Academia And Society

International Journal of Education and Society

Print Journal: ISSN 2393-9419

Online Journal: eISSN 2393-8919

Volume 9 Number 1&2 October 2022-February 2023

Publisher's Detail

Publisher:

Holy Cross Publishing House, Holy Cross College (Autonomous), Tiruchirapalli 620 002.

Publication details

Academia and Society Print: ISSN 2393-9419

Online: eISSN 2393-8919

Frequency: Bi-annual

 # started in the year 2014

Printed at: Holy Cross Publishing House, Holy Cross College (Autonomous), and Tiruchirapalli- 620 002.

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Articles

A REVIEW ON STUDIES ON YELLOW SPOTTED MILLIPEDE HARPAPHE HAYDENIANA

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ABSTRACT

A range of studies have explored the diversity and distribution of millipedes, including the yellow spotted millipede. Chen (2023) and Patil (2018) both identified new species in their respective studies in China and India, while Boccardo (2001) and Bogyó (2015) focused on the habitat and seasonal variations in millipede populations in Brazil and Hungary. These studies collectively contribute to our understanding of the yellow spotted millipede's ecological role and its potential as a bioindicator of environmental health. In India, particularly in the Western and Eastern Ghats, Patil, 2018 and Ramanathan, 2023 has revealed a rich diversity of species. Hence, the present study focus on the importance and application of the yellow millipede collected from various literature available in google scholar.

INTRODUCTION

Millipedes, while generally harmless, can become a nuisance when they invade homes in large numbers, potentially contaminating food and causing respiratory problems for those with allergies (Cranshaw, 2019). They are particularly attracted to damp areas, and their presence can be a sign of excess moisture in the home (Cranshaw, 2019). To address infestations, it is recommended to wait for a few days for the problem to subside and then vacuum the remaining bodies, while also removing debris and sealing openings around the foundation (Cranshaw, 2019). If problems persist, insecticides may be used (Cranshaw, 2019). Insight Pest Solutions offers millipede extermination services to address these issues.

The yellow spotted millipede, a non-native species, has been introduced to various locations, including Arkansas, Louisiana, Oklahoma, Texas, India and Singapore (McAllister 2019; Decker, 2012). These millipedes are known to have arrived in non - native sites via potted plants and compost from greenhouses (McAllister, 2019). They are most commonly found in the order Polydesmida, which produces the brightest fluorescence under ultraviolet light (Marek, 2017). Despite being a pest of potatoes in some areas, no pathogenic microorganisms have been found in these millipedes (Brito, 1994).

MILLIEPEDE IN A BIRDS EYE VIEW

The yellow spotted millipede, a member of the Chelodesmidae and Paradoxosomatidae families, has been found in canola cultivation in Brazil (Bouzan, 2023). In Australia, the 'Ommatoiulus moreleti' millipede is a nuisance pest, with activity patterns influenced by climatic conditions (Baker, 1988). Fossil evidence of millipedes, including the Sinosoma luopingense, has been found in the Middle Triassic Luoping biota of China (Huang, 2018). In the Kalahari, millipedes exhibit unique behaviors and

ecological adaptations, such as burrowing and surface activity after rainfall (Dangerfield, 1998).

Research on the yellow spotted millipede in India is limited, with most studies focusing on other millipede species. Verma (1980) identified various pests of pearl millet in India, but did not specifically mention the yellow spotted millipede. Ramanathan (2023) and Alagesan (2013) both conducted studies on millipede diversity and distribution in different regions of Tamil Nadu, but did not specifically mention the yellow spotted millipede. Gour (2020) studied the diversity of millipedes in the Amravati region of Maharashtra, but also did not specifically mention the yellow spotted millipede. Therefore, there is a gap in the literature regarding the overall view of the yellow spotted millipede in India.

CLASSIFICATION OF MILLIPEDE

The yellow spotted millipede, a member of the class Diplopoda, is a diverse and ecologically important group of arthropods (Alagesan, 2016). It is found in various habitats, including Jamaican caves (Loomis, 1969) and the Yintiaoling National Natural Reserve in Southwest China (Chen, 2023). The species is not considered a pest in the cultivation of canola in Brazil (Bouzan, 2023).

TAXONOMIC POSITION

The millipede belongs to the kindom Animalia, class diplopoda, order polydesmida and family Xystodesmidae. The Genus Harpaphe and Species: Harpaphe haydeniana (Wood, 1864).

RESEARCH IN INDIA

Research on millipedes in India, particularly in the Western and Eastern Ghats, has revealed a rich diversity of species (Patil, 2018; Ramanathan, 2023). The presence of *Trigoniulus corallines* in both regions suggests a potential overlap in their habitats (Patil, 2018; Ramanathan, 2023). Similarly, the Alagar Hills Reserve Forest in Tamil Nadu has been found to host a variety of millipede species, with mid-elevations being particularly rich in diversity (Alagesan, 2013). However, specific information about the yellow spotted millipede in India is not provided in these studies, indicating a need for further research (Chakraborty, 2018; Alagesan, 2013; Abdar, 2022; Patil, 2018) Fig - 1.

Figure 1 - Yellow-spotted millipede, *Harpaphe Haydeniana*

The yellow-spotted millipede, *Harpaphe Haydeniana*, is a common bug found in the moist forests along the Pacific coast (Looney, 2012). These millipedes have long dark brown or black bodies with contrasting yellow spots down their sides and are known for having multiple body segments, each containing two pairs of legs (Foster, 2011). Females usually consist of 31 pairs of legs while males have 30 (Foster, 2011). The activity of these millipedes is influenced by environmental conditions, with a change in activity rhythm observed in late summer and autumn (Baker, 1988). They play an important role as detritivores in the ecosystem (Foster, 2011).

DIVERSITY OF MILLIPEDE IN INDIA

Research on millipede diversity in India has revealed a variety of species in different regions. In the Yelagiri hills of Tamil Nadu, 10 species were identified, with the genus Arthrosphaera being dominant

(Chezhian, 2016). Similarly, the Sirumalai Hills in Tamil Nadu were found to host 8 species, with differences in species composition across elevations (Ramanathan, 2023). The Alagar Hills Reserve Forest, also in Tamil Nadu, showed a peak in millipede diversity at mid-elevations, with specific species being more abundant at 450m (Alagesan, 2013). In the Chandoli National Park in Western Maharashtra, a higher diversity of millipedes was found, influenced by less habitat disturbance and food availability (Abdar, 2022). These studies collectively highlight the rich and varied millipede diversity in India, with specific species being more prevalent in certain regions and elevations.

MILLIPEDE HABITAT AND THE PREVENTION STRATEGIES

Yellow-spotted millipedes, which are harmless to humans, prefer damp and cooler environments and feed on organic debris (Cranshaw, 2019). They can become an annoyance, especially if there is an invasion near your home. To prevent this, it is recommended to reduce moisture and seal potential entry points (Cranshaw, 2019). Removing attractants, such as decaying plants and keeping the home clean can also help (Cranshaw, 2019). In severe infestations, professional pest control services may be necessary (Cranshaw, 2019).

ENVIROMENTAL USES IN INDIA

A significant part of the forest ecosystem in India, plays a crucial role in the turnover of organic matter and the availability of minerals in its habitat (Bano, 1992). However, its specific environmental uses in India, particularly in relation to pearl millet, are not explicitly discussed in the available literature. Further research is needed to explore the potential applications of the yellow spotted millipede in the context of pearl millet and other agricultural practices in India.

IMPACT OF POLLUTANT IN THIS SPECIES

The studies by Surber (1959) and Farfan (2008) both highlight the ability of certain invertebrates, such as the midgefly and specific millipede species, to survive in polluted environments. This suggests that the yellow spotted millipede may also have a high tolerance for pollutants. However, the specific impact of pollutants on this species is not directly addressed in the available literature. Further research is needed to understand the potential effects of pollutants on the yellow spotted millipede.

MILLIPEDES AS A FOOD FOR TRIBALS IN INDIA

The use of the yellow spotted millipede by tribals in India is not directly addressed in the provided research papers. However, Enghoff (2014) and Patil (2018) provide valuable information on the nutritional value and diversity of millipedes, respectively. Lever (1939) discussed that the irritant exudation from a centipede, has anti-parasitic effect, which may be relevant to the use of millipedes by tribals. Patil (2003) highlights the use of wild animal parts, including millipedes, by tribals in Nandurbar district, Maharashtra, for medicinal purposes. This suggests that the yellow spotted millipede may have traditional medicinal uses among tribals in India.

CONCLUSION

The present study focusses on the review of the yellow spotted millipede *Harpaphe Haydeniana.* The diversity and the economic importance were discussed. In India, different species were identified and which showed a good diversity in Western and Eastern Ghats. From various literature it has been proved that tribes lived in India used the yellow spotted millipede as food as well as

medicine. But research need to explore in this site to know the full pledged medicinal properties of this organisms. Hence it was concluded that further research is need to be conducted in yellow spotted millipede.

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A STUDY ON THE CONSUMERS BUYING BEHAVIOUR IN CLOUD KITCHEN IN TIRUCHIRAPPALLI CITY

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ABSTRACT:
Online food delivery is a service that uses digital platforms to make it easier for food to be delivered straight to customers from restaurants or food providers. A Cloud Kitchen is a restaurant that specializes solely in takeout services, emphasizing a delivery-centric approach. As the food industry shifts towards cloud-based models, it becomes essential to examine the factors that impact how consumers make purchasing decisions. The goal is to uncover and comprehend the key elements that influence consumer preferences within the specific context of cloud kitchen services, This analysis is crucial for business operating in this space, as it enables them to tailor their strategies based on a thorough understanding of consumer behaviours, ultimately enhancing their competitiveness and meeting customer expectations more effectively.
Keywords:
Cloud Kitchen, Online food delivery.

INTRODUCTION:

In the cloud kitchen only the food production takes place. Factors such as convenience, menu variety, pricing strategies, online reviews, and delivery experience, we seek to gain insights into customer preferences and decision-making processes. The restaurant only accepts online orders, and the food is then delivered to the consumer as takeout. The development of Cloud Kitchen, an online restaurant chain without a physical location, has been crucial to the expansion of the food sector overall. Food Delivery Apps (FDSs) are the base upon which cloud kitchens work, providing a predetermined means of connecting with customers. These restaurants

have been and will continue to play a significant role in the COVID-19 Pandemic, particularly in light of India's strict lockdown. Another example of an artificial intelligence invention in their world is the cloud kitchen. An additional advantage of employing cloud kitchens is the ability to access and analyse client data, enabling them to enhance product offerings and refine marketing strategies for online orders and deliveries. This entails leveraging information on customer preferences to tailor menus and promotional efforts more effectively to meet the needs and desires of their patrons.

LITERATURE REVIEW:

Mrs. K. Kaavya and Dr.V. Andal (2023) the purpose of this study was to investigate the impact that online brand communities have on the level of customer loyalty in the cloud kitchen business. The results show that a vibrant online community that represents a brand can positively impact how committed customers are to cloud kitchens. This implies that companies managing cloud kitchens must consider allocating resources towards building robust online brand communities to enhance customer satisfaction and foster brand loyalty.

According to Aditya Jain (2022) entitled on Zomato and Swiggy consists of over 95% of the total market share in the food delivery sector. The elements that matter most to Indian customers when they choose an online meal delivery service to satisfy their essesentials were assessed here: perceived service excellence, proper communication flow made by the deliverer, a wide range of choices, fresh, properly prepared, and packaged meals delivered on time; cost and any available reductions; real-time tracking of deliveries; and online promotion and advertisements.

Verma, S.M., Pawar, M.S.K., & Bose, M.I. (2022) states that although a cloud kitchen does not require prime premises or off-site staff, it does have a benefit over a regular restaurant in that its admission and operating costs—such as equipment pricing, leasing fees, and licensing fees—are less. This is discussed in their piece about the advantages of modern technologies for the cloud kitchen industry. It is also flexible enough to add new delivery items and change destinations. Setting competitive charges is made easier by the ease with which customer information can be retrieved from websites and applications. The cost of acquiring new customers is lower than with earlier strategies. Because they do not require an aesthetically pleasing design or a more complex workforce organization, cloud kitchens also offer lower administrative costs. Consequently, cloud kitchens have larger profit margins than conventional dining establishments.

Amist et al (2021) entitled on "A Comparative Study of Online Food Delivery Start-ups in the Food Industry noted that internet meal ordering is expanding rapidly in India, with a 15% rise in the previous year and anticipated growth in the years to come. In the Indian market, internet aggregators have enormous development potential, especially in rural areas. Zomato, Swiggy, Food Panda, and Uber Eats are the most widely used applications, per an analysis of Indian customers' purchasing and perception trends about online meal ordering services.

d'Amour, C.B (2020) describes how customers' tastes are taken into account when choosing food products, the standards that are used, and the decision-making process while dining out. The present research investigation examined customer behaviour related to Indian cuisine products from multiple perspectives. When buying food products, Indian consumers place a great importance on a number of important factors, including the product's hygiene, free from pesticides, freshness, the nutritional value, and sanitary environment.

H.M. Moyeenudin (2020) concluded the study stating as a result, branding a cloud kitchen could be more efficient with these methods and the consumers are through online

food delivery applications such as Uber Eats, Swiggy, and Zomato, and web ads consist of social media pages. Because consumers use food delivery service applications, marketing a cloud kitchen might be more effective with these approaches. Therefore, the cloud kitchen requires to have a deeper relationship with these applications or develop their own customized application.

Gupta (2019) discovered that the main motivation for the online meal ordering system is the comfort of the clients. Sitting at home, customers may quickly examine the entire menu, complete with name, image, specialty, and price. Customers are occasionally offered significant discounts by meal delivery services. Additionally, it saves the client's time and effort and the meal is available right in front of the customer's door.

Jacob et.al (2019) found it was discovered that the primary drivers of online meal ordering include discounts, exclusive deals, a large selection of alternatives from a variety of restaurants, ease of use, and quick and simple food ordering. Online meal ordering has additional benefits due to the tracking. Compared to adults, children are more likely to use the online meal ordering system.

According to Yeo et al, (2017) there are two types of retailers providing food delivery services. Fast-food restaurants that offer their own delivery services, such as McDonald's and Kentucky Fried Chicken (KFC), fall under the first group. Restaurant intermediates, such as Food Panda, who provide delivery services for a range of eateries, fall into the second category. Food delivery from restaurants to consumers' homes is changing dramatically due to the rise of new internet platforms as businesses fight for global market share and clientele.

