisciplinary research in addressing pressing global issues and creating meaningful change.

❖ CONCLUSION:

In conclusion, multidisciplinary research offers a unique approach to addressing complex research questions and solving real-world problems. It brings together diverse expertise, perspectives, and methodologies, leading to innovative solutions and comprehensive understanding. However, conducting multidisciplinary research is not without challenges. Effective communication, methodological harmonization, and securing adequate funding are critical factors for success. The presented case studies illustrate the potential impact of multidisciplinary research in various fields and provide inspiration for future collaborative endeavors. In the subsequent chapters, we will delve deeper into specific aspects of multidisciplinary research, exploring cross-disciplinary collaboration strategies, the role of data science and artificial intelligence, and emerging technologies in advancing multidisciplinary approaches.

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IMPACT OF HRD PRACTICES ON JOB SATISFACTION AND ORGANIZATIONAL CLIMATE

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❖ ABSTRACT:

Human resource development practices are those set of conventions which devises a proactive mechanism for effective implementation of organizational functions and practices. Job satisfaction can be defined as a type of emotional state that results into the appraisal of a person for a particular job on self-basis. Organizational climate represents the overall environmental setup within the organization which is required for effective implementation of a type of citizenship behavior required for achieving organizational objectives. The research study aims to identify the association between various HRD practices along with job satisfaction and organizational climate of telecom sector workers offering their services in Rajouri district. The study considers training and development, performance management, appraisal and reward, compensation management and industrial relations as the dimensions of HRD practices. The association of all these dimensions shall be analyzed with job satisfaction and organizational climate.

Keywords: *HRD Practices, Job Satisfaction, Organizational Climate, Performance Management, Training and Development, Appraisal and Reward, Compensation Management, Industrial Relations etc.*

❖ INTRODUCTION:

Human Resource Development Practices are now a day of much concern in all types of organizations whether large, medium or small organizations. These practices include all aspects required for effective survival of an organization. Human Resource Development Practices are responsible for effective development of employees competencies at all levels of management which includes strategic, tactical, functional and operational level. Human Resource Development Practices are also responsible for development which is based on a continuous pattern and also includes contribution towards specialized well-being of all employees. Resource Development Practices improves enthusiasm among employees as they feel self-recognition. Further Human Resource Development Practices motivates people through the integrated phenomenon of persistence, intensity and direction. Job satisfaction represents a type of feeling the person has about a particular job in a particular period of time. This level of satisfaction can be positive and negative depending on the very situations within the organization. These situations determine the level of satisfaction a particular employee has with respect to his job. Organizational climate represents a type of citizenship behavior that is prerequisite for achieving all types of goals within the organization which may be either the goals of the individual, goals of a group or team or the

overall goals of the organization. The current research study considers Performance Management, Training and Development, Appraisal and Reward, Compensation Management and Industrial Relations as the dimensions of HRD practices and the relationship of these dimensions with job satisfaction and organizational climate shall be evaluated.

❖ LITERATURE REVIEW:

- **Stanka, S. & Veronika, P. (2014),** conducted a research study in order to determine the relationship between HRD practices, organizational climate and job satisfaction and found that HRD practices has a direct association with organizational climate and job satisfaction at all levels within the management whether strategic, technical or operational level. Organizational climate further enhances the level of organizational commitment within the organization of employees and also motivates them work for more progress and productivity.

- **Mossholder, K. W., Richardson, H. A., & Settoon, R. P. (2011),** conducted a research study to analyze the effect of HRD Practices on organizational climate and job satisfaction. Findings from the study found that HRD practices have a greater role to play IN effective development of climate within the organization and also enhances the positive job satisfaction.

- **Bhuian, S., Al-Shammari, E., Jefri, O. (1996),** conducted a research study considering HRD practices, job satisfaction and organizational climate. Findings from the study found that HRD practices has a significant role in devising positive mechanisms for implementation of effective organizational climate and also enhances the level of job satisfaction among the employees.

❖ OBJECTIVES:

1. To study the relationship between performance management dimension of HRD practices with job satisfaction and organizational climate.
2. To study the relationship between training and development dimension of HRD practices with job satisfaction and organizational climate.
3. To study the relationship between appraisal and reward dimension of HRD practices with job satisfaction and organizational climate.
4. To study the relationship between compensation management dimension of HRD practices with job satisfaction and organizational climate.
5. To study the relationship between industrial relations dimension of HRD practices with job satisfaction and organizational climate.

❖ MATERIAL AND METHODS:

Present research study shall be carried out with the help of both primary as well as secondary data. Secondary data shall be collected from various sources like books, magazines, journals and other published documents. Primary data shall be collected using a pretested questionnaire based on various items considering HRD practices, job satisfaction and organizational climate. The detailed information so collected shall be utilized in order to determine the impact of HRD practices on job satisfaction and organizational climate of telecom sector workers in district Rajouri.

❖ RESULT AND DISCUSSION:

HRD practices have a greater level of impact on job satisfaction and organizational climate of telecom sector workers in district Rajouri in Jammu and Kashmir. It has been found from the study that performance management dimension of HRD practices has a significant impact on job satisfaction and organizational climate of telecom sector workers as depicted by a P value of 0.020 and 0.012. Moreover

the training and development dimension of HRD practices has also been found to be significantly impacting the job satisfaction and organizational climate of telecom sector workers. The calculated P values are 0.032 and 0.027. In addition to this the appraisal and reward dimension of HRD practices also have a positive association with job satisfaction and organizational climate. The estimated P values for these relationships are 0.003 and 0.011. Compensation management dimension of HRD practices shows a significant connotation with job satisfaction and organizational climate through a P value of 0.023 and 0.004. Furthermore, the industrial relations dimension of HRD practices also has a greater role in devising the mechanism for job satisfaction and organizational climate. The calculated P values are 0.022 and 0.003. This shows that the HRD practices play a very crucial role in devising and implementing the mechanisms for job satisfaction and organizational climate of telecom sector workers offering their services in district Rajouri in Jammu and Kashmir.

Table 01: HRD Practices, Job Satisfaction and Organizational Climate

Dimension & Sub-dimension	Relationship	Estimates	Standard estimates	p-value	Significance (Y/N)
Performance Management – Job Satisfaction	PM – JS	0.101	0.012	0.020	Y
Performance Management – Organizational Climate	PM – OC	0.119	0.011	0.012	Y
Training and Development – Job Satisfaction	T&D – JS	0.112	0.031	0.032	Y
Training and Development – Organizational Climate	T&D – OC	0.096	0.044	0.027	Y
Appraisal and Reward – Job Satisfaction	A&R - JS	0.049	0.055	0.003	Y
Appraisal and Reward – Organizational Climate	A&R - OC	0.100	0.035	0.011	Y
Compensation Management – Job Satisfaction	CM - JS	0.112	0.028	0.023	Y
Compensation Management – Organizational Climate	CM - OC	0.114	0.028	0.004	Y
Industrial relations – Job Satisfaction	IR - JS	0.108	0.026	0.022	Y
Industrial relations – Organizational Climate	IR - OC	0.110	0.014	0.003	Y

❖ CONCLUSION:

HRD practices play a significant role in devising the mechanism for job satisfaction and organizational climate. From the current study we have found that the performance management dimension of HRD practices has a positive association with job satisfaction and organizational climate. In addition to this the training and development dimension of HRD practices also has a direct association with job satisfaction and organizational climate. The appraisal and reward dimension also has a greater role in devising the positive mechanisms for job satisfaction and organizational climate. Furthermore the compensation management and industrial relations dimension of HRD practices also have a positive association with both job satisfaction and organizational climate.

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PRAGMATIC METHODS FOR ENVIRONMENTAL EDUCATION

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❖ ABSTRACT:

Environment plays a vital role in our life. We are completely dependent on our environment for survival. But environmental indicators show that our environment is deteriorating rapidly. This has led to many problems which are making our survival difficult on this planet. One of the major problem that has arisen is "Climate change". It is the defining issue of this century. Actual cause of these problems is we the "Humans". We are utilizing natural resources at an alarming rate, without giving nature, time to regenerate them. We also pollute the environment so much that nature cannot absorb the pollutants. In the race of progress and development we are forgetting our environment and exerting extra burden on it. The problem is that we all know that environment is affecting badly but in spite of that we don't do anything to solve the problem. The problem can be solved by educating people about environment and its conservation. This chapter deals with some pragmatic methods of environmental education.

We should concern on the environmental issues, not just for ourselves, but also for the entire mankind now existing and the generations to follow. By educating people about environmental concerns we can exert a collaborative effort for saving our environment.

Keywords: *Environmental education, Pragmatic methods, Environmental issues, Environmental protection.*

1) INTRODUCTION:

"There are three principal means of acquiring knowledge available to us: observation of nature, reflection, and experimentation. Observation collects facts; reflection combines them; experimentation verifies the result of that combination".- Denis Diderot

The entire world is facing the global problem of environmental change. Hence, the concept of environmental education is of vital concern. Environment is known to be comprising of all the things around us. It is an integration of both living and non-living organisms. Air, Water land, forests, oceans, animals and plants, are all components of environment and very important for maintaining its balance. But all these natural resources are limited, and human activities are the causative factors for environmental degradation, each one of us need to feel responsible to protect the environment. To share this responsibility, we have to educate people for environment. With the help of environmental education, we can develop awareness, concern and knowledge regarding our environment in common people. This will further help in preservation and conservation of environment. Being environmentally

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educated, the people will be able to solve various environmental issues and in taking care of environment. The environmental education will help in the sustainable development of our planet and will be conserving it for future generations.

2) DEFINITION OF ENVIRONMENTAL EDUCATION:

Environmental Education is aimed at introducing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems and motivated to work towards their solution. -Stapp.W.B.,et al(1969)

When a person knows about the environment, how it works? What is adversely affecting the environment?, he will surely learn and understand the management of environment. With environment education the people will learn about sustainable development. This will make our environment safer for future generations. Mainly the environmental education is aimed at raising knowledge and awareness in people about environment. It is associated with 3 'A's, that are awareness, attitude and action. An environmentally educated person will be able to develop an attitude to conserve and protect environment. With this attitude he will take necessary action for preservation, conservation and improvement of the environment.
In this way we can define "Environmental Education" as

- education for the environment
- education about the environment and
- education through the environment.

3) OBJECTIVES AND STEPS OF ENVIRONMENTAL EDUCATION:

Environmental education has the main objective of being educating the people about environment. To fulfil this objective following steps must be followed:

I. Awareness: In the initial step of environmental education awareness must be created among people about benefits of environment and its overexploitation by human beings.
II. Knowledge: In this step knowledge must be imparted among individuals about environmental destruction with the help of facts and figures.
III. Attitudes: At this step, persons should be encouraged for developing an attitude towards environmental safety and protection. Attitude should be such that they consider it as their duty to protect environment.
IV. Skills: in this step, persons are helped out for developing skills for identifying and solving environmental problems.
V. Participation: During this step the persons should be motivated to actively participate in all the activities related to environmental protection.

In order to follow these steps, the present chapter suggests some pragmatic methods for environmental awareness. The word pragmatic means "dealing with problems in a practical way rather than by following ideas or principles"

Meaning of pragmatic is solving problems in a sensible way that suits the conditions that really exist now, rather than obeying fixed theories, ideas, or rules.
This chapter focuses on methods which will actually help in solving the environmental related problems in a practical way.

4) NEED FOR ENVIRONMENTAL EDUCATION:

As well-known now that our environment is degrading at a very fast pace, being environmentally educated people will understand the problem and can work for sorting its solution. Environmental

education involves many other aspects also besides environmental awareness. It teaches about ecological aspects, conservation of natural resources, effects of pollution and overpopulation on environment. Creating awareness for environment will make people think about our mother earth. Since the increase in population and overexploitation of earth's natural resources has drastic effects. It is now being faced as the most threatening point for survival of life on earth. Thus the problem is global and it has be sort out globally, involving many people. The global environmental issues like global warming, ozone depletion, loss of biodiversity have to be discussed.

5) PRAGMATIC METHODS OF ENVIRONMENTAL EDUCATION:

There are many articles suggesting various ways of environmental education. But the need of the hour is to take some immediate action. As the traditional methods have been used but they does not provide a strict line of action. In this section we provide a discussion on some innovative methods which are simpler to follow and can involve active participation of many people simultaneously.