H.S. Sethu (2016) The two terms used most commonly in hospitality marketing are customer satisfaction and customer loyalty.A food portal called "foodzoned.com" in Maniple provided a means for customers to place online food orders. Many restaurants and their diverse menus had been recruited by it. Taking into account client recommendations, a study on customer happiness and loyalty was conducted. According to the survey, there is a significant uptake of online meal ordering platforms.

OBJECTIVES:

1. To identify the socio-economic attributes of the respondents
2. To determine the factors that affects the choice of cloud kitchen.
3. To identify the satisfactory level of the cloud kitchen users.

METHODOLOGY:

The research is confined to individuals residing in Tiruchirappalli City. A convenient sample of 110 respondents were chosen. Primary data was collected through a structured questionnaire. Information from research reports, magazines and journals were also incorporated in the research work. The data collected from the respondents were analyzed using SPSS software to interpret the results.

RESULTS AND DISCUSSIONS:

The research findings have exhibited the following results. Majority of the respondents are quite familiar about cloud kitchen. The age group of 20 to 30 and a category of four members are found to use cloud kitchen facility. The positive factors influencing people towards cloud kitchens are said to be expanded menu option, quality of food, fast delivery and better value. The respondents agreed to be satisfied and are more likely to share their experiences and recommend others.

CONCLUSION:

The food sector is being revolutionized by cloud kitchens, commonly referred to as "virtual" or "ghost kitchens". Cloud kitchens must prioritize convenience by offering easy ordering processes and timely deliveries. They should focus on providing a diverse menu with options for customization, must ensure

consistent quality and freshness of food, be certain with their pricing strategies and have to maintain strong online presence and actively engaging with customers through social media platforms so that they can enhance brand visibility and reputation which is crucial for consumer satisfaction. Cloud kitchens may successfully satisfy customer demands and preferences by comprehending and resolving these factors., drive sales, and establish themselves as trusted players in the competitive food delivery market. However, challenges include intense competition in the virtual space and a reliance on third-party delivery services. Navigating these hurdles is essential for sustained success. Despite challenges, the emergence of cloud kitchens signifies a revolutionary change in the way the food sector responds to consumer expectations, leveraging technology to create more efficient and adaptable business mode.

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AN OVERVIEW OF THE ENVIRONMENTALLY SUSTAINABLE PRACTICES IN INDUSTRY 5.0 IN INDIA

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ABSTRACT:
"India's Industry 5.0 revolution integrates AI, IOT, and robotics into manufacturing, prioritizing environmental sustainability to meet global climate commitments and national eco-friendly goals. Industry 5.0 in India is progressing towards a more sustainable future exploration into specific case studies and quantitative assessment of the impact of these practices on India's industrial landscape.
Keywords: Industry,Artificial Intelligence, Technology, Sustainability, Environment.

INTRODUCTION

"This study examines the role of Industry 5.0 in promoting sustainability, despite the limited research in this area. A systematic review of 48 articles published between 2019 and 2022 reveals a growing trend in exploring Industry 5.0's contributions to sustainability worldwide. The most commonly used technologies for sustainability purposes are the Internet of Things, Artificial Intelligence, and Collaborative Robots. The study categorizes current research into four themes. Robot Advancement Developing sustainable robotics. Higher Education Sustainability Integrating sustainability into

education. Human-Centric Focusing on human well-being and environmental sustainability. Ecosystem Advancement: Enhancing environmental sustainability through Industry 5.0. This study highlights the need for further research in these areas and identifies potential directions for future investigation.

REVIEW OF LITERATURE:

"According to Neela Rajahans et al., Industry 5.0 (I5.0) will eventually replace Industry 4.0 (I4.0), even as I4.0 continues to grow in emerging countries like India.As India aims to become a global manufacturing leader, I5.0 offers significant opportunities for India to pioneer intelligent and collaborative manufacturing. This research article explores the connection between I5.0 and sustainable manufacturing, identifies its impact and challenges, assesses its effect on Triple- Bottom-Line sustainability, and provides a comprehensive framework for I5.0 adoption in Indian businesses."

"Tariqum et al. (2024) investigate how Industry 5.0 can transform environmental, social, and governance (ESG) aspects in corporate environments. This research clarifies the impact of Industry 5.0 technologies on ESG factors, identifies potential ESG-related risks, and proposes mitigation strategies."

"Rajahans et al. believe Industry 5.0 will replace Industry 4.0, despite its growing adoption in India. As India strives to become a global manufacturing leader, Industry 5.0 can help the country pioneer intelligent and collaborative manufacturing. This research Explores the Industry 5.0-sustainable manufacturing relationships. Identifies impact and implementation challenges Analyzes effects on Triple-Bottom-Line Sustainability Presents a framework for Industry 5.0 adoption in Indian manufacturing"

"Ghobakhloo et al. note that despite Industry 5.0's potential for sustainability, the specific ways it can drive socio-environmental benefits are not well understood. To address this, their study developed a strategic roadmap for leveraging Industry 5.0 to enhance sustainable manufacturing. Through a literature review, they identified 12 key functions and created a roadmap to maximize their impact. The study found that the most significant implications of Industry 5.0 for sustainable manufacturing are Value network integration Sustainable technology governance sustainable business model innovation Sustainable skill development. These factors can synergistically drive sustainability in manufacturing."

"According to Youssef Mejri et al., Industry 5.0 represents a new industrialization phase emphasizing human-centered, resilient, and sustainable approaches. Given the growing significance of Industry 5.0 research, this study performs a comprehensive bibliometric analysis using 300 Scopus publications to provide an overarching perspective on the field. The review covers a wide range of themes related to Industry 5.0, offering a holistic understanding of the current research landscape.

OBJECTIVES OF THE STUDY

To analyze the environment friendly practices in industry 5.0.To observe the environmentally benefits attained through industry 5.0. To examine obstacles in the industry 5.0 sector while also implementing environmentally sustainable practices.

RESEARCH METHODOLOGY:

"The study's data was gathered from secondary sources,including published reports, publications, online journals, and websites.The search for relevant articles focused on the keywords "Industry 5.0" and environmentally sustainable practices, yielding a collection of suitable sources for analysis."

SOME ENVIRONMENT FRIENDLY PRACTICES INCLUDE:

1.Circular Economy:

Implementing processes that reduce waste and

promote recycling of materials.

2.Renewable energy:

"Transitioning to clean energy sources, such as solar, wind, or hydroelectric power, to decrease dependence on fossil fuels and promote sustainable energy solutions."

3.Energy efficiency

Adopting technologies and processes that minimize energy consumption and maximize efficiency.

4.Green Supply Chain:

Ensuring suppliers follow sustainable practices to reduce environmental impact throughout the supply chain.

5.Water Management:

Implementing strategies to conserve water and reduce water usage in industrial processes.

6.Reducing Carbon Footprint:

Implementing measures to lower greenhouse gas emissions through cleaner production methods and transportation.

7.Biodiversity Conservation:

Incorporating practices that protect and promote biodiversity in and around industrial facilities.

8.Environmental Monitoring:

Regularly monitoring and reporting on environmental impacts to ensure compliance with regulations and identify areas for improvement.

SOME OF THE ENVIRONMENTALLY BENEFICIAL OUTCOMES OF INDUSTRY 5.0 INCLUDE:

1.**Resource Efficiency**:

Through advanced automation and AI, Industry 5.0 can optimize resource use, reducing waste and conserving materials.

2.**Energy Efficiency**:

Smart technologies and IoT in Industry 5.0 enable better energy management, minimizing energy consumption and emissions.

3.**Circular Economy**:

Emphasis on recycling and reuse within Industry 5.0 promotes a circular economy, reducing the need for raw materials and lowering environmental impact

4.**Sustainable Practices**:

Integration of sustainable practices such as eco-friendly manufacturing processes and green logistics systems are promoted in Industry 5.0.

5.**Reduced Carbon Footprint**:

By optimizing processes and logistics, Industry 5.0 can contribute to lower carbon emissions across various sector.

INDUSTRY 5.0 DESPITE ITS POTENTIAL BENEFITS FACES SEVERAL OBSTACLES THAT NEED TO BE ADDRESSED FOR ITS SUCCESSFUL IMPLEMENTATION:

1.**Technological Integration**:

Adopting Industry 5.0 requires significant investments in new technologies such as advanced robotics, AI, IoT, and digital twins. Many companies may struggle with the initial costs and complexity of integrating these technologies into their existing infrastructure.

2. **Workforce Skills**:

"The advent of Industry 5.0 necessitates a workforce with advanced skills to effectively utilize and maintain cutting-edge technologies, posing a significant challenge in upskilling and reskilling existing employees to meet these new technological demands."

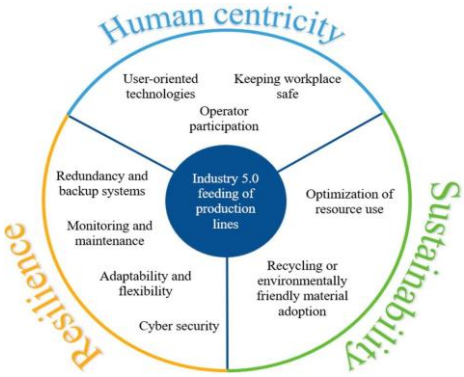
3. **Data Privacy and Security**:

"The amplified connectivity and data sharing in Industry 5.0 elevates the risks of data breaches and cyber threats, making it essential to implement robust security measures and protocols to safeguard sensitive information."

4. **Regulatory and Standards Compliance**:

Industry 5.0 operates in a regulatory environment that may not always be prepared for rapid technological advancements. Adapting regulations and standards to accommodate new technologies while ensuring safety and fairness is a challenge.

DIAGRAM



FINDINGS:

This study tried to analyse the future sustainable practices through industry 5.0.

CONCLUSION:

"In summary, this systematic review offers a thorough analysis of the current research on Industry 5.0's role in sustainability, revealing a surge in interest and potential for technologies like IoT, AI, and collaborative robotics to drive sustainable practices. Further research is essential to deepen our understanding of Industry 5.0's contributions to sustainability, enabling the development of effective strategies and solutions for a sustainable future."

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EXAMINING THE IMPACT OF INTERNET OF THINGS (IOT) ON AGRICULTURE: CHALLENGES AND BENEFITS

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ABSTRACT

Agriculture is the main source of nation. Industry and intensive agriculture are required to meet the increasing demand for food in terms of quality and quantity. Day by day, technology in agriculture continues to grow and produce positive results. Internet of Things IoT offers a wide range of innovative solutions to modernise the agriculture sector, and is an emerging technology. The advanced digitalization breakthrough known as the Internet of Things (IoT) helps devices to interact with one another while simultaneously automating and controlling the process online. There are numerous advantages to using a lot in agriculture for crop management and monitoring. The findings indicate a mixed impact of technological change on agriculture. In conclusion the research contributes to nuanced understanding of the internet of things in agriculture. It also covers the primary problems and difficulties researched in the area of smart farming. The research focuses on examining the benefits of implementing technologies in agriculture.

Keywords: Internet of things, Technology, Smart farming, Access challenges, benefits

INTRODUCTION

India is basically a agricultural nation. More number of people in rural rely on agriculture for their livelihood Agriculture in India is highly dependent on the environment, but climate change and global warming are

making agriculture invisible. It is very important to train farmers in new technologies and methods to increase productivity and improve yields. IoT can be defined as "things that are associated over the Internet." This association is designed to facilitate the transfer of information collected from different devices into specified places on the Internet. With the exponential growth of world population, "According to the UN Food and Agriculture Organization, the world will need to produce 70% more food in 2050". The paper is mostly based on automation and Internet of Things technology, with a view to making agriculture smart. Innovative technologies and techniques, such as the Internet of Things, are needed to enhance productivity and reduce barriers in agriculture. This ensures that food products are of the highest quality and minimize waste, thus improving supply chain efficiency. In order to achieve precision monitoring, data driven decision making and sustainable practices, the future of agriculture lies in the use of the Internet of Things.

REVIEW OF LITERATURE

Khanna, Kaur et al., (2019) : "Evolution of Internet of Things (IoT) and its significant impact in the field of Precision Agriculture'' , In this paper the authors highlights the current challenges for the management of agriculture and future research opportunities.This research fully fulfills the expectations related to the concepts of the new IoT and also emphasizes the new requirements and their corrective options in agriculture.Finally, this research also sheds light on the challenges faced by IoT field.This paper provides a comprehensive view on the concept of the Internet of Things in the context of sustainable agriculture.

Patil, Gawande et al., (2017): "Smart agriculture system based on IoT and its social impact'' This paper aims to apply IOT and automation technology to agriculture to make it smarter. The main features of this article are the intelligent watering and the intelligent control based on real data. Second, temperature protection, humidity protection and other environmental parameters. Finally providing advises to farmers on smart farming.

Polymeni, Plastras et al., (2023): "The impact of 6G-IoT technologies on the development of agriculture 5.0" The paper highlights the importance and influence of these emerging technologies in the growth of smart agriculture, followed by a discussion of future problems and prospects. The paper analyzed the impact of 6G technologies on Agriculture 5.0 applications and the future challenges.

Liang, Shaetal.,(2023):"IoT in agriculture: The future of precision monitoring and data-driven farming"This study explores the revolutionary potential of IoT in agriculture and demonstrates its use in monitoring critical parameters such as soil moisture, temperature, humidity, crop health and animal behavior.This study analyzes the introduction of IoT in agriculture and lays the foundation for the development of decision support systems.The paper suggests that by analyzing historical data and current trends, farmers can make data-driven predictions about yields,epidemics and market demand.

Alkhafaji, Mohamad et al., (2024). "Revolutionizing Agriculture: The Impact of AI and IoT" This research emphasizes the importance of these technologies in boosting agricultural output, maximizing the use of resources, and guaranteeing long-term sustainability in addressing the issues posed by an expanding worldwide population and environmental issues. This paper suggests that overcoming these challenges requires significant investment in new technology, policy and education.

OBJECTIVES OF THE STUDY

- To study about the transformative impact of IoT in the agriculture.
- To study about the challenges and complexities in combining advanced technology to the traditional agricultural practices.
- To examine the benefits of implementing IoT technology in agriculture.

RESEARCH METHODOLOGY

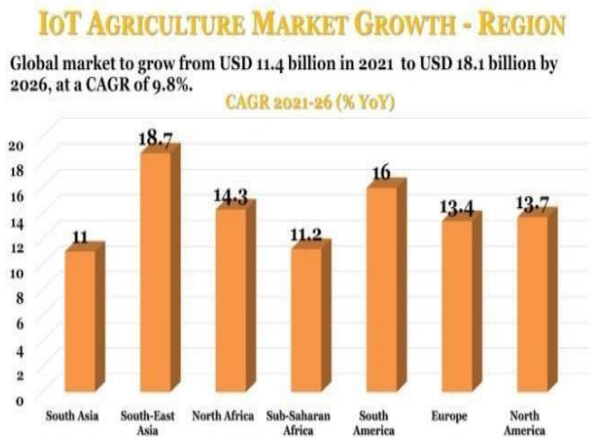
This research paper mainly uses secondary data. The information are collected from published sources like reports, articles, blog database, online journals, etc. The key terms used to search for suitable articles included "IoT in agriculture".

TABLE:

USAGE OF IOT APPLICATIONS IN AGRICULTURE	PERCENTAGE
IRRIGATION MONITORING	16%
PRECISION FARMING	16%
SOIL MONITORING	13%
TEMPERATURE MONITORING	12%
HUMIDITY MONITORING	11%
ANIMAL MONITORING AND TRACING	11%
WATER MONITORING AND CONTROLLING	7%
DISEASE MONITORING	5%
AIR MONITORING	5%
FERTILIZATION MONITORING	4%

SOURCE: MDPI

The certain percentages most likely reflect the proportional emphasis or acceptance of certain IoT applications in the agricultural business. Each application targets distinct agricultural concerns, such as resource management, environmental monitoring, and crop and livestock precision management. Overall, these findings point to widespread use of IoT technology in agriculture, with a primary focus on enhancing efficiency, sustainability, and yield through datadriven decision-making and accurate resource allocation.



Source: LinkedIn

The bar chart shows the IoT Agriculture Market Growth by Region from 2021 to 2026, with a Compound Annual Growth Rate (CAGR) of 9.8%. The global market is predicted to expand from $11.4 billion in 2021 to $18.1 billion in 2026.Southeast Asia has the highest CAGR of 18.7%, demonstrating significant adoption of IoT technologies in agriculture across the region. This trend means that during the next five years, there will be significant investment and breakthroughs in using IoT to improve agricultural practices, production and efficiency.

TRANSFORMATIVE IMPACT OF IOT IN AGRICULTURE

Given its numerous applications, the Internet of Things (IoT) has had a major impact on agriculture.

- **Accurate data analysis:** The data taken from the measurements of soil temperature, moisture content, ambient temperature and humidity are highly accurate and reliable. This helps to enhance agricultural output and efficiency
- **Improved Farm Efficiency:** Farm production and efficiency have increased significantly as a result of the growing use of IoT in agriculture. This is made feasible by a variety of Internet of Things (IoT) devices that can collect and process data for monitoring purposes. Examples of these devices include

irrigation devices and sensors for measuring soil moisture. Crop yields are then increased by using this data to make decisions in a timely manner.

- **Supply Chain Optimization:** IoT technology provides real-time tracking of products from farm to market. This ensures quality control, reduces waste, and allows for better inventory management and distribution planning.
- **Monitoring The Drought:** Dry weather presents a significant challenge for many farmers. Fortunately, they can detect water shortages before they become a significant problem by using Internet of Things solutions. AllMETEO is a useful example of weather monitoring technology. AllMETEO is well-known for its precision in atmospheric measurement technology and plays a vital role in weather monitoring as the authorized distributor of BARANI DESIGN Technologies.
- **Automation and Robotics:** IoT devices integrated with robotics automate tasks such as planting, harvesting, and weeding. This reduces labor costs, improves efficiency, and enables operations on a larger scale.

CHALLENGES

Systems for smart agriculture have several advantages, including higher yields, more efficiency, and improved environmental management. But, there are drawbacks to be mindful of with any technology.

- **High startup costs:** The equipment required to use IoT in agriculture is costly. The high upfront costs of IoT technology, including the price of buying sensors and other devices, make it impossible for most farmers to implement.
- **Insufficient technical knowledge:** The skills required to configure and manage Internet of Things technologies are lacking in many farmers. Training and assistance are required for widespread adoption.
- **Lack of Infrastructure:** The main issue preventing IoT device connectivity in agriculture is insufficient network coverage, particularly in rural or isolated areas. Inadequate power sources could also be a problem for long-term sensor and gadget maintenance. Deployment and integration of IoT systems can be hindered by restricted access to data management tools and advanced technology.

BENEFITS OF IMPLEMENTING IOT IN AGRICULTURE

- **Reduction of cost:** IoT helps reduce operational costs by optimizing resource use (water, fertilizers, etc.) and inputs like fertilizers and pesticides and also minimizing waste. The requirement for constant on-site monitoring is also lessened by the capacity to monitor and control farming activities remotely.
- **Automation: IoT** facilitates automation of routine tasks such as irrigation, fertilization, and harvesting. Automated systems can operate based on real-time data, crop conditions and weather forecasts, reducing labor costs and improving efficiency.
- **Water conservation:** Water is essential for crops; its wasteful use cannot continue. IoT sensors support agricultural sustainability by helping farmers monitor water usage. In order to preserve our limited resources and the environment, smart sensors and devices track usage, identify leaks, and improve irrigation.
- **Better Livestock Management: IoT** solutions for livestock farming offer real-time insights into the location, health, and behavior of animals. This promotes the general wellbeing of animals, strengthens breeding programs, and aids in the early detection of health issues.
- **Mitigation of Weather Risk:** Weather sensors and other Internet of things (IoT) devices can help farmers anticipate and manage weather-related risks. Farmers can adjust planting and harvesting schedules, protect crops from unfavorable weather events, and minimize losses by using accurate weather forecasts.

FINDINGS

- It is clear the technological development will create a huge impact in the agricultural sector.
- Farmers that use IoT in the agricultural industry will reap many benefits, but they will also encounter certain difficulties.
- Farmers must be equipped with knowledge of modern technology and creative strategies to improve productivity and increase profitability.

CONCLUSION

The future of agriculture lies in the combination of precision monitoring and data-driven farming practices, as rural areas undergo significant changes due to IoT developments. Technologies used in precision agriculture, such as drones, GPS systems, smart sensors and automated farming equipment, can be expensive. Small farmers and people living in developing countries find it difficult to adopt these technologies. Sharing this data with technology providers can put farmers at risk. Incentives and regulations from the government will be essential in encouraging the use of precision farming. These could come in many different ways, such as farmer training programs or subsidies for precision farming technologies. Furthermore, farmers in these regions might not have the expertise to apply the technology even when it is available.

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A STUDY ON CONSUMER AWARENESS TOWARDS THE USAGE OF HERBAL NAPKINS

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ABSTRACT:

The sanitary napkin market is competitive and diverse, with various players offering different types of products catering to different consumer preferences. Herbal napkins represent a niche segment within this market, but one that is experiencing growth due to changing consumer preferences. Despite the growing popularity of herbal akin, the literature on pupils' knowledge and comprehension of this substitute smoking product is noticeably lacking. Therefore, there is an urgent need for empirical research to examine students' level of awareness, knowledge, and attitude toward herbal akin, as well as the factors that influence their decision making regarding herbal use. This research project intends to close this gap by carrying out a thorough investigation on 3 students' awareness, perception and attitudes towards herbal akin use. By examining various dimensions such as ingredient knowledge,

perceived health benefits, potential risks, and social acceptance, the purpose of this study is to provide light on the variables that influence attitude among college students and behaviours toward herbal akin consumption. The area is restricted to respondents in Tiruchirappalli Corporation. In this study, convenient sampling method is used. The sample size for the study refers to the 110 respondents of college going students who are using herbal napkins.

Keywords:
Herbal Napkins, Consumer Behaviour, health

INTRODUCTION:

In recent years, the consumption of herbal products has significantly increased in popularity as people increasingly look for natural and alternative remedies for various health and wellness needs. Menstruation is the process by which women release sperm and other substances from the uterus every 28 to 32 days, starting at puberty and continuing until menopause. This is why women use sanitary pads. Herbal pads are pads made from natural materials such as herbs and skin-care ingredients. They are designed to provide additional comfort and potency benefits during the menstrual cycle. Some promise to reduce odors, relieve cramps, or promote a more normal menstrual cycle. and is often promoted as a healthier alternative for people who want to reduce or quit smoking. This herbal napkin consumption trend is particularly significant among college students, a demographic known for their openness to innovative lifestyle practices and cultural trends. As young adults gain independence, students often encounter a variety of influences that shape their behavior and preferences, including peer interactions, media exposure, and social norms. Additionally, this stage of life is characterized by experimentation and exploration, with people often willing to try new products and adopt alternative lifestyles. Therefore, understanding students' awareness, perceptions, and attitudes toward herbal medicine is critical to understanding changing consumer behavior and developing targeted interventions to promote the health and well-being of this population.

LITERATURE REVIEW:

Babu, S. R., Deepika, A. M., & Sivarao, K. V. (2023, November) This study aims to focus on consumers' perceptions of locally produced restorative products and the related concerns with the aid of the Likert scale approach. The review made use of purposeful inspecting. The price, brand recognition, and item accessibility have all been identified as the problems. Growing consumer 14 interest in natural healing products is focused on the precious natural resources that nature provides on a regular basis. In order to protect people from various medical issues, herbal products play a vital role in people's lives. Research reveals a significant correlation between a client's .

Abudalo, R., Abudalo, R., Alqudah, A., Abuqamar, A., Abdelaziz, A., Alshawabkeh, M., &Taha, L. (2022) The purpose of the study is to evaluate Jordanian pharmacy practitioners' knowledge and awareness of the dispensing of herbal products and cardiovascular medication interactions. The understanding of herbal products among pharmacy practitioners was deemed moderate; still, the curriculum for pharmacy education ought to provide greater emphasis to the interactions between herbs and drugs. To deliver competent and efficient pharmaceutical treatment, pharmacy practitioners should also regularly attend educational courses to update their skills and utilize reputable sites for information on herbal products.

Angeli, F., Jaiswal, A. K., &Shrivastava, S. (2022) This study finds from a discrete-choice experiment which include 164 women (n = 1148) in two Indian slums in Delhi and Ahmedabad demonstrate that the most important factor influencing women's preferences for handling their

menstrual hygiene solutions is the biodegradability of sanitary products, which also interacts strongly with female socioeconomic and sociological features. The results we obtained demonstrate how business models can effectively position solutions within the broader socio-ecological framework of beneficiary societies and uncover beneficial linkages between ecological preservation and addressing poverty aims.

Miray, E. G. E., Kurt, M. Y., Bilal, E. G. E., Koparal, M., & Yildiz, S. (2021) The purpose of this study is to find out how much patients know and are aware of the usage of medicinal substances in dentistry. The current study's findings demonstrated that patients are open to using herbal remedies. This finding implies that it would be advantageous for dentists to include physiotherapy in their treatment plans.

Aldin, K. (2020) The current study's goal is to determine how social media influences customers' attitudes about herbal cosmetics and their health. According to our findings, the majority of Jordanians favored herbal cosmetics over organic ones because of their safety. Additionally, 61.33% of the sample agreed that social media had a significant influence in their decision to convert from organic to herbal cosmetics, with social media stars being the main influencer. Jordan came up with a creative strategy to promote natural cosmetics by encouraging social media celebrities to promote herbal cosmetics.

Chandran, S. R., Rangarai, H., &Parayitam, S. (2020) The findings also show a positive relationship between (a) product use and influence and consumer satisfaction with the product; (b) brand use and influence and consumer satisfaction with the brand; (c) product satisfaction and product loyalty; and (d) brand gratification and brand loyalty are positively correlated. The study under review has ramifications for Ayurveda and natural goods as complementary therapies, which are becoming more and more popular in the West and some Asian nations. Apart from adding to the current body of knowledge regarding brands and goods, this study also helps raise awareness about the advantages of natural products. There is a discussion on the implications for certain scholars and practitioners.

Gupta, V. (2020) It is observed that young men place more value on brands than on the effectiveness of herbal products. It is recommended that marketers appropriately target male youth with advertisements and regular awareness campaigns, set fair prices for herbal products that take into account the disposable income of different socioeconomic classes, periodically update the features of the products to meet the needs of male youth, and introduce more herbal products with beneficial health attributes, among other things.

Ghalawat, S., Mehla, S., Malik, J. S., &Goyal, M. (2019) According to the study, the usage of ayurvedic medicine and its effects have senior high Cronbach alpha prises of.550 and.562, respectively. Thus, it can be concluded that common diseases can benefit from the combination of allopathic and homeopathic treatment and ayurveda medicine. Furthermore, while everyone is interested in ayurveda or nature-based products and concerned about their health, ayurvedic medications should only be taken under a doctor's prescription. However, if we use ayurvedic medications without supplements, they also have negative impacts on our health.

OBJECTIVES:

1) To identify the socio- economic attributes conditions of the respondents

2)To identify the main reasons for using herbal napkin

3)To identify the benefits of using herbal napkin.

METHODOLOGY:

The research is confined to college going students in Tiruchirappalli City. A

convenient sample of 110 respondents were chosen. Primary data was collected through a structured questionnaire. Information from research reports, magazines and journals were also incorporated in the research work. The data collected from the respondents were analyzed using SPSS software to interpret the results.

RESULTS AND DISCUSSION:

The research findings have exhibited the following results. Post Graduation students has been found that majority of the respondents who have purchased herbal napkins. Many respondents are aware about the herbal napkins by the advertisement. 70 percent of the respondents agree to be benefitted by herbal napkins. The major factor influencing the purchase of herbal napkins is the organic ingredients, health benefits, price and environmental impact. The majority respondents also agreed to recommend herbal napkins to others.

CONCLUSION:

Herbal Napkins is a novel idea which has a huge positive impact in the lives of consumers within a short time of innovation. The impact of herbal napkins in the future could be significantly important as they offer a natural and potentially sustainable alternative for traditional menstrual products. It is expected that the usage of these napkins to grow constantly. Herbal Napkins will be Eco friendly options or for those with sensitivities to synthetic harmful materials. Additionally, our investigation into the benefits associated with herbal napkin usage revealed tangible advantages, including reduced exposure to harmful chemicals, potential therapeutic properties of herbal ingredients, and environmental sustainability. These findings carry significant implications for public health initiatives, consumer advocacy efforts, and product innovation in the menstrual hygiene sector. Targeted interventions aimed at increasing awareness and accessibility of herbal napkins, coupled with regulatory measures to ensure transparency and consumer safety, are imperative to address the complex challenges surrounding menstrual hygiene and promote healthier, more sustainable practices.