5.1 Organising Lectures

Lectures on various aspects of environment can be organised at regular time durations. According to Eison (2010), it is the most popular teaching method. Since many years, it has been used as a means of transmitting cognitive or factual data from a teacher to a group of students (Ganyaupfu, 2013). The lecture method may be seen as one way channel of communication of information because the emphasis is mainly on the presentation of the topic and the explanation of the content to the students (Richards & Rodgers, 2014).With the help of lectures the people can be provoked to work for environment.

5.2 Arranging Discussions

In order to get views of more people at one time, discussions can be arranged for them. Discussion methods involves an open-ended and collaborative exchange of ideas among learning people for further thinking, learning, problem solving and understanding. During discussion, the participants discuss their views, learn others views and build their knowledge, understanding, or interpretation for the matter (Wilkinson, Ian. 2009).When discussion is organised taking various topics of environment, many problems are raised and various solutions for these problems are also suggested by one and all participating in discussion. During discussions related to environment, different informations are shared. This will promote co-operative learning. A proper discussion will assist learners to reach a critically informed understanding of the topic, self-awareness and capacity for self-critique, appreciation of diversity, and informed action (Applebee et al., 2003; Parker, 2003).

5.3 Planning of Symposium & Seminars

For providing environmental education, Symposiums and seminars can be planned out. For a symposium some experts of environmental concerns are selected who will give a systematic presentation on various aspects related to environment. This is followed by general discussion. The purpose of symposium is to investigate and understand the various aspects of problem.

Seminar is an instructional technique involving creation of a situation for a group to have a guided interaction among themselves on a particular theme. The purpose of seminar is to provide opportunity to learners to actively participate in finding answers to questions or solution to problems using scientific approach. For this purpose an environment based theme is selected and participants are allowed to raise questions and finding answers to them. In seminars, individuals prepare a paper or report and present it in front of experts.

5.4 Executing workshops

All the methods discussed till now involve lectures or talks but workshops are something different. It is an activity-oriented technique. It may be regarded as learning by doing. In workshops some activity must be planned out for learners which will show them the benefits of environment and how humans are destroying it. The ill effects of environmental degradation may also be shown.

5.5 Excursion/ Field Trips

For environmental education, it is very important to show an actual view of the subject to the learner. For this purpose excursions or field trips can be organised. The trips can be planned to some areas with

natural beauty which give them a pleasant scene leading them to analyse the positive and beneficial effects of nature and environment. The trips can also be planned for the places where pollution and deforestation prevails. This will help learners to compare the two sites.

5.6 Assigning Projects

In this, a topic related to environmental studies is assigned to the learners. A guide must be assigned to him who will direct him to solve the problem. The learner will find facts and data, organised it in proper format and will submit a proper report. Now days a compulsory project for Post graduates and under graduates is required in some universities. So a project based on environmental concerns can be assigned to them. They will analyse and generate data regarding the problem and can also give possible solutions for them. The project can be assigned to individual students or group of students. They will execute the work and will submit a completed report to their institute.

5.7 Organising Science fairs and Exhibitions

Environmental education can better be provided in the form of some creative visualization. For this purpose, science fairs and exhibitions can be organised in which students will be asked to prepare and demonstrate some environmental based models. This will increase their creativity too and will make them more attached to our mother earth. These fairs and exhibitions shall be made open for parents of students and for common people, so that they also look and analyse the problems related to environment. This will provoke them to work for environment.

5.8 Holding competitions

Competitions help in better grooming of learners. The competitions like debate, poster presentations, lecture, extempore, photography etc. can be organised. The theme of such competitions may be kept for environmental concerns. In photography contest students should be asked for photos related to natural beauty. This will help them to explore the nature more. Their photos can be presented in exhibitions to inculcate "love for mother earth" in them. For competitions such as lectures and debate, topics focused on environmental issues should be assigned. To present it better students will search for more and more "facts and figures" related to environment. This will increase their concern for environment and also in their listeners.

5.9 Making documentary films and videos

Videos are the best way for involving learners in a particular topic. When they watch a particular video they understand the concept better. For this purpose short videos and documentary films can be prepared. This type of method will be more applicable for rural people. They are more attached with nature. If we present them the current scenario of environment, they will defiantly put their concern on it. Many environmental issues like climate change, deforestation loss of biodiversity can be shown to them using videos. All learners cannot be brought up to fields to investigate the issues. So information can be given to them using these videos and films.

5.10 Celebrating important dates

Some important days related to environment can be searched out and celebrated to involve learner's participation in them. These days can be "World Environment Day", "World Earth Day" World Wild life Day", "National pollution control Day" and "World Forest Day" etc

5.11 Changing Habits

During providing environmental education to the learners, they must be urged to change their common habits which can directly or indirectly affect environment. For example, proper waste management must be taught to them. For showing them importance of planting trees, a habit must be developed of giving /gifting plants at special occasions. Habit must be developed not to consider mother earth as our own property. We should not harm the plants and trees and should keep our surroundings clean.

6) CONCLUSION:

Environment is destroyed to a maximum stage and environmental problems are at their peak. It's a strong point now to take some active step for environmental protection. For this purpose a collaborative effort is required. Along with government and NGO's, the active participation of common people is

required. The people will involve in this matter only if they are environmentally educated. This chapter suggests some pragmatic methods to educate people about environment and its problems. We know that many organisations are working towards environmental protection but an individual involvement must be there. We have to create an environmentally educated society who finds its responsibility to save our mother earth and provide good natural environment to our future generations.

"*If we join forces and change our ways of living, we can still stop the destruction and save humanity."*

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SENSORS FOR ANIMAL RECOGNITION

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❖ ABSTRACT:

Sensors for animal recognition are devices or systems designed to identify and detect animals based on various physical, behavioral, or biological characteristics. These sensors use advanced technologies, such as computer vision, infrared imaging, radio frequency identification (RFID), biometric recognition, and acoustic sensors, to analyze and interpret the unique features of animals. Animal recognition sensors are utilized in a wide range of applications, including wildlife monitoring and conservation, livestock management, pet identification, and research studies. These sensors play a crucial role in automating data collection, tracking animal movements, identifying individual animals, and providing valuable insights for various fields, contributing to more efficient and sustainable animal management practices.