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SOLVING THE MULTI OBJECTIVE FRACTIONAL TRANSPORTATION PROBLEM THROUGH AN INTERACTIVE PYTHAGOREAN-HESITANT FUZZY AND NEUTROSOPHIC GOAL PROGRAMMING APPROACHES UNDER UNCERTAINTY

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ABSTRACT

The transportation problem is a linear programming problem in which the total cost of transportation is reduced to a minimum by moving goods from one place to another while considering the supply and demand of each location. Real-world transportation problems are inherently unpredictable. Several variables determine the uncertain framework for transportation model optimisation. To address these problems associated with transportation, efficient modelling and optimisation configuration will be required. In this study, we have examined a multi-objective fractional transportation problem and We have proposed a Pythagorean-hesitant fuzzy computational algorithm and neutrsophic goal programming to derive the Pareto-optimal solution for the presented model. A numerical example is discussed for this model. comparative analysis with other present methods and the efficiency performance of the suggested approach have also been addressed.

KEYWORDS: Transportation problem, Multi objective,Pythagorean-hesitantfuzzy programming,neutrsophic goal programming.

I. INTRODUCTION

The transportation problem is an optimisation problem that deals with moving goods from origin to destination in a way that reduces the overall cost of transportation. An optimisation problem involving multiple objective functions is referred to as a multi-objective transportation problem when it is necessary to identify one or more optimal solutions. Additionally, there cannot be a single best solution that simultaneously achieves all those involved in a set of conflicting objectives. Sets of optimal solutions with different levels of objective values are the outcome results. Finding a compromise between two or more competing objectives is therefore preferable. When the objective function is a ratio of two linear functions, fractional programming is a generalisation of linear programming. Likewise, in the fractional transportation problem, the goal is to maximise the ratio between two demand or cost functions. Fractional programming models become more applicable to real-world scenarios when the ratio of two functions is considered. Considering the intricacies of actual transportation problems, such as the ambiguity and unpredictability of the parameters. Using the fuzzy technique can be highly beneficial. Consequently, a multi-objective fractional transportation problem has been taken into consideration in this project. Demands, supply, and all of the parameter coefficients are regarded as fuzzy numbers. To address the ambiguity and uncertainties surrounding the parameters, fuzzy numbers have been utilised. Currently, Ahmed and Adhami (2019a) proposed neutrosophic optimization technique to solve the multi-objective non-linear transportation problem under fuzzy parameter. Likely many literatures found that the compromise solutions of transportation problem under both MOTP AND MOFTP. Here, in both methodologies, each objective function as MOFTP by solving this we attain the optimal solutions in both cases. When we compare the methodologies, there is a slight difference that is, in PHFPA using only membership and non-membership degrees but it fails to manage with the degree of indeterminacy. In an uncertain environment, the neutrosophic set has been used to overcome those fuzzy set issues. As a result, a

novel compromise solution framework based entirely on the neutrosophic goal programming technique is developed in this paper to address the MOFTPS. This approach offers fresh insight into the neutrosophic environment inside the MOFTP by applying Zimmermann principles to find the best compromise solution combining the three memberships of truth, indeterminacy, and falsity. Section 2 provides a brief summary of the fundamental preliminaries related to the Pythagorean fuzzy set, neutrosophic fuzzy set, and reluctant fuzzy set. The PFMOFrTP mathematical model and a method for converting the IFMOTP into the crisp model are presented in Section 3. Two methods for solving the crisp model are shown in Section 4: PHFP and NGP. Section 5 discusses the findings and presents a numerical example to support our suggested problem. Finally, the paper's conclusion and recommendations for further research are found.

2. PRELIMINARIES

Definition 2.1

A fuzzy set A in R is a set of ordered pair $A = \{r, \mu_A(r) | r \in R\}$ if R is an object collection represented generally by r. For each r, A membership function is denoted by $\mu_A(r)$. Every element of R is mapped by the membership function to a continuous membership value between 0 and 1.

Definition 2.2

Pythagorean fuzzy set A in R is $A = \{\langle r, \lambda_A(r), \delta_A(r)\rangle | r \in R\}$ Where $\lambda_A(r)$: R⟶[0, 1] denotes the membership function and $\delta_A(r)$: R⟶[0, 1] denotes the non-membership function and with the condition$0 \leq \lambda_A(r)^2 + \delta_A(r)^2 \leq 1$. And also degree of indeterminacy is stated by $\sqrt{(1 - \lambda_A(r)^2 - \delta_A(r)^2)}$

Definition 2.3

The hesitant fuzzy set B in R is denoted by $h_B(r): R \to [0, 1]$ and mathematically it can be stated below: $B = \{\langle r, h_B(r)\rangle | r \in R\}$ where $h_B(r)$ is a hesitant fuzzy element.

Definition 2.4

Pythagorean-hesitant fuzzy set on R is stated as follows: $P_h = \{\langle r, \lambda_h(r), \delta_h(r)\rangle | r \in R\}$ where $\lambda_h(r), \delta_h(r) \in [0, 1]$. $\lambda_h(r)$, $\delta_h(r)$ represent Pythagorean hesitant membership and non-membership degrees of element $r \in R$ to set P_h respectively with the following conditions are $0 \leq L, M \geq 1$ and $0 \leq L^2 + M^2 \leq 1$ where $L \in \lambda_h(r), M \in \delta_h(r)$ for all $r \in R$ $P_h = \{\lambda_h(r), \delta_h(r)\}$ and is a Pythagorean-hesitant fuzzy element.

Definition 2.5

Let Y be a neutrosophic set in R which is represented by three membership functions are (i) the degree of truth membership ($\alpha_y(r)$) (ii) degree of indeterminacy ($\beta_y(r)$) (iii) degree of falsity membership ($\gamma_y(r)$) it is represented by the form. $Y = \{\langle r, \alpha_y(r), \beta_y(r)\, \gamma_y(r)\rangle | r \in R\}$ where all three $\alpha_y(r)$, $\beta_y(r)$, $\gamma_y(r)$ are standard or non-standard belongs to (0, 1) and, we have $0 \leq sup\alpha_y(r) + sup\beta_y(r) + sup\gamma_y(r) \leq 3$

Definition 2.6

Single-valued neutrosophic set is $Y = \{\langle r, \alpha_y(r), \beta_y(r)\, \gamma_y(r)\rangle | r \in R\}$ where $\alpha_y(r)$, $\beta_y(r)$, $\gamma_y(r) \in [0, 1]$ and $0 \leq \alpha_y(r) + \beta_y(r) + \gamma_y(r) \leq 3$ for each $r \in R$

Definition 2.7

$S(h_B) = \frac{1}{h}\sum_{\gamma \in h_B} \gamma$ when n is the number of values in h_B

Definition 2.8

Let A be any fuzzy set defined on R. Let $A = [p, q, s]$ be a parabolic fuzzy parameter then the ranking function PEP is defined as

$$R(A) = \frac{p + 2q + s}{4}$$

3. MATHEMATICAL FORMULATION OF MULTI OBJECTIVE FRACTIONAL TRANSPORTATION PROBLEM

3.1 Notations

x_{ij}: Amount of merchandise moved from supply i to demand j.

$n_{ij}(k)$: Constant vector for numerator of the objective function

$d_{ij}(k)$: Constant vector for denominator of the objective function

c_i: Quantity of products on the market.

d_j: Requirement of the product

3.2 Mathematical Model

$$\text{Min} Z_k = \frac{N_k(x)}{D_k(x)} = \frac{\sum_{i=1}^{m} \sum_{j=1}^{n} n_{ij}^{(k)} x_{ij}}{\sum_{i=1}^{I} \sum_{j=1}^{J} d_{ij}^{(k)} x_{ij}} \qquad k = 1, 2, 3, \ldots . K$$

Subject to

$$\sum_{j=1}^{n} x_{ij} \le c_i$$

$i = 1, 2, 3, , , , , , , m$ …….(1)

$$\sum_{i=1}^{m} x \le d_j \qquad j = 1, 2, 3, \ldots . . n$$

$$x_{ij} \ge 0 \qquad i = 1, 2, 3, , , , , , , m \, , j = 1, 2, 3, \ldots . . n$$

4.1PYTHAGOREAN-HESITANT FUZZY PROGRAMMING APPROACH:

In this methodology, the given MOFTP of fuzzy numbers should be defuzzied into crisp. After doing this using the LINGO software the upper and lower bounds have been obtained and it is denoted by U_k and L_k, the formulation for this bound is given by

$U_k = max[Z_k(X^k)]$ and …….(2)

$L_k = [Z_k(X^k)] \, , k = 1, 2, 3, \ldots . K$ …….(3)

By making use of the above framework the membership and non-membership functions under PHFP domain have been framed. The Pythagorean-hesitant membership function is defined as follows

$$\lambda_h^{E_1}(Z_k(x)) = \begin{cases} 1, & if\ Z_k(x) < L_k \\ a_1 \frac{U_k - Z_k(x)}{U_k - L_k}, & if\ L_k \le Z_k(x) \le U_k \\ 0, & if\ Z_k(x) > U_k \end{cases} \quad \ldots\ldots\ldots\ldots (4)$$

$$\lambda_h^{E_2}(Z_k(x)) = \begin{cases} 1, & if\ Z_k(x) < L_k \\ a_2 \frac{U_k - Z_k(x)}{U_k - L_k}, & if\ L_k \le Z_k(x) \le U_k \\ 0, & if\ Z_k(x) > U_k \end{cases} \quad \ldots\ldots\ldots\ldots (5)$$

… … …

… … …

$$\lambda_h^{E_2}(Z_k(x)) = \begin{cases} 1, & if\ Z_k(x) < L_k \\ a_2 \frac{U_k - Z_k(x)}{U_k - L_k}, & if\ L_k \le Z_k(x) \le U_k \\ 0, & if\ Z_k(x) > U_k \end{cases} \quad \ldots\ldots\ldots\ldots (6)$$

… … … …

$$\delta_h^{E_n}(Z_k(x)) = \begin{cases} 1, & if\ Z_k(x) < L_k \\ b_n \frac{U_k - Z_k(x)}{U_k - L_k}, & if\ L_k \le Z_k(x) \le U_k \\ 0, & if\ Z_k(x) > U_k \end{cases} \quad \ldots\ldots\ldots\ldots (9)$$

Where $a_n, b_n \in (0, 1)$ are the set of hesitant values for both the functions that is attributed by n^{th} experts under PHP is defined by

$$\text{Max } Z = \frac{L_1^2 + L_2^2 + \cdots + L_n^2}{n} - \frac{M_1^2 + M_2^2 + \cdots + M_n^2}{n}$$

The Pythagorean-hesitant non-membership functions:

$$\delta_h^{E_1}(Z_k(x)) = \begin{cases} 1, & if\ Z_k(x) < L_k \\ b_1 \frac{U_k - Z_k(x)}{U_k - L_k}, & if\ L_k \le Z_k(x) \le U_k \\ 0, & if\ Z_k(x) > U_k \end{cases} \quad \ldots\ldots\ldots\ldots (7)$$

$$\delta_h^{E_2}(Z_k(x)) = \begin{cases} 1, & if\ Z_k(x) < L_k \\ b_2 \frac{U_k - Z_k(x)}{U_k - L_k}, & if\ L_k \le Z_k(x) \le U_k \\ 0, & if\ Z_k(x) > U_k \end{cases} \quad \ldots\ldots\ldots\ldots (8)$$

… … ….

Where $a_n, b_n \in (0, 1)$ are the set of hesitant values for both the functions that is attributed by n^{th} experts under PHP is defined by

$$\text{Max } Z = \frac{L_1^2 + L_2^2 + \cdots + L_n^2}{n} - \frac{M_1^2 + M_2^2 + \cdots + M_n^2}{n}$$

Subject to

$$\left[\lambda_h^{E_n}(Z_k(x))\right]^2 \ge L_1^2, \left[\lambda_h^{E_n}(Z_k(x))\right]^2 \ge L_2^2, \left[\lambda_h^{E_n}(Z_k(x))\right]^2 \ge L_n^2$$

$$\left[\delta_h^{E_n}(Z_k(x))\right]^2 \le M_1^2, \left[\delta_h^{E_n}(Z_k(x))\right]^2 \le M_2^2, \left[\delta_h^{E_n}(Z_k(x))\right]^2 \le M_n^2$$

$$\sum_{j=1}^{n} x_{ij} \le R(c_i) \qquad i = 1, 2, 3, , , , , , , m$$

$$\sum_{i=1}^{m} x \le R(d_j) \qquad j = 1, 2, 3, \ldots . . n$$

$$x_{ij} \ge 0 \quad L_n^2 \ge M_n^2, \quad i = 1, 2, 3, , , , , , , m \, , j = 1, 2, 3, \ldots . . n \quad \ldots\ldots\ldots (10)$$

$$0 \le L_1^2, L_2^2, \ldots \ldots . L_n^2 \le 1$$

$$0 \le M_1^2, M_2^2, \ldots \ldots . M_n^2 \le 1$$

$$0 \le L_n^2 + M_n^2 \le 1, for\ n$$

Where $L_1, L_2 \ldots . L_n$ and $M_1, M_2, \ldots . M_n$ are the degree of acceptance and rejection for each objective function under various experts opinion.

4.2NEUTROSOPHI GOAL PROGRAMMING APPROACH FOR MOFTP:

In this method, the MOFTP was solved by NGP approach. This approach is predicated on an extension of Zimmermann's principles using a neutrosophical perspective. Basically, to attain the optimal solution, the three degrees of membership functions are needed that are represented as truth, indeterminacy, falsity.

Now consider each objective function as a parabolic fuzzy number after defuzzifying this gets the solutions of each objective functions.

To find the upper and lower bounds substitute the above solutions in each objective functions the upper values and lower values have been attained which are denoted $\overline{Z_k}$ and $\underline{Z_k}$ respectively.The formation of $\overline{Z_k}$ and $\underline{Z_k}$ are as given below:

$$\overline{Z_k} = max\{Z_k(x)\}_{k=1}^{K} \quad .....(11)$$

$$\underline{Z_k} = min\{Z_k(x)\}_{k=1}^{K} \quad .....(12)$$

After that the bounds of neutrosophic domain are calculated by

For Truth membership,

$$\overline{Z_k}^{\alpha} = \overline{Z_k}$$
$$\underline{Z_k}^{\alpha} = \underline{Z_k} \quad .....(13)$$

For indeterminacy membership,

$$Z_k{}^{\beta} = \underline{Z_k}^{\alpha} + S_k(Z_k{}^{\alpha} - \underline{Z_k}^{\alpha}),$$
$$\underline{Z_k}^{\beta} = \underline{Z_k}^{\alpha} \quad .....(14)$$

For falsity membership,

$$\underline{Z_k}^{\gamma} = \underline{Z_k}^{\alpha},$$
$$\overline{Z_k}^{\gamma} = \underline{Z_k}^{\alpha} + t_k(\overline{Z_k}^{\alpha} - \underline{Z_k}^{\alpha}) \quad \text{……..(15)}$$

Where s_k and t_k are real numbers belongs to (0,1)

The membership functions of the above bounds are stated below:

$$\alpha_k(Z_k(x)) = \begin{cases} 1 & , Z_k(x) < \underline{Z_k}^{\alpha} \\ 1 - \frac{\left(\sum_{i=1}^{m}\sum_{j=1}^{n} n_{ij}{}^{(k)}x_{ij}\right) - \underline{Z_k}^{\alpha}}{\overline{Z_k}^{\alpha} - \underline{Z_k}^{\alpha}} & , \underline{Z_k}^{\alpha} \le Z_k(x) \le \overline{Z_k}^{\alpha} \\ 0 & , Z_k(x) > \overline{Z_k}^{\alpha} \end{cases} \quad .....(16)$$

$$\beta_k(Z_k(x)) = \begin{cases} 1 & , Z_k(x) < \underline{Z_k}^{\beta} \\ 1 - \frac{\left(\sum_{i=1}^{m}\sum_{j=1}^{n} n_{ij}{}^{(k)}x_{ij}\right) - \underline{Z_k}^{\beta}}{\overline{Z_k}^{\beta} - \underline{Z_k}^{\beta}} & , \underline{Z_k}^{\beta} \le Z_k(x) \le \overline{Z_k}^{\beta} \\ 0 & , Z_k(x) > \overline{Z_k}^{\beta} \end{cases} \quad ..... (17)$$

$$\gamma_k(Z_k(x)) = \begin{cases} 1 & , Z_k(x) > \overline{Z_k}^{\gamma} \\ 1 - \frac{\overline{Z_k}^{\gamma} - \left(\sum_{i=1}^{m}\sum_{j=1}^{n} n_{ij}{}^{(k)}x_{ij}\right)}{\overline{Z_k}^{\gamma} - \underline{Z_k}^{\gamma}} & , \underline{Z_k}^{\gamma} \le Z_k(x) \le \overline{Z_k}^{\gamma} \\ 0 & , Z_k(x) > \underline{Z_k}^{\gamma} \end{cases} \quad ..... (18)$$

Where $\underline{Z_k}^{(.)} \neq \underline{Z_k}^{(.)}$ for each objective. If $\underline{Z_k}^{(.)} = \underline{Z_k}^{(.)}$ for three memberships, then the entries of this membership is 1. The principle of Bellman and Zadeh of this model of MOFTP is

$$\begin{aligned} &\text{Max min}_{k=1,2,\dots K}\, \alpha_k\left(Z_k(x)\right) \\ &\text{Min max}_{k=1,2,\dots K}\, \gamma_k\left(Z_k(x)\right) \\ &\text{Max min}_{k=1,2,\dots K}\, \beta_k\left(Z_k(x)\right) \\ &\text{Sub to } \textstyle\sum_{j=1}^{n} x_{ij} \le c_i, i = 1,2,3,\dots\dots m \\ &\quad \textstyle\sum_{i=1}^{m} x_{ij} \ge d_j, j = 1,2,3,\dots\dots n \\ &\quad x_{ij} \ge 0,\ i = 1,2,3,\dots\dots m, \\ &\quad\quad j = 1,2,3,\dots\dots n. \end{aligned} \quad ..... (19)$$

By utilizing the above subordinate parameters, the above problem can be rewritten as below:

$$\begin{aligned} &\text{Max L, Max N, Min M} \\ &\alpha\left(Z_k(x)\right) \ge L, \beta\left(Z_k(x)\right) \ge N, \gamma\left(Z_k(x)\right) \ge M \\ &\text{Sub to } \textstyle\sum_{j=1}^{n} x_{ij} \le c_i, i = 1,2,3,\dots\dots m \\ &\quad \textstyle\sum_{i=1}^{m} x_{ij} \ge d_j, j = 1,2,3,\dots\dots n \\ &\quad x_{ij} \ge 0,\ i = 1,2,3,\dots\dots m,\ j = 1,2,3,\dots\dots n. \\ &\quad L \ge N, L \ge M, L + M + N \le 3, \\ &\quad L, M, N \in [0,1] \\ &\quad k = 1,2,\dots\dots K \end{aligned} \quad ..... (20)$$

This can be further redefined as follows:

$Max\ \ L - M + N,$

$$\frac{\sum_{i=1}^{m}\sum_{j=1}^{n} n_{ij}^{(k)} x_{ij}}{\sum_{i=1}^{m}\sum_{j=1}^{n} d_{ij}^{(k)} x_{ij}} + \left(\overline{Z_k}^{\alpha} - \underline{Z_k}^{\alpha}\right) L \le \overline{Z_k}^{\alpha} |$$

$$\frac{\sum_{i=1}^{m}\sum_{j=1}^{n} n_{ij}^{(k)} x_{ij}}{\sum_{i=1}^{m}\sum_{j=1}^{n} d_{ij}^{(k)} x_{ij}} + \left(\overline{Z_k}^{\beta} - \underline{Z_k}^{\beta}\right) N \le \overline{Z_k}^{\beta}$$

$$\frac{\sum_{i=1}^{m}\sum_{j=1}^{n} n_{ij}^{(k)} x_{ij}}{\sum_{i=1}^{m}\sum_{j=1}^{n} d_{ij}^{(k)} x_{ij}} + \left(\overline{Z_k}^{\gamma} - \underline{Z_k}^{\gamma}\right) M \le \underline{Z_k}^{\gamma}$$

Sub to constraints (20) ……. (21)

Further the above problem can be redefined as follows:

Max L-M+N.

$$\sum_{i=1}^{m}\sum_{j=1}^{n} n_{ij}^{(k)} x_{ij} + \left(\overline{Z_k}^{\alpha} - \underline{Z_k}^{\alpha}\right) L - \overline{Z_k}^{\alpha}\left(\sum_{i=1}^{m}\sum_{j=1}^{n} d_{ij}^{(k)} x_{ij}\right) \le 0$$

$$\sum_{i=1}^{m}\sum_{j=1}^{n} n_{ij}^{(k)} x_{ij} + \left(\overline{Z_k}^{\beta} - \underline{Z_k}^{\beta}\right) N - \overline{Z_k}^{\beta}\left(\sum_{i=1}^{m}\sum_{j=1}^{n} d_{ij}^{(k)} x_{ij}\right) \le 0$$

$$\sum_{i=1}^{m}\sum_{j=1}^{n} n_{ij}^{(k)} x_{ij} + \left(\overline{Z_k}^{\gamma} - \underline{Z_k}^{\gamma}\right) M - \underline{Z_k}^{\gamma}\left(\sum_{i=1}^{m}\sum_{j=1}^{n} d_{ij}^{(k)} x_{ij}\right) \le 0 \quad \ldots(22)$$

Sub to (20) constraints

Solving the problem (22) using LINGO software the optimal solution will be obtained.

5. Numerical Example

In this chapter, an illustration is discussed to check validity of proposed method and the optimal solutions have been compared.

Consider the following MOFTP

$$Min\ Z_1 = \frac{\begin{array}{c}(4.25,13.95,6.23)x_{11} + (12.05,18.6,6.75)x_{12} + (6.93,9.55,5.65)x_{13} + (7.68,15.95,9.55)x_{14} \\ +(4.95,8.95,7.23)x_{21} + (10.2,12.6,12.95)x_{22} + (15.40,13.0,16.6)x_{23} + (9.95,7.95,6.85)x_{24} + \\ (4.25,6.95,16.23)x_{31} + (2.695,6.75,8.50)x_{32} + (16.5,15.25,12.75)x_{33} + (10.85,8.695,6.95)x_{34}\end{array}}{\begin{array}{c}(10.95,14.85,18.95)x_{11} + (9.2,13.65,12.95)x_{12} + (20,12.85,19.95)x_{13} + (6.85,7.75,9.95)x_{14} + \\ (5.63,13.75,6.95)x_{21} + (7.50,3.95,8.55)x_{22} + (6.5,12.5,20.5)x_{23} + (10.25,11.65,14.95)x_{24} + \\ (6.60,15.45,12.65)x_{31} + (14.8,16.25,12.95)x_{32} + (12.85,12.75,9.25)x_{33} + (9.95,6.55,16.95)x_{34}\end{array}}$$

……(23)

$$Min\ Z_2 = \frac{\begin{array}{c}(11.95,15.85,12.00)x_{11} + (9.63,6.75,12.95)x_{12} + (4.95,16.95,6.75)x_{13} + (7.95,9.85,8.90)x_{14} \\ +(13.85,11.75,10.95)x_{21} + (8.63,6.35,14.95)x_{22} + (8.50,3.95,8.55)x_{23} + (12.95,16.75,13.80)x_{24} + \\ (8.20,3.65,8.95)x_{31} + (10.95,6.75,11.80)x_{32} + (5.85,17.75,6.95)x_{33} + (13.85,9.75,7.25)x_{34}\end{array}}{\begin{array}{c}(9.20,12.45,13.95)x_{11} + (9.95,15.25,16.95)x_{12} + (7.68,5.95,8.75)x_{13} + (25.25,13.025,17.00)x_{14} + \\ (4.68,5.59,8.75)x_{21} + (7.68,13.95,8.55)x_{22} + (13.95,12.85,12.90)x_{23} + (0.25,16.65,6.25)x_{24} + \\ (9.95,8.85,8.90)x_{31} + (13.9,16.85,13.95)x_{32} + (7.2,13.45,13.95)x_{33} + (14.95,17.85,13.9)x_{34}\end{array}}$$

Sub to

$$x_{11} + x_{12} + x_{13} + x_{14} \le (12.65,15.35,16.65)$$

$$x_{21} + x_{22} + x_{23} + x_{24} \le (26.4,25.5,22.6)$$

$$x_{31} + x_{32} + x_{33} + x_{34} \le (14.00,21.45,23.10)$$

$$x_{11} + x_{21} + x_{31} \ge (4.00,21.45,13.10)$$

After defuzzify the above problem, we get

$$Min\ Z_1 = \frac{\begin{array}{c}(9.595x_{11} + 14x_{12} + 7.92x_{13} + 12.28x_{14} \\ +7.52x_{21} + 12.087x_{22} + 14.5x_{23} + 8.175x_{24} + \\ 8.595x_{31} + 6.237x_{32} + 14.937x_{33} + 8.925x_{34})\end{array}}{\begin{array}{c}(14.9x_{11} + 12.36x_{12} + 16.4x_{13} + 8.075x_{14} + \\ 10.02x_{21} + 5.99x_{22} + 13x_{23} + 12.125x_{24} + \\ 12.54x_{31} + 15.06x_{32} + 11.9x_{33} + 10x_{34}\end{array}}$$

……(24)

$$Min\ Z_2 = \frac{\begin{array}{c}(13.9x_{11} + 9.02x_{12} + 11.4x_{13} + 9.14x_{14} \\ +12.1x_{21} + 9.07x_{22} + 6.24x_{23} + 15.1x_{24} + \\ 6.11x_{31} + 9.06x_{32} + 12.08x_{33} + 10.15x_{34})\end{array}}{\begin{array}{c}(12.01x_{11} + 14.35x_{12} + 7.08x_{13} + 17.07x_{14} \\ +6.15x_{21} + 11.03x_{22} + 13.14x_{23} + 9.95x_{24} + \\ 9.14x_{31} + 15.39x_{32} + 12.01x_{33} + 16.14x_{34})\end{array}}$$

Sub to

$$x_{11} + x_{12} + x_{13} + x_{14} \le 15$$

$$x_{21} + x_{22} + x_{23} + x_{24} \le 25$$

$$x_{31} + x_{32} + x_{33} + x_{34} \le 20$$

$$x_{11} + x_{21} + x_{31} \ge 15$$

$$x_{11} + x_{22} + x_{32} \ge 25$$

$$x_{13} + x_{23} + x_{33} \ge 5$$

$$x_{14} + x_{24} + x_{34} \ge 15$$

$$x_{11}, x_{12}, x_{13}, x_{14}, x_{21}, x_{22}, x_{23}, x_{24}, x_{31}, x_{32}, x_{33}, x_{34} \ge 0$$

5.1 Comparison Table:

The comparison of the optimal solution obtained by an interactive Pythagorean-hesitant fuzzy and neutrosophic goal programming is shown below:

DVs	MOFTP (for Crisp)	MOFTP (fuzzy) by using PHFP	MOFTP (fuzzy) by using NGP
x_{11}	0	0	0
x_{12}	3	3	3
x_{13}	0	0	0
x_{14}	12	12	12
x_{21}	15	15	15
x_{22}	2	2	2
x_{23}	5	5	5
x_{24}	3	3	3
x_{31}	0	0	0
x_{32}	20	20	20
x_{33}	0	0	0
x_{34}	0	0	0
Z_1	0.7827	0.7839	0.7839
Z_2	0.7809	0.7760	0.7760

From the above table we observe that the solution obtained by Pythagorean hesitant fuzzy is comparatively better than the Neutrosophic goal programming approach.

6. CONCLUSION:

In this study the solution methodologies of multiobjective fractional transportation problem using Pythagorean-hesitant fuzzy and Neutrosophic goal programming have been proposed. Illustration is discussed to check validity of method. Solution obtained in above two methods have been compared. The solution obtained by Pythagorean hesitant fuzzy is comparatively better than the Neutrosophic goal programming approach. The suggested approach can be utilised in any applied field of research as well as for a variety of real-world issues, including supply chain management, portfolio optimisation, and supplier selection.