Keywords: *cameras, facial recognition, identification*

a) Two Dimensional (2D) and Three Dimensional (3D) cameras

Image analyser translates the acquired images into indices of distribution (animal location and proximity) and activity (animal position and movement) (Kashiha *et al*, 2014). Imaging in livestock has been used to estimate weight, aggressive behaviour, walking patterns, posture, and behaviour during lactation (Nasirahmadi *et al.,* 2017).There is a broad range of imaging technology available, ranging from basic 2D camera sensors that require adequate ambient lighting to produce useful images and video, to 3D sensors that can provide more details, to Infrared and depth sensors which become useful for capturing footage in low light and at night, and in determining proximity of other animals. Image analysis research using 2D cameras, provides digital information such that researchers were able to monitor and estimate growth rates even up to 1 kg (DeBoer *et al*.,2013) However, 2D camera sensors require adequate ambient lighting and contrasting background—such as a white pig on dark cement floor. Three-dimensional depth-based sensors (3D camera) such as Microsoft Kinect and Intel R. RealSense™ cameras are equipped with a high-definition camera, an infrared illuminator and time-of flight (ToF) depth sensor that produces color (Kongsro, J., 2014). Infrared is of importance during low lighting and for observing nocturnal behavior. Depth sensors are important to determine the proximity of the animal to the camera (Mittek *et al*. 2017).

b) Microphones

Simple microphones and computers can be used to capture and process sound, which has proven useful in classifying and localising specific acoustic events such as indicators of stress or illness (Schön

et al., 2001). High frequency calls could signal the occurrence of stressful events and an increase in the rate of coughing could indicate respiratory disease. (Berckmans, D., 2014)

c) Thermistors and infrared imaging

Temperature monitors using a contact measuring media typically utilise thermistors embedded in a data logger or ear tag sensor. The sensor has direct contact with the tissue to monitor temperature measurements and provide temperature accuracies to 0.1 ^{0}C. Infrared cameras measure physiological and pathological processes related to changes in body temperature and they can be applied as non-contact, non-invasive and instantaneous method of collecting temperature data.

d) Accelerometers

Among the most promising technologies for monitoring livestock behavior are wearable sensors containing accelerometers. An accelerometer is an electromechanical device used to measure accelerating forces. Forces can be static (eg, animal is lying down or resting) or acceleration due to movement.

❖ LIVESTOCK IDENTIFICATION:

In order to gain meaningful output from gathering animal data on a large-scale, commercial basis, an accurate method of identifying each animal is essential. This identification system must also be automated and affordable in order to be of value to the farmer.

a) Radio Frequency Identification (RFID)

The device is primarily implanted in ear tags; it stores information such as animal and farm records. The radio wave (low, high or ultra-high frequency) is the medium of communication between the transponder circuit within the tag and an RFID reader to wirelessly read and write data.

b) Optical character recognition

A low-cost identification system, optical character recognition, is the recognition of printed, stamped, or written text characters (e.g., license plates, barcodes, Quick Response (QR) codes) by a computer. Optical character recognition is performed with a digital camera and data is developed with machine learning to provide remote identification.

c) Facial recognition

An example of marker-less animal identification is facial recognition, initially developed for human identification, monitoring, and surveillance purposes. Hansen *et al*. (2018) used digital photos taken from a camera mounted on a water drinker and developed a program that differentiated 10 pigs, with 96.7% accuracy.

d) Mobile applications, wifi and bluetooth

As the technology keeps advancing, the current networking infrastructure limitations for the farm industry poses challenges. Not all precision livestock farming devices will require internet connectivity. Sensors can be used in isolation, where encrypted data can be collected from various sites within the farming system, compiled, and sent to a local computational system for processing to filter unnecessary data. Then, the utilization of mobile applications such as smartphones and tablets can be used for the convenient display of results or alerts via WiFi or Bluetooth.

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EVIDENCE OF MARINE INFLUENCE IN THE FORM OF TIDAL BUNDLES IN BARAKAR FORMATION, RANIGANJ BASIN, INDIA

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❖ ABSTRACT:

The early Permian Barakar Formation was known to have been deposited in a fluvial depositional setting. But evidences of primary sedimentary structures that are exclusively tidal in origin are interpreted through detailed sedimentological analysis of the Barakar Formation along Khudia Nala section, Raniganj Basin. The tidal signatures include alternate sandstone and mudstone dominated intervals of variable thickness indicating energy fluctuations, sandstone foreset draping by mud indicating slackwater phases, double mud drape structures indicating two successive slackwater phases, laterally and vertically accreted cross-strata sets where lateral accretion is understood by presence of reactivation surfaces and vertical accretion is identified by intermittent thin sandstone-mudstone plane laminations. Apart from these, there are inclined heterolithic strata in which we got flaser and lenticular bedding that are typical of tidal environment and bi-directional cross-strata sets which gave rise to herring-bone cross-stratification locally. Measurements of the alternate thicker and thinner lamina set manifests spring-neap tidal fluctuation and provides clue to understand the moon-earth orbital forcings.

❖ INTRODUCTION:

Tidal rhythmites are periodically deposited sedimentary units that bear a record of cyclical episodes depicting semi-diurnal or diurnal spring and neap tidal events. These sandstone-mudstone interbeds show lateral and/or vertical accretion of cross-strata and thin plane laminations. Such characteristic sedimentary features are generally deposited in an estuary, delta slopes, distal tide-influenced deltas and macrotidal coasts (Kvale et al., 1999; Ghosh et al., 2005; Bhattacharya and Bhattacharya, 2006; Mazumder and Arima, 2005; Bhattacharya et al., 2012; Mallik et al., 2012). These are thus records of marine evidences in ancient sedimentary deposits like the unfossiliferous Precambrian sedimentary successions (cf. Eriksson and Simpson, 2000), however, the preservation potential is better for recent sediments. But these not only record marine signatures but also can be used to know the past lunar orbit and the trend of evolution of the Earth–Moon system (cf., Mazumder and Arima, 2005; Kvale, 2006; Coughenour et al., 2009; Greb et al., 2011; Kvale, 2012 and many others).

❖ DETAILED DESCRIPTION OF THE TIDAL STRUCTURES NOTED FROM THE STUDY AREA AND THEIR INTERPRETATION:

Thin alternation of sandstone and mudstone layers produced due to the migration of ripples during one tidal current is referred to as a **tidal bundle**. The studied sandstone-mudstone heterolithic facies are

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characterized by such tidal bundles, with different arrangement of the tidal cross-strata set. In the study area, five different types of tide-generated rhythmic sand-mud sequence are observed, viz., (i) laterally accreted cross-strata set, (ii) vertically accreted cross-strata set, (iii) bi-directional cross-strata set, (iv) inclined heterolithic strata (IHS), and (v) sigmoidal cross-strata set. Apart from these, flaser bedding and lenticular bedding are characteristically present within thinly-bedded sandstone-mudstone heteroliths. Different tide-generated features within the Barakar Formation are described below:-

- **Laterally-accreted cross-strata set –** These are represented by unidirectional cross-strata sets, enclosed within near-parallel upper and lower bounding surfaces. In this type of cross-strata set, a set containing foresets of almost similar thickness and inclination is laterally accreted by another set with different foreset thickness and inclination from the former. This difference in thickness and inclination is marked by a reactivation surface (R), which is a surface of erosion or non-deposition separating the bundles. In the study area, two different types of lateral accretion of cross-strata sets is observed – (i) in coarse-grained, thick-bedded (bed thickness >15 cm) sandstone with little mudstone and (ii) fine-grained, thin-bedded (bed thickness <10 cm) sandstone with abundant mudstone.

(i) In case of coarse-grained sandstone beds the cross-strata sets are thicker (15-40 cm thick) and widespread. Cross-strata are dominantly planar tabular in nature with thick (thickness 2-6 cm), sandy foresets truncating with the upper and the lower bounding surfaces at an angle of 18°-35°. Mud drapes are present on the sandstone foresets, but foresets without mud drapes are not uncommon. Double mud drapes are also common. Reactivation surfaces demarcate sharp change in the inclination of the foresets. Alternate thick-thin sandstone foresets within one cross-stratum set as well as across vertically adjacent sets, attest to spring-neap tidal fluctuations.

(ii) Within thin-bedded sandstone, the thickness of the cross-strata sets vary from 1-5cm. Dark colored mudstone is abundant and commonly makes thick drape on the sandstone foresets as well as the reactivation surfaces. The cross-strata sets show cyclic variation in stratification style, with foreset geometry changing from concave-up to planar, convex up and sigmoidal, in the downcurrent direction. Double mud drapes are very common. Locally, smaller sandy foresets accrete on larger foresets with a dominant reactivation surface. These smaller sandy foresets show downcurrent flaring out within mud. Thickness of mudstone drapes increases along the foreset dip, and is maximum near the toe region of the foresets. Often adjacent thick mudstone drapes coalesced near the toe of the foreset to produce intermittent muddy lenses. These laterally accreted cross-strata sets are often overlain and underlain by mm-thin plane laminated sandstone/siltstone-mudstone units.

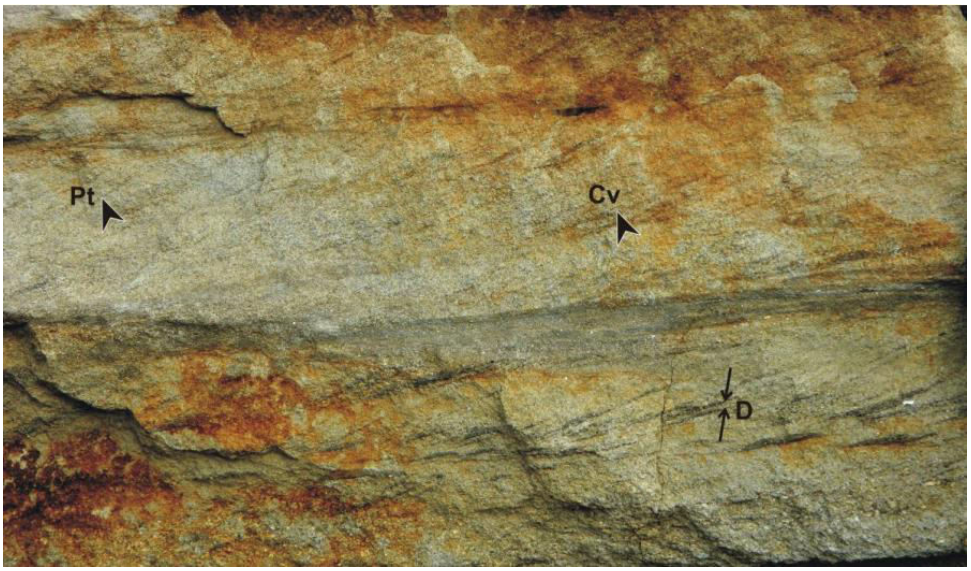

Figure 1: Field exposure of coarse-grained sandstone showing amalgamation of multiple laterally accreted cross-strata set. Foresets are dominantly concave-up (Cv) and planar tabular (Pt) in nature with mud drapes. Double mud drapes (D) are also common.

Interpretation: Sequences of beds deposited in the form of thin alternations of sandstone, siltstone or mudstone representing a dominant tidal phase are known as tidal bundles. Alternating thin layers of sand and mud indicates fluctuations in energy conditions with high energy condition marked by deposition of sand and periods of quiescence marked by mud. Mud drapes on sand foresets are indicative of high concentration of suspended mud due to low strength of tidal currents. Laterally accreted cross-strata sets are considered as produced due to the migration of ripples or sandwaves during flood or ebb tide. These stratification types have been reported from subtidal environments of different ages (Mazumder, 2004; Bhattacharya and Bhattacharya, 2006; Bhattacharya et al., 2012). Preservation of unidirectional cross-strata sets indicates dominance of either ebb or flood current. Preservation of thicker cross-strata set within coarse-grained sandstone and rarity of mudstone indicate their formation in relatively higher energy subtidal condition. Reactivation surfaces within these successive strata sets are produced due to velocity-asymmetry during or between tides. There is a gradual change of grain size and thickness across the bundles towards downcurrent that indicates energy differences of successive tides in a systematic way.

- **Vertically-accreted cross-strata set –** These are constituted by superposed laterally accreted cross-strata sets within fine-grained sandstone-mudstone heterolithic facies. Such vertically-accreted cross-strata sets are commonly separated by an intermittent mm-thin plane-laminated sandstone or mudstone layer. Thickness of these cross-strata sets vary from 3-15 cm. This accretion of alternate cross-stratified set and plane-laminated unit is few centimetres thick. The ripple cross-lamina within the vertically accreted cross-strata sets are trough shaped, concave upward, planar or sigmoidal in geometry. The sandstone foresets are commonly draped by thin mudstone layers. There is a decrease in foreset thickness and grain size of the cross-strata sets towards top. Locally such vertically accreted cross-strata sets amalgamate together with complete absence of the intermittent plane-laminated veneer. Often the ripples exhibit a tendency to climb up, especially near the upper part of a thick vertically-accreted cross-strata unit. The length and height of these climbing ripples are 8-9 cm and 0.3-0.5 cm, respectively, with the stoss side having thicker mud drapes than the lee side. The nature of climb of the climbing ripples is dominantly sub-critical where the angle of climb is less than the stoss side angle (Reineck and Singh, 1982).