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A STUDY ON CONSUMER BEHAVIOUR TOWARDS INSURANCE PRODUCTS

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ABSTRACT:

In the world of uncertainties, people face various kinds of risks in their daily lives. Even though we act very cautious, it is impossible

for anyone to avoid them or provide for them. It is also not viable to forecast all the risks and calamities ahead of us. Many families are pushed towards impoverishment at the untimely death of the sole bread winner. These uncertainties and risks cannot be removed totally but can be reduced by taking precautionary steps. Although many risks can be reduced, the ill-fated victims cannot bear the suffering by themselves. Someone has to bear the responsibility so that the unfortunate persons who got affected by the loss are relieved from the burden. There lays a need for such institution to provide help to them and it is known as "Insurance". Insurance penetration in India shows a positive sign but still it is rising very slow in comparison to the world. But constant growth is very good as we can make India as the 6th largest insurance market in the world by 2030 from the current position of being the 10th. My present research conducted focuses on understanding the variables influencing the households' procurement of insurance products. The study is necessary to understand the insurance penetration and adoption of products among the households constituting majority savings of the country. The area is restricted to respondents in Tiruchirappalli Corporation. In this study, simple random sampling method is used. The sample size for the study refers to the 80 respondents who have taken insurance policies.

KEYWORDS: *Insurance, satisfaction level, adoption factors*

INTRODUCTION:

In the world of uncertainties, people face various risks and uncertainities. These uncertainties and risks cannot be removed totally but can be reduced by taking precautionary steps. Although many risks can be reduced, the ill-fated victims cannot bear the suffering by themselves. Someone has to bear the responsibility so that the unfortunate persons who got affected by the loss are relieved from the burden. There lays a need for such institution to provide help to them and it is known as "Insurance".The institution that provides such form of help is termed as "Insurer" and the person who benefits such protection against the happening is termed as "Insured". Insurance can be defined as, "a social device to accumulate funds to meet the uncertain losses arising through a certain risk to a person insured against the risk."The Insurance industry have attained a greater significance and predominant progress. It has undergone numerous transformations in names of development,modifications in the regulations, proposals for amendments and growth. These progressive developments have created new channels for growth of the industry keeping in track that the insurers stay relevant with changes and new digital disturbance. All these was made possible in India by the Insurance Development and Regulatory Authority (IRDA), the statutory body that promotes and regulates several different types of insurance companies in India. It is believed that insurance contributes income to the total national income. The acceptance of the people to avail insurance products is known as insurance adoption. In India, the Insurance Penetration ratio is rising very slowly and slightly declined in the FY 22-23 4% whereas in the FY 21-22 4.2%. Nonetheless, the increase in penetration of insurance over the previous five years is encouraging for the insurance market's overall growth and maturity. Therefore a research has been undertaken to analyse demographic profile of the people who have insured and identify the factors which influence the people to purchase insurance products. The following are the previous researches conducted earlier in this area.

LITERATURE REVIEW:

Thilakraj G 2024, The purpose of this evaluation of the literature is to investigate how health insurance enrollment in the Dakshina Kannada District is impacted by health insurance education and satisfaction. In order to comprehend the influence of health

insurance education and satisfaction on enrollment with health insurance, the study examines and summarizes previously published research papers, studies, and reports.The present study is grounded in a positivist research paradigm, and the data will be analyzed using a deductive research methodology. We will employ the method of descriptive research since it provides a thorough plan and process for gathering data. The impact of health insurance education and satisfaction on health insurance enrollment in the Dakshina Kannada District study provides insightful information that can benefit many stakeholders and advance the expansion and efficiency of the insurance sector.

Mr. Bharath G, Dr. Chandrakala V G, Mrs. Sowmya C U 2023, This study helps us to find out the customer perception and customer knowledge about private health insurance. India being viewed as a potential market for health insurance, challenges such as low insurance awareness and inadequate healthcare infrastructure in rural areas persist, making it a risky business venture. Private health insurers, focusing on the middle-class population, face criticisms for potential health disparity and rising costs for the poor, prompting calls for regulatory measures to ensure equitable benefit packages and protect customers.

Justice Ofori, Frank Boateng & Sulaiman Olusegun Atiku, 2023 This research employs two perspectives. The first is the way that individual traits that influence insurance uptake are controlled. Firm elements that may influence the uptake of insurance are the second. The majority of studies have focused on the specific variables influencing insurance uptake. Rogers' theory of innovation adoption serves as the foundation for this investigation. Rogers' innovation adoption theory thus explains the interaction among supply-side factors (firm strategy) and acceptance or adoption of insurance services, and also the moderating impact of sales agents. This theory examines how innovations spread and are embraced by businesses (insurance companies) and people (insured). The supply-side factors influencing uptake of insurance products investigated in this article are customer education, insurance product design, customer service, market positioning, perceived reputation, and insurance product cost. The findings indicate that market positioning, customer service, and insurance product design are the three supply-side variables affecting insurance uptake. Greater degrees in sales representative effectiveness strengthen the linkages between market positioning, customer service, insurance product design, and insurance uptake. The possibilities for practice highlight the need for a coordinated effort to establish insurance products that span income levels, with costs appropriate for each group and with sufficient knowledge to increase insurance product acceptance.

Suchismita Paul Dr. Soumitra Sarkar, 2023 investigates the perceptions that households have regarding the purchase of private health insurance in order to identify the key factors influencing the decision to purchase health insurance and to provide recommendations based on the findings above to close the coverage gap among the intended target households. Primary data for the study was gathered from West Bengali middle-class homes. The results emphasized aspects such as demographics, insurance knowledge, perceived health insurance advantages, self-beliefs, policy cost, and service quality that influence people's decisions to obtain health insurance.

Swithan Kaunda1, Taonaziso Chowa 2023, Kasama is a rural farming district. The smallholder farmers face multiple production risks and Weather Insurance Index (WII) has been designed to help them**.** In this work, the predicted change in the likelihood of WII uptake given a unit change in the regressors was measured using the Probit regression model. A semi-structured questionnaire with 200 farmer participants and an interview guide with five key informants who were purposefully chosen were used to gather the

data for the analysis. The Chi-Square test was used to analyze quantitative data using SPSS at the 5% and 1% levels of significance.The study came to the conclusion that the adoption of WII by small-scale farmers in the Kasama district was statistically significantly influenced by characteristics such as age, awareness of WII, and alternative sources of income. Furthermore, understanding of WII had a favorable and substantial impact on uptake, while age and other sources of income had an adverse substantial impact. Because WII is essential to smallholder farmers' adoption of it, the research advised policymakers, insurance service providers, and multilateral partners in the sector to try to increase awareness of it.

Zhang Sheng a, Fu Rao,b, Li Yike,c 2023, This study uses data from the 2015 China Household Finance Survey (CHFS) to empirically investigate the factors impacting the consumption behavior of commercial personal insurance in one-child households in China, based on the Stimulus – Organism - Response(SOR)theory.The study's conclusions show that household assets, interpersonal interaction costs, and the head of the household's health all strongly influence whether or not a family chooses to purchase commercial personal insurance. Nonetheless, households headed by women and those in the institutional sector are less likely to buy commercial personal insurance. Conversely, heterogeneity analysis showed that urban households and families with a single daughter have a higher need for business individual insurance. Expenses associated with social interactions do not substantially increase the adoption of insurance in single-son households compared to single-daughter families.Financial education greatly increases the acceptance of insurance in rural households as compared to urban households. This study advances the growth and evolution of the corporate private insurance sector and offers insightful information on the consumption habits of single-child households. Additionally, it provides factual support for the development of customized policies for various family configurations.

Prajapati, Kalpeshkumar B, Jetwat, Jaideepsingh H, 2022 The study's objective was to determine the variables influencing Gujarati customers' decisions to buy life insurance products in relation to their age groups. Researchers used the Chi-square Analysis Approach to identify a variety of dependent and independent variables. The outcome of the hypothesis test about age and life insurance product purchase choice was obtained. This empirical investigation has discovered a total of thirty factors.

Yumeng Huang 2022, Commercial health insurance, one of the key elements of China's basic medical security system, is crucial for the steady advancement of society as well as extra protection for individuals beyond basic medical insurance. This paper summarized the issues and described the current state of China's commercial health insurance development, using a linear regression framework based on panel data from 31 provinces, municipalities, and autonomous areas from 2011 to 2019. It then conducted an empirical analysis to identify the elements influencing China's commercial health insurancemarket and offered recommendations for its positive development.

Dr. Anil Singh Parihar, Dr. Malay Ghosh 2021, This paper has determined various variables responsible for making the selection during the procurement of health insurance by the clients. The Gwalior region's 240 residents provided the data and Factor analysis test was conducted. Six criteria were discovered to be responsible for the decision-making process when purchasing health insurance coverage. The elements are: Tax advantages; risk; company-related knowledge; marketing; as well as awareness.

Warodom Techasurin ,Chompu Nuangjamnong and Kitikorn Dowpiset 2021, Thailand is the second-largest market in ASEAN for auto insurance and has continued

to expand in this regard. This study aims to analyze and determine the variables impacting used automobile insurance purchase decisions made by consumers in the Bangkok region. The people who work or reside in Bangkok, Thailand, are the target populations. Price, brand name, and brand image were the independent variables and the dependent variable in the conceptual framework that represented the consumer's purchasing decision. Non-probability sampling was used to gather the data, and 400 respondents completed an online questionnaire survey. To determine how independent variables affected the dependent variable, multiple linear regressions were used. Price, brand recognition, and reputation therefore have a big impact on what customers in Bangkok decide to buy when it comes to auto insurance**.**

Sangita Basak 2021, examines the elements that influence policyholders' satisfaction with life insurance plans in Bangladesh and aids in the development of strategies by insurance companies to expand and maintain their life insurance business. When weighed against product features, the cost, adaptation, perceived value, growth in the economy, and advantages of maturity on policyholder satisfaction, factors including affordable premiums, high-quality services, effective agents,credibility,technology,and communication emerge as the most compelling aspects. This study may help Bangladesh's insurance industry progress.

Maseke B, Lipinge D 2021,The purpose of the paper was to analyze the various aspects that affect clients' selection of insurance providers. This paper's primary goal was to pinpoint the elements that influence consumers' preferences when choosing insurance providers; its secondary goal was to weigh the relative significance of these specific elements (advertising, social media, and behavioral aspects).This study used a questionnaire methodology with 185 randomly chosen Keetmanshoop, Namibia residents who completed questionnaires. Similar to what most other researchers discovered in earlier studies, the majority of participants selected insurers as a result of being persuaded by agents or brokers, according to the data. Nevertheless, 87% of those surveyed are happy with the insurers they currently use, whereas 13% are not along with plan to move to a new provider**.**

Bamgbose Olalekan Sodiq 2020, This study examines the variables influencing Nigerian Millennials' decisions to buy insurance products and services. In addition, investigating the preferred means used by Nigerian millennials to obtain insurance-related services and products as well as the effects of marketing and communication strategies on this population's adoption of insurance offerings. Data was collected using the questionnaire designed on the five-point likert scale and correlation, regression analysed was conducted. When purchasing insurance products and services, the majority of Nigeria's millennial population prefers to deal directly with insurance companies, according to research. Because they prefer the internet to traditional mainstream media, millennials are more likely to buy products and services related to insurance that have been promoted on social media sites and the internet. Millennials are starting to show a growing preference for mobile ads. Direct communicationwith insurance representatives and brokers becomes more prevalent as one becomes older and has more money, as opposed to using social media and peer referrals.

Simon Laura Drogas, Cristian Mihai Drogas, Gabriela Mihaela Muruesan 2020, The authors of this study investigated a number of conduct hypotheses regarding the impact of behavioral and sociodemographic characteristics on the decision to purchase a private pension or life insurance policy. Five separate areas of determinants were highlighted in the questionnaire design: economic considerations, social and demographic variables, general behavioral aspects, particular behavioral aspects, and a

self - constructed insurance knowledge score.To conduct hypotheses testing, data were gathered from a sample of 1579 individuals and data was analysed Using logit regression model to emphasize on the relationship between the factors that influence private pensions and life insurance intentions and decisions. The findings indicate that, for both types of products, certain behavioral characteristics and insurance literacy are extremely significant for the choice of purchasing, but not for the intent to buy.

Violeta Wilfred 2020, explores on the elements affecting the public's purchasing of life and medical insurance as well as the relationships between these variables. The study was both descriptive and quantitative with 200 randomly selected samples from clients of CIMB Bank Branches around Kota Kinabalu, Sabah. It reveals that the intention to purchase life and health insurance is highly, positively, and significantly correlated with parameters such as financial status, education level, financial security, risk mentality, and social variables.

Chi-Hsuan Lin; Kuang-Hsun Shih; Wei-Chuan Wang; Lee-Fen Chuang; Wei-Chun Tsai; Chung-Fu Huang 2020, This study aims to combine the information system success model and Davis's technology acceptance model to investigate the factors that lead customers to buy travel insurance through the mobile banking system. The information system success model includes variables related to system quality, information quality, and service quality. A total of 300 survey forms were gathered, nearly reaching a perfect response rate. There were 261 valid questionnaires, or 87% of the total number of responses. The findings of our research indicate that, out of the twelve hypotheses tested, just one is invalid. In conclusion, the research offers guidelines and suggestions that the banking sector can utilize as a point of reference for future promotions of mobile banking services.

OBJECTIVES:

1. To examine the socio demographic profile of the respondents
2. To ascertain the awareness level of the insurance products among the respondents
3. To identify the factors influencing the purchase of insurance products among households.

METHODOLOGY:

The research is confined to individuals residing in Tiruchirappalli Corporation. A random sample of 80 respondents were chosen. Primary data was collected through a structured interview schedule. Information from research reports, magazines and journals were also incorporated in the research work. The data collected from the respondents were analysed using SPSS software to interpret the results.

RESULTS AND DISCUSSION:

The research findings have exhibited the following results. IT has been found that majority of the female respondents have purchased insurance products. Insurance products are usually purchased before marriage and their age group lies between 18 to 25 years. Many respondents in nuclear families have opted for insurance products which are usually long term and are majorly influenced by their family members. The major factor influencing the purchase of insurance products is the reputation of the company, consumer perception and benefits of the insurance projects. Many respondents are aware of life insurance products and more awareness is to be created with regard to other insurance products as well.

CONCLUSION

Insurance is a necessity in the contemporary world. It acts as a huge investment opportunity. It secures our futuristic period from unanticipated hazards. The marked

transformation of digital insurance contributes to the convenience of individuals and the development of the economy. Thus, it is crucial that all should make sure that they are sufficiently covered in the occurrence of unforeseen occurrences by evaluating your risk and procure the indispensable insurance coverage.