Interpretation: Vertically accreted cross-strata sets with mud-draped sandstone foresets with intermittent thin, horizontally laminated sandstone/mudstone veneers indicate sand deposition by traction currents (high energy) and mud deposition by suspension sedimentation (low energy) (Kreisa and Moiola, 1986). Climbing ripples indicate net aggradations of the sediments under relatively low energy condition. Alternate traction current deposition and suspension sedimentation signifies periodic flow fluctuations, and are common features in subtidal to intertidal zones (Bhattacharya et al., 2012).

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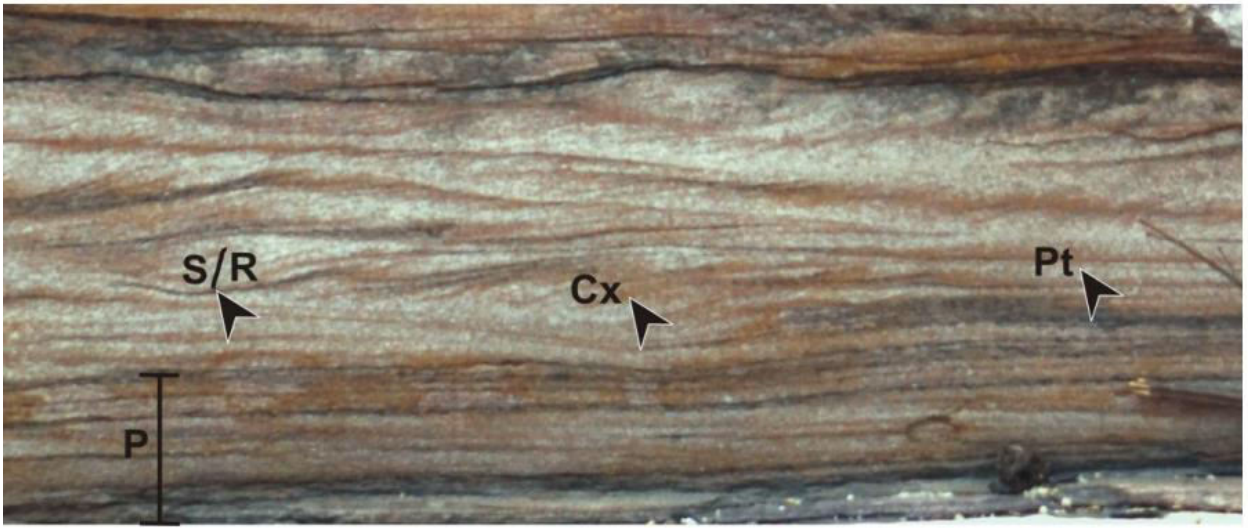

Figure 2: Plane laminated (P) sandstone-mudstone alternations overlain by vertically accreted cross-stratified unit in which lateral accretion has taken place in each set. Please note the lateral grading of convex upward foresets (Cx) to sigmoidal foresets (S), resulting in low angle climbing of the ripple cross-strata set. Also note the presence of smaller planar tabular foresets (Pt) in between reactivation surfaces (R).

- **Bi-directional cross-strata set –** This type of cross-strata set is represented by mutually opposite cross-strata in vertically adjacent beds. Such cross strata sets are observed in coarse-grained, thick-bedded (bed thickness 17-54 cm) sandstone as well as in very fine-grained, thinly-bedded (bed thickness 1.5-10 cm) sandstone with abundant mudstone intercalations.

(i) For coarse-grained, thick bedded sandstone, the cross-strata thickness varies from 15-42 cm, and are characterized by dearth of mudstone, large and thick sandy foreset with planar to concave up geometry. Reactivation surfaces are common across individual cross-strata sets. Foreset thickness also varies laterally as well across the strata sets. An irregular, sub-horizontal erosional surface separates two consecutive vertically accreted cross-strata sets. Bi-directionality in orientation of the foresets in the two consecutive cross-strata is result of current reversals. In such structures, size of the foreset in one cross-strata set is larger and thicker with respect to the foresets in vertically adjacent cross-strata sets.

(ii) In fine-grained, thinly-bedded sandstone, the foresets and topsets in the bi-directional cross-strata sets are draped by mud. Thickness of cross-strata sets varies from 0.5 to 4 cm. Within individual cross-strata set, variation in foreset inclination within laterally accreted planar-tabular cross-laminae grading to sigmoidal cross-laminae is common. These variations resulted in separate zones of sand-rich and mud-rich thicker and thinner foresets respectively. Double mud drapes are common. Vertically these cross-strata sets are separated from each other by a thin mudstone unit.

Interpretation: Bi-directional cross-strata set is a characteristic feature of tidal environment suggesting current reversals under ebb-flood tidal fluctuations. Abundance of the structure suggests both way net sand transports by very strong ebb-flood tidal currents. Development of such structures within coarse-grained sandstone with larger size of the strata set and rarity of mudstone indicate their formation in high energy condition. Predominance of traction transport in one direction with respect to the opposite direction, as reflected from contrasting size of the foresets within vertically adjacent cross-strata suggest strong ebb current and weak flood current within subtidal channels. The thinner sandstone beds with alternate sand-mud lamina and mutually opposite cross-strata sets suggest deposition in lower energy, intertidal setting. Further, thick-thin periodic variations in foreset thickness and mud drapes completely support tidal influence and semi-diurnal periodicities (Mallik, 2012).

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Figure 3: Coarse-grained, thick-bedded sandstone showing well preserved herring bone cross-stratification. The planar tabular foresets in the lower bed show variation in inclination from gentle to moderate. Apparent palaeoflow orientations are marked by arrows. The lower and upper bed is separated by a sharp erosional surface. Length of the hammer is 30.5cm.

- **Inclined heterolithic strata (IHS) set –** These are represented by sub-horizontal plane-laminated sandstone-mudstone alternations in which the number of alternating units of sand and mud are almost the same with little thicker sand lamina (4-5 mm) towards the upper part. Vertical variation in grain size towards upward direction has resulted in sandstone and mudstone-rich intervals. Sandstone dominated units are commonly known as **cyclosams** and mudstone dominated units are **cyclopels** (Brennand, 2000; Bhattacharya et al., 2012). Locally, the thin mudstone units contain intermittent layers of finely macerated organic debris of black colour. The total thickness of the beds containing such heterolithic strata varies from 5 to 36 cm. The sandstone lamina thickness within single bed ranges between 1 to 5 mm, while the mudstone lamina thickness varies between 0.4 and 3.5 mm. The sandstone units commonly show closely spaced thick-thin pairs, which are separated by persistent shale laminae. Each pair consists of at least four to nine laminae. Double mud drapes on sandstone laminae are common. Bioturbation is sparse to abundant in some places. This type of inclined heterolithic strata set grades vertically to thick coal horizons. Within the mudstone-dominated intervals, lenticular bedding with discontinuous sandstone lenses is common. Ripples are sinuous and mud is concentrated on the ripple troughs. Thicker sandstone laminae occur at the middle of the bundles. Sandstone-dominated intervals preserve small (1-2 cm in height) ripple cross-lamina showing lateral and/or vertical accretion with discontinuous, concave-up mudstone streaks forming flaser bedding. Length of the streaks varies from 0.5 to 4 cm.

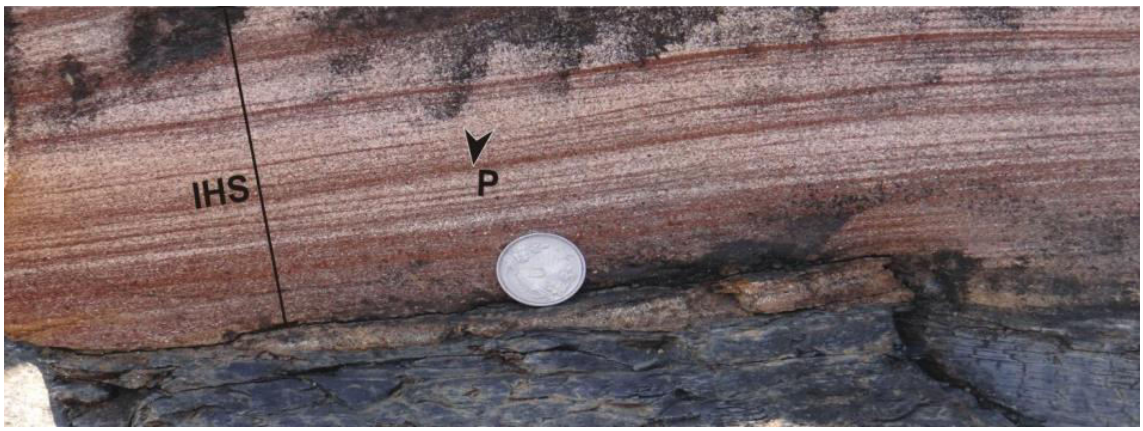

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Figure 4: Inclined heterolithic strata (IHS) showing alternate sandstone and mudstone dominated units of varying thickness, within the sandstone-mudstone heterolithic facies. This facies is underlain by the mudstone facies. Diameter of the coin is 2.5cm.

Interpretation: Deposition of alternate sand-dominated and mud-dominated units indicate quick fluctuation in the depositional conditions with predominance of traction current followed by suspension settling of sediment grains. Such alternate depositional mechanisms suggest quick and repetitive fluctuations in the energy condition in the depositional realm. However, sub-parallel lamina with abundant mud content and absence of parting lineation indicates overall calm, low-energy condition (Bhattacharya et al., 2012; Mallik et al., 2012). Cyclically alternating sand-rich and mud-rich units are results of spring-neap tidal cycles. Thickness variations in the individual sand-rich and mud-rich units are indicative of varying suspension settlement rates. Presence of flaser bedding and lenticular bedding suggests alternate sand and mud deposition within upper subtidal to intertidal flat setup.

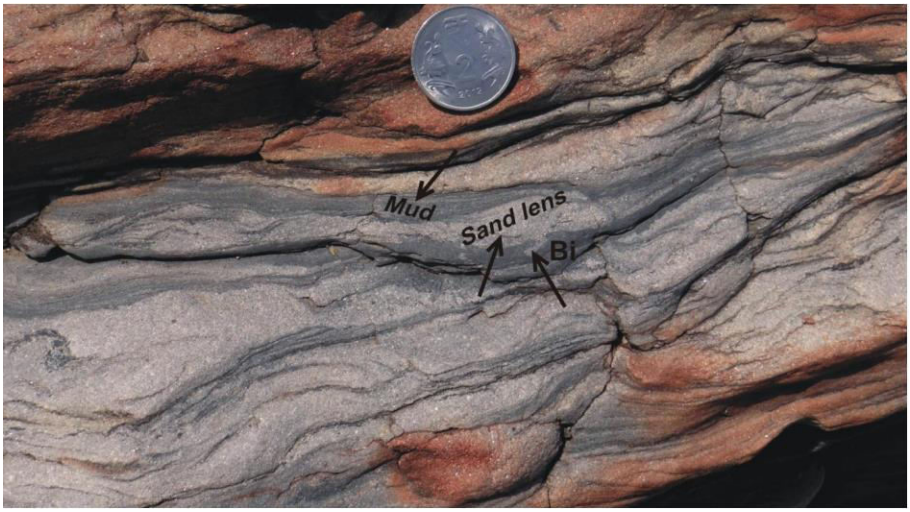

Figure 5: Field exposure of sandstone-mudstone alternations showing development of lenticular bedding. Arrows indicate ripple cross-laminated sand lenses interbedded with mud. Note the presence of bioturbations (Bi). Diameter of the coin is 2.5cm.