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A STUDY OF SEASONAL UNEMPLOYMENT IN KUMBAKUDI VILLAGE,KUMBAKUDI GRAM PANCHAYAT, TIRUVERUMBUR TALUK, TIRUCHIRAPPALLI DISTRICT, TAMILNADU

"Hunger is not the worst feature of unemployment; idleness is – William Barrett"

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ABSTRACT

Despite being a developing country, the majority of Indians live in impoverished economic conditions. Due to unemployment, it was particularly difficult for residents of rural areas to meet even their most basic necessities. Since agriculture is the primary source of income for most villagers, seasonal unemployment is becoming more and more prevalent in rural regions. Since agriculture is a seasonal industry, labor is always in high demand throughout the busy planting,

weeding, and harvesting seasons.This paper analyses the nature of seasonal unemployment existing in Kumbakudi village of Tiruchirapalli district. This paper deeply studies the reasons for seasonal unemployment in the village. This paper has discussed thealternative ways of creating employment opportunities in the village.

(Keywords: Seasonal unemployment, Labour, Village, Agriculture, Standard of living)

INTRODUCTION

Unemployment is a major economic issue in India. Various types of unemployment exists in India and the rate of unemployment directly affects the GDP growth rate of the country. The government has taken many steps to reduce and eventually eliminate the unemployment rate in the economy. But, lack of sufficient capital and increased rate of population is continuously augmenting the level of unemployment in the nation. Even Though, India is a developing nation, most of the people's economic living conditions are poor. Especially, people living in rural areas were finding it difficult to satisfy even their basic needs as they are unemployed. As the occupation of most of the villagers is agriculture, the existence of seasonal unemployment rate is rapidly increasing in rural areas. Agriculture is a seasonal occupation and there is always a heavy demand for labour during the busy season, that is, during sowing, weeding and harvesting. During slack season, demand for labour falls considerably.Such unemployment varies from state to state, depending upon the methods of farming, nature of soil and possibility of multiple cropping. It has been estimated that agricultural labour remains idle from 4 to 6 months in a year. They mostly belong to economically and socially backward classes. Due to lack of unemployment opportunities in off-season, such labourers are compelled to borrow from village money-lenders and rich farmers at high rate of interest. They are also compelled to accept the low wages even in the busy season at the behest of their creditors. Due to illiteracy, poverty and poor health, they cannot move out of agricultural work elsewhere. This paper analyses the nature of seasonal unemployment existing in Kumbakudi village of Tiruchirapalli district. This paper deeply studies the reasons for seasonal unemployment in the village and it clearly defines the impact of seasonal unemployment on the villager's standard of living and finally addresses the possible ways to reduce seasonal unemployment rate in the village. This paper has also discussed the alternative ways of creating employment opportunities in the village.

OBJECTIVES:

- **To study the nature of seasonal unemployment existing in Kumbakudi village of Tiruchirappalli district.**
- **To study the reasons for the existence of seasonal unemployment in the selected village.**
- **To become aware about the impact of seasonal unemployment on villager's socio economic conditions.**
- **To find possible solutions to reduce the seasonal unemployment rate in the village.**

METHODOLOGY:

In this research study, primary data method was used to gather information from the villagers about seasonal unemployment and it's impact on their living conditions.

PRIMARY DATA: Questionnaire was prepared to collect responses from 27 respondents.

LIMITATIONS:

- The period of study is limited
- Most of the ruralites were illiteratesa.

So it was so hard to collect accuratedata from them.

- The data is inaccurate and exact due to personal bias and villager's signoranceonseasonal unemployment.
- Reliability of data is less.

REVIEW OF LITERATURE

1.ASHISH KUMAR SRIVASTAV in his study has highlighted that Seasonal unemployment refers to a type when the demand for labour or workforce is lower than normal under certain conditions.

2. According to article published by **Bachelor's in resource management human (2022),"**Seasonal unemployment is the result of the decreased demand in labour that occurs at each season's end, making the seasonal rate more predictable than other types of unemployment."

3.According to published by **"THE JOURNAL OF POLITICAL BARRYR. CHISWICK ECONOMY" (1976),** "Some off season unemployment is anticipated on a regular basis, the involuntary nature of unemployment during the off- season is questionable. In addition, there is a particular concern for the effects of unemployment compensation on the work effort (employment) of those in seasonal industries"

4. According to **S.A.R. BILGRAMI (2018),** "Agriculture is a seasonal occupation and there is always a heavy demand for labour during the busy season, that is, during sowing, weeding and harvesting. During slack season, demand for labour falls considerably. Such unemployment varies from state to state."

5. According to **Fredeline van Schalkwyk Izaks; Jana Avenant; Izanette (2018),** "Seasonal unemployment is a common phenomenon in rural areas ; it occurs when people are not employed at 5 certain times of the year as they work in industries where they are not needed all year round."

6**. KIMBERLY AMADEO (2022)** in his article has mentioned that seasonal unemployment results from regular changes in the season. Workers affected by seasonal unemployment include resort workers, ski instructors, ice cream vendors and crop harvesters.

7. **MARCIN GEBAROWSKI , RENATA LISOWSKA** in their article have mentioned that in economic terms, seasonality is associated with revenue that has not been achieved because business activity is reduced or ceased altogether in certain periods.

8. According to **PATRICK GRADY AND COSTA KAPSALIS (2002),** "Seasonal employment is particularly high in the primary sector such as agriculture, forestry, fishing and construction."

9. **PINCHUAN ONGAND JASON WARD (2019)** in their study have explained that Seasonal unemployment is generated when demand for labour falls according to the time of the year, and is generally driven by factors unrelated to individual worker preferences.

10. **PRAJJWAL KAUSHIK (2018)** in his study has mentioned that the joblessness happens during specific periods of the year. In certain enterprises and occupations like agribusiness, occasion resorts, ice plants and so forth, generation exercises occur just in certain seasons. So they offer work for just a specific time frame in a year. Individuals 6 occupied with such kind of exercises may stay jobless during the off-season.

11. According to the article published by **RESERVE BANK OF AUSTRALIA**, "Seasonal unemployment occurs at different points over the year because of seasonal patterns that affect jobs. Some examples include ski instructors, fruit pickers and holiday-related jobs."

12. **SMRITI CHAND** in her article highlighted that Seasonal unemployment is

unemployment that occurs during certain seasons of the year. In some industries and occupations like agriculture, holiday resorts, ice factories etc., production activities takes place only in some seasons. So they offer employment for only a certain period of time in a year.

13. **SUNIL KUMARD (2022)** in his article has highlighted that Seasonal unemployment occurs at different points over the year because of seasonal patterns that impact the jobs. This is applicable to employments that are based on seasonal changes and is operational only during a particular season in a year such as fruit pickers and holiday-related jobs (tourism).

14. According to the article published by

THE OFW ORLD PROBLEMS & ENCYCLOPEDIA HUMAN POTENTIAL, "A seasonal worker generally works in one to four month periods, most often in the building, construction, sugar, food preserves or hotel industries, or in agriculture" 7

15. According to article published **by U.S. BUREAU OFL ABOR STATISTICS**, "Total employment and unemployment are higher in some parts of the year than in others. For example, unemployment is higher in January and February, when it is cold in many parts of the country and work in agriculture, construction, and other seasonal industries is curtailed.

ANALYSIS AND DISCUSSION

TABLE - .1: CLASSIFICATION OF RESPONDENTS BY AGE
RESPONDENTS BY AGE

SL. NO	AGE IN YEARS	NO. OF. RESPONDENTS	PERCENTAGE TO THE TOTAL
1	BELOW 18	1	3.7%
2	18-30	18	66.7%
3	31-43	6	22.2%
4	44-56	1	3.7%
5	ABOVE 56	1	3.7%
	TOTAL	27	100.0%

SOURCE: COMPILED FROM PRIMARY DATA COLLECTED

From the above table, it is found that 66.7% of the selected respondents belong to the age group ranging between 18-30 years. It constitutes the maximum percentage in this study. 22.2% of the selected respondents belong to the age group ranging between 31-43 years. 3.7% of the selected respondents belong to the age group ranging between 44-56 years. 3.7% of the selected respondent belong to the age group of above 56 years. In this study, it can be noted that both young farmers and old farmers have shown their interest in serving the society as farmers and responsible agents of the society in order to feed the growing population.

TABLE-2 CLASSIFICATION OF RESPONDENTS BY MONTHLY INCOME

S.NO	MONTHLY INCOME in rupees)	NO. OF RESPONDENTS	PERCENTAGE TO THE TOTAL
1	BELOW 2000	0	0%
2	2000-7000	4	14.8%
3	8000-13000	18	66.7%
4	14000-19000	2	7.4%
5	ABOVE 19000	3	11.1%
	TOTAL	27	100.0%

SOURCE: COMPILED FROM PRIMARY DATA COLLECTED

From the table given above, it can be seen that for 66.7% of the selected respondents, the monthly income ranged between Rs.8000-Rs.13000. It constitutes the maximum percentage in this study. For 11.1% of the selected respondents, the monthly income was above Rs.19000. 14.8% of the selected respondents were earning monthly income ranging between Rs.2000 - Rs.7000.

For 7.4% of the selected respondents, the monthly income ranged between Rs.14000-Rs.19000. None of them were earning monthly income below Rs.2000. So ,it can be noted that the monthly income of a major percentage of the selected respondents in this study ranged between Rs.8000- Rs.13000.

TABLE-3: CLASSIFICATION OF RESPONDENTS BASED ON CULTIVATION OF MAIN CROP

SL .NO	CULTIVATION OF MAIN CROP	NO. OF. RESPONDENTS	PERCENTAGE TO THE TOTAL
1	PADDY	26	96.3%
2	WHEAT	0	0%
3	PULSES	0	0%
4	OTHERS	1	3.7%
	Total	27	100.0%

SOURCE:COMPILED FROM PRIMARY DATA COLLECTED

From the table given above, it can be seen that 96.3% of the selected respondents were cultivating paddy in their fields and it constitutes the maximum percentage of the total in this study. None of the selected respondents were cultivating wheat and pulses in their fields. From this study, it can be seen that paddy was the main crop cultivated in Kumbakudi village.

TABLE- 4: CLASSIFICATION OF RESPONDENTS BASED ON ACRES OF LAND OWNED BY THEM

SL. NO	NO. OF. ACRES	NO. OF RESPONDENTS	PERCENTAGE TO THE TOTAL
1	1 ACRE	9	33.3%
2	2 ACRES	7	26%
3	3 ACRES	5	18.5%
4	MORE THAN 3 ACRES	6	22.2%
	TOTAL	27	100.0%

SOURCE: COMPILED FROM PRIMARY DATA COLLECTED

From the table above, it can be seen that 33.3% of the selected respondents were owning 1 acre of land and 26% of the selected respondents were owning 2 acres of land. 22.2% of the selected respondents were owning more than 3 acres of land and 18.5% of the selected respondents were owning 3 acres of land. So, in this study it can be seen that the maximum percentage of the selected respondents (i.e.33.3 %) were owning 1 acre of land and the minimum percentage of the selected respondents (i.e. 18.5 %) were owning 3 acres of land.

TABLE- 5: CLASSIFICATION OF RESPONDENTS BASED ON IRRIGATION TYPE

SL. NO	TYPE OF IRRIGATION	NO. OF. RESPONDENTS	PERCENTAGE TO THE TOTAL
1	DRIP IRRIGATION	1	3.7%
2	CANAL IRRIGATION	11	40.7%
3	WELLS	10	37.1%
4	OTHERS	5	18.5%
	TOTAL	27	100.0%

SOURCE: COMPILED FROM PRIMARY DATA COLLECTED

From this study, it can be noted that 40.7% of the selected respondents were using canal irrigation. It constitutes the maximum percentage of the total in this study. 37.1% of the selected respondents were using wells and 3.7% of them were using drip water irrigation. 18.5% of the selected respondents were using other types of irrigation such as borewells, pumpsets, etc. So, it can be noted that a major percentage of the selected respondents (i.e.40.7 %) were using canal irrigation and a minimum percentage of them (i.e.3.7 %) were using drip water irrigation.

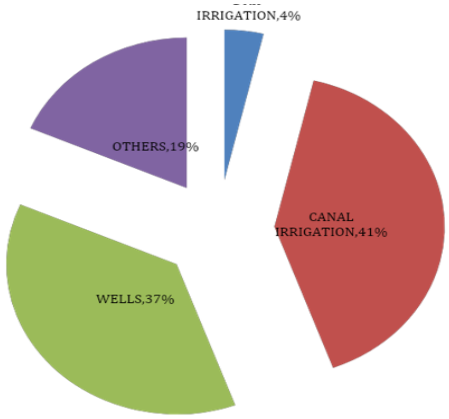

TABLE - 6 CLASSIFICATION OF RESPONDENTS BASED ON ALTERNATIVE OCCUPATION

SL. NO	ALTERNATIVE OCCUPATION	NO. OF. RESPONDENTS	PERCENTAGE TO THE TOTAL
1	BUSINESS	2	7.4%
2	DAIRY FARMING	4	14.8%
3	PRIVATE JOBS	3	11.1%
4	OTHERS	11	40.7%
5	NO JOBS	7	26%
	TOTAL	27	100.0%

SOURCE:COMPILED FROM PRIMARY DATA COLLECTED

From the above table, it can be found that 40.7% of the selected respondents have chosen other types of jobs as their alternative occupation and it constitutes the maximum percentage. 26% of the selected respondents didn't have any alternative occupation. 14.8% of the selected respondents have chosen dairy farming as their alternative occupation and 11.1% of the selected respondents were working in private firms during off season. 7.4% of the selected respondents were involved in small business during the off season. Major percentage of them have chosen other types of jobs (i.e.40 .7 %) such as unorganized works as their alternative occupation and the minimum percentage (i.e. 7.4 %) of the selected respondents were doing small business during off season.

TABLE - 7 CLASSIFICATION OF RESPONDENTS BASED ON INCOME FROM ALTERNATIVE OCCUPATION

SL. NO	INCOME THROUGH ALTERNATIVE OCCUPATION (IN RUPEES)	NO. OF. RESPONDENTS	PERCENTAGE TOTHE TOTAL
1	Nil Income	7	26%
2	BELOW 4000	2	7.4%
3	4000-10000	13	48.1%
4	11000-17000	5	18.5%
5	ABOVE 17000	0	0%
	TOTAL	27	100.0%

SOURCE: COMPILED FROM PRIMARY DATA COLLECTED

From the table given above, it can be seen that 48.1% of the selected respondents were earning income ranging between Rs.4000- Rs.10000 through their alternative occupation and it constitutes the maximum percentage of the total in this study. 26% of the selected respondents were not earning any income through alternative occupation. 18.5% of the selected respondents were earning income ranging between Rs.11000- Rs.17000 through alternative occupation and 7.4% of the selected respondents were earning income below Rs.4000 through their alternative occupation. None of them were earning income above Rs.17000 from their alternative occupation. So, the income of a major percentage of the selected respondents ranged between Rs.4000- Rs.10000.

TABLE-8RESPONDENT'S DIFFICULTY IN CHOOSING ALTERNATIVE OCCUPATION DURING OFF SEASON

SL. NO	DIFFICULTY IN CHOOSING ALTERNATIVE OCCUPATION	NO. OF. RESPONDENTS	PERCENTAGE TO THE TOTAL
1	YES	22	81.5%
2	NO	5	18.5%
	TOTAL	27	100.0%

SOURCE:COMPILED FROM PRIMARY DATA COLLECTED

From the above table, it can be seen that 81.5% of the selected respondents agreed that they found it difficult in choosing alternative occupation and 18.5% of the selected respondents didn't agree that they found it difficult in choosing alternative occupation. So, it can be noted that for a major percentage of the selected respondents in this study, choosing their alternative occupation was very difficult especially during the off season.

TABLE-9:PROFITEARNED THROUGHMULTI ROPPING

SL. NO	PROFIT EARNED THROUGH MULTI CROPPING	NO. OF. RESPONDENTS	PERCENTAGE TO THE TOTAL
1	YES	8	29.6%
2	NO	19	70.4%
	TOTAL	27	100.0%

SOURCE: COMPILED FROM PRIMARY DATA COLLECTED

From the above table, it can be found out that 70.4% of the selected respondents were not earning profit through multi cropping and 29.6% of the selected respondents were earning profit through multi cropping. From this study, it can be seen that a majorpercentage of the selected respondents were not earning any profit through multi cropping system.

TABLE- 10 AWARENESS OF RURAL UNEMPLOYMENT SCHEMES

SL. NO	AWARENESS OF RURAL UNEMPLOYMENT SCHEME	NO. OF. RESPONDENTS	PERCENTAGE TO THE TOTAL
1	YES	12	44.4%
	NO	15	55.6%
	TOTAL	27	100.0%

SOURCE: COMPILED FROM PRIMARY DATA COLLECTED

From the above table, it can be found that 55.6% of the selected respondents were not aware of any rural unemployment schemes and 44.4% of the selected respondents were aware of some rural unemployment schemes such as For 66.7% of the selected respondents, the monthly income ranged between Rs.8000- Rs. 12000.

TABLE- 11: IMPACT OF SEASONAL UNEMPLOYMENT ON LIVING

CONDITIONS

SL. NO	IMPACT OF SEASONAL UNEMPLOYMENT ON LIVING CONDITINS	NO. OF. RESPONDENTS	PERCENTAGE TO THE TOTAL
1	YES	24	88.9%
2	NO	3	11.1%
	TOTAL	27	100.0%

SOURCE: COMPILED FROM PRIMARY DATA COLLECTED

From the above table, it can be seen that 88.9% of the selected respondents agreed that Seasonal Unemployment has affected their living conditions and 11.1% of the selected respondents did not agree that seasonal unemployment has affected their living conditions. From this study, it can be noted that the living conditions of a major percentage of the selected respondents (i.e. 88.9 %) were affected by seasonal unemployment.

TABLE-12:SEASONAL UNEMPLOYMENT CONTRIBUTION FOR MAJOR UNEMPLOYMENT RATE IN KUMBAKUDI VILLAGE

SL. NO	MAJOR UNEMPLOYMENTRATE	NO.OF. RESPONDENTS	PERCENTAGE TO THE TOTAL
1	YES	14	51.9%
2	NO	13	48.1%
	TOTAL	27	100.0%

FINDINGS

1. 66.7% of the selected respondents belong to the age group ranging between 18-30 years.
2. 100% of the selected respondents were male farmers.
3. 88.9% of the selected respondents belong to the BC Community
4. 92.6% of the selected respondents were Hindus
5. For 66.7% of the selected respondents, the monthly income ranged between Rs.8000-Rs. 12000.
6. 96.3% of the selected respondents were cultivating paddy in their fields.
7. 33.3% of the selected respondents were owning 1 acre of land.
8. 40.7% of the selected respondents were using canal irrigation for their agricultural land.
9. 26% of the selected respondents didn't have any alternative occupation during the off season.
10. 81.5% of the selected respondents agreed that they found it difficult to choose alternative occupation.
11. 55.6% of the selected respondents were not aware of any rural unemployment schemes.
12. 88.9% of the selected respondents agreed that Seasonal Unemployment was affecting their living conditions.
13. 51.9% of the selected respondents agreed that Seasonal Unemployment was the main cause or this unemployment problem to persist in this village.

SUGGESTIONS

1. In this village, proper transport facilities through the construction of metallic roads are not being provided. So, this Kumbakudi village needs proper road and transport facilities.
2. There is a need to improve the transport facilities of Kumbakudi village.
3. In this Kumbakudi village, effective steps must be taken to open one Library in order to help the students cultivate the habit of reading.
4. In this Kumbakudi village, since many people are illiterates the educational status must beimproved through adult education centres/ Arivoli Iyakkam program.

CONCLUSION

As agriculture is the main occupation of this village, people in this village remain unemployed during the off-season and most of the ruralites were unable to find any alternative occupation to lead their economic life during the off-season. In this village, both the old and young ruralites showed their interest in agricultural practices in order to serve the society as farmers. As most of the villagers were illiterates, they were unable to find any other jobs. So, they stuck on to Agricultural Practices alone. Even in doing Agriculture, they were facing a lot of problems such as lack of Capital, infertile lands, unfavourable climate, improper irrigation, etc. So, they didn't get more revenue from agriculture. So, the standard of living of the ruralites in this village was poor. Since, the ruralites were illiterates, they were not aware of any rural unemployment schemes which had been offered by the government and they didn't get any benefits out of it.

From this study, it is clearly observed that Seasonal Unemployment exists in this selected village and it has adversely affected the ruralites living conditions. So, it is noted from this study that this village needs some assistance in order to overcome the issue of Seasonal Unemployment and it requires some support to improve the ruralites educational status and economic living condition.

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A STUDY ON THE EFFECT OF VITAMIN C AND DEXAMETHASONE ON MESENCHYMAL STEM CELLS DERIVED FROM AMNIOTIC MEMBRANE

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ABSTRACT:

In the present study, the mesenchymal stem cells (MSC) are isolated from the amniotic membrane and the effect of different concentration of Vitamin C, dexamethasone and combination of both on passage 3 MSCs were analysed and the cell viability of the treated MSCs are checked by MTT assay. Significant outcomes of the present study are Vitamin C at higher concentration (50µg/ml and100µ/ml) showed dose dependent toxicity toward amniotic membrane derived MSCs. At lower concentration, Vitamin C (10µg/ml and 20µ/ml) showed no toxic effect and they help in the formation of MSC cell sheet. For all the concentration of dexamethasone studied,toxic effect was not detected. Increasing concentration of dexamethasone increased the viability of cells and showed profound dose dependent effect on proliferation of MSCs. Toxicity effect of Vitamin C is ameliorated by dexamethasone at the concentration of 10nM/ml and 20nM/ml. This was a preliminary study to assess the supportive role of dexamethasone in reducing toxicity of high concentration Vitamin C. Further studies to evaluate the role of Dexamethasone in stable sheet formation induced by Vitamin C are in pipeline.

Key Words: Vitamin C, Dexamethasone, Mesenchymal Stem cells, MTT assay.

INTRODUCTION

Stem cells are the cells that have the capability of clonogenicity, self-renewal and differentiation into several cell lineages. Stem cells are the basic unit of all multi-cellular organisms and are vital for maintaining tissue homogeneity and proper functioning of the organism. Stem cells are usually classified based on two characteristics namely their potency to differentiate and source of isolation. Based on their potency, stem cells can be broadly classified into 5 distinct types (Totipotent, Pluripotent, Multipotent, Oligopotent Unipotent). Based on sources, stem cells are of three types: Adult stem cells, Embryonic stem cells and Induced pluripotent stem cells [1]. Embryonic stem cell is derived from the inner cell mass of blastocyst stage embryo and is pluripotent in nature. They express high levels of telomerase activity [2]. Adult stem cells are also called as somatic stem cell, it is exist in the postnatal organism [3]. Adult stem cells reside in almost all tissues and are undifferentiated pluripotent (hematopoietic stem cells) or multipotent cells. Mesenchymal and Hematopoietic stem cells are typical examples for adult stem cells [4].

Mesenchymal stem cells (MSC) belong to adult stem cells. MSCs are multipotent. They are a group of clonogenic cells, capable of self renewal and multi-lineage differentiation [5]. The sources of mesenchymal stem cells are bone marrow, adipose tissue, peripheral blood and neonatal birth-associated tissues including placenta, umbilical cord, cord blood and amniotic membrane [6]. MSC are usually identified by four ways namely plastic adherence and fibroblast-like morphology, trilineage differentiation capacity; expression of surface markers such as CD73, CD90, and CD105; and lack of lineage-specific markers such as CD34, CD14, CD45 [7]. MSCs are used to treat many diseases including acute myocardial ischemia (AMI), stroke, liver cirrhosis, amyotrophic lateral sclerosis (ALS) and GVHD [8]. Amniotic membrane (AM) is a source of MSCs from inner side of the fetal placenta, which is a fetal tissue that is usually discarded after pregnancy [9]. MSCs have unique immunologic character, which promote their survival and growth in allogeneic or xenogeneic environments [10]. AM or AM–derived MSC also exhibit some embryonic stem cell properties like pluripotency markers are expressed, high expansion in invitro, or trilineage differentiation capacity [11].

Vitamin C is a water-soluble compound and an essential nutrient for living organisms. It is abundantly available in natural sources, including fruits and vegetables. [12]. Vitamin C is an antioxidant, vital for the biosynthesis of extracellular membrane and encourages the differentiation of many mesenchymal stem cells [13]. Dexamethasone (Dex) is a potent synthetic component of the glucocorticoid class of steroid drugs. Frequently, Dexamethasone has been used to enhance the osteogenic, chondrogenic and adipogenic differentiation of mesenchymal stromal cells. Dexamethasone is being used recently, to promote MSC proliferation [14].

The main objective of the present study is to assess the effect of different concentration of Vitamin C alone and in combination with dexamethasone on human MSCs culture and growth. Also, they induce the stem cell sheet formation for clinical use. The sheet thus formed can be used as alternative to commercially available collagen sheets for burns and ulcers treatment.

MATERIALS AND METHOD:

Procurement of amniotic membrane:

Human Amniotic Membrane (a biological waste material after delivery) was collected in a sterile container after getting informed consent from mother undergoing

elective caesarean delivery. The tissue was transferred to cGMP compliant laboratory and processed within 24 hours of collection.

Amniotic membrane processing and isolation of mesenchymal stem cells:

Human amniotic membrane was washed systematicly with Dulbecco's phosphate buffer saline containing antibiotic (2% Penstrep) to remove residual blood contaminants. After the wash, tissue was minced into small pieces with sterile blade and subjected to enzymatic digestion using enzymes such as collagenase Type I for approximately 1.5 - 2 hours. The digested tissues were filtered using 100µ cell strainer and centrifuged at 2500 rpm for 10 minutes, supernatant was discarded and the cell pellet was re-suspended using 10 ml of pre-warmed complete media (DMEM-HG, 89%; Platelet lysate, 10%; Antibiotic, 1%). Resuspended cells were then seeded into 100mm culture dish and incubated in the presence of 5% CO_2 and at 37°C.

Observation and media replenishment:

After 24 hours of seeding, the cells were observed for adhesion under inverted microscope. To remove the floating and dead cells, complete media was freshly prepared and replaced to flasks with a PBS wash. Thereafter media was replenished every 2-3 days until the flask reaches sub-confluency (80%).

Passage 1:

When the flask reached an optimal confluency of around 85-90%, cells were harvested and expanded for an additional passage. Briefly, the spent media were discarded and PBS wash was given twice. 5ml of trypsin was added to the cells and the dish was incubated for 1-2 minutes and observed for cell detachment under microscope. Once more than 80% of the cells are detached, dish was tapped gently to detach cells from the edges of the dish. To neutralize trypsin, an equal volume of pre-warmed complete media was added and mixed gently to get a single cell suspension. Then for a minimum of 5 minutes at 1500 rpm, cell suspension were centrifuged. Supernatant was discarded and pellet was resuspended with pre-warmed complete media and seeded in a T25 and a T75 flask and incubated at 37^0C, 5% CO_2. Upon reaching 85-90% confluency cells were harvested. Approximately 8 million cells were obtained, and from these 7 million cells are taken and frozen for experiment and 1 million cells were seeded for next passage.

Passage 2:

Approximately 1 million cells were reseeded in a T75 and media replacement was done as before. Upon confluence cells were subjected to trypsinization and frozen in vapour phase of liquid nitrogen.

Cryopreservation:

To preserve the living cells and tissues, structurally intact, the use of very low temperatures namely Cryopreservation technique was employed. Cells from passage 2 were frozen until further use. Briefly, cells were harvested, counted and resuspended in pre-cooled cryopreservation medium at a density of $1 – 3 \times 10^6$ cells/mL in cryovials and kept at -80^0C over night in Mr. Frosty and transferred to vapour phase of liquid nitrogen (-160^0C) the next day.

Stock preparation:

Dexamethasone stock:

Commercially available dexamethasone (Dexa) comes as 2mg/ml vial. Previous studies suggest addition of dexamethasone at a concentration of 5-10 ng/mL stabilizes Vitamin C induced stem cell sheet [33]. Hence to prepare an optimal concentration to be used in this study, 3.8µl of commercially available dexamethasone is diluted in 14,995.14µl of complete media (10ng/mL).

Treatment protocol:

All the cells used for experiment were from passage 3. Approximately, 34,000 cells/well in two 6 well plates and 5000 cells/well in 96 well plate were seeded. Subsequent media changes were done every two to three days till the multi-well plate reaches 80-85% confluency, after which, media with the following constituents were added to the cells as given below.

Compound	96 well plate (concentration (µg /ml in complete media)	6 well plate (concentration/ml in complete media)
Vitamin C	10µg