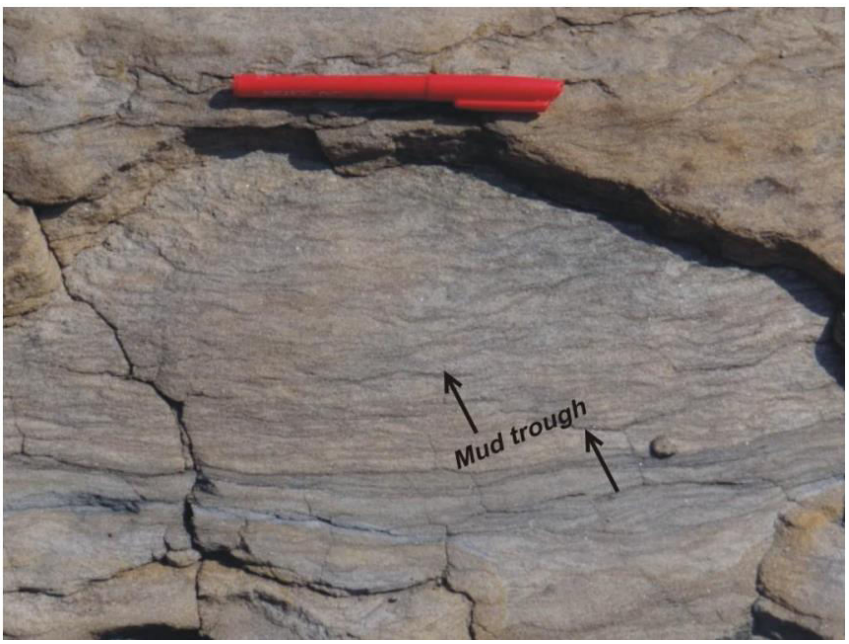

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Figure 6: Field exposure of sandstone-mudstone alternations with development of discontinuous, concave-up mudstone streaks within sandstone, forming flaser bedding (arrow). Mud is concentrated on the ripple troughs. Length of the pen is 14.5cm.

- **Sigmoidal cross-strata set –** Sigmoidal cross-strata sets consist of sigmoid-shaped foresets within lensoid sandstone beds. These are commonly developed from the laterally accreted cross-strata sets along the downcurrent direction. In such sigmoid-shaped cross-strata, individual foresets show 5–10° dip near the topset and steep dip (25–30°) near the middle part. Thickness of the foresets varies widely, from 0.5-6 cm measured perpendicular to the foresets, based on the grain size of the host sandstone. The brink point separates the topset and the foreset because it is from this point that the foreset lamina become steeper and a little thicker. The topset lamina bridges a gap between the bedform crest and the brink point. The sigmoidal cross-laminae are separated from the laterally-accreted cross-strata by a predominant reactivation surface. The topset lamina overlies some erosional surfaces truncating the tops of the foreset laminae towards the downcurrent direction of the sigmoidal cross-sets. The upper bounding surface of some sigmoidal cross-strata sets is truncated by a planar to undulatory scour surface or by a single, superimposed set of tabular cross-strata. In coarser-grained, thick-bedded sandstone, such sigmoidal sets are up to 6 cm thick (measured normal to the foresets, at their thickest part) and laterally persist for as much as 170 cm. In such cases, the sigmoidal cross-strata sets are underlain by thick beds of inclined heterolithic strata sets and overlain by coarse-grained sandstone beds containing large trough cross-stratification. Locally within the topset, double mud drapes occur, separated by thin sandstone veneer.

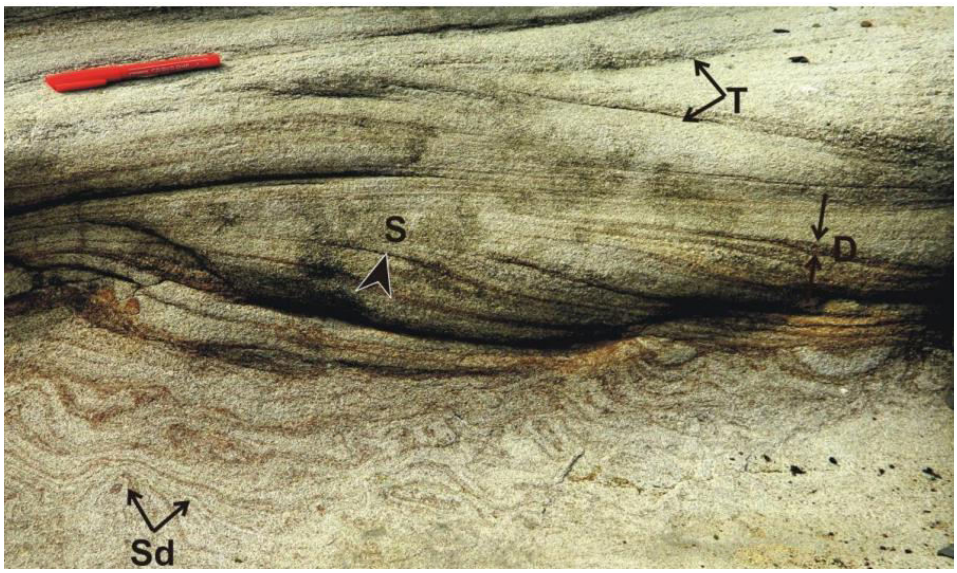

Figure 7: Field exposure of coarse grained sandstone showing well developed sigmoidal (S) cross-strata, overlain by large trough (T) cross-strata. Double mud drapes (D) are common within the sigmoidal set. Underlying beds show abundant soft sediment deformation (Sd) structures. Length of the pen is 14.5cm.

Interpretation: Migration of linguoid ripples is responsible for development of sigmoidal cross-strata sets. Their development requires a higher tidal flow velocity condition than that for laterally accreted cross-strata bundles. Sigmoidal foresets are characterized by low angle topsets that are formed by migration of humpback ripples in which there is non-flow separation between crest and brink point and flow separation from brink point (Kreisa and Moiola, 1986).

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❖ CONCLUSION:

Sedimentary successions within the early Permian coal-bearing Barakar Formation, Raniganj Basin, India, were earlier considered as deposited under continental fluvial/lacustrine condition. This concept was challenged by some recent works, which depicted proof of marine flooding during the depositional process. This research work describes different tide-influenced sedimentary structures, as discussed in the preceding part, from the upper part of the Barakar sedimentary succession, exposed along the Khudia Nala section, Raniganj Basin, India. Periodic fluctuation in the flow is interpreted and the cyclicity is measured, which matches with the tidal cycles of modern and ancient times. Locally, signatures of spring–neap–spring cycles is preserved. Such tidal interference within the well established fluvial system calls for a reappraisal of the overall depositional setup during Barakar sedimentation. The present research work, thus infers a tide-influenced fluvio-marine transitional setting based on the facies types, tide-generated features and overall fining-upward lithosequence.

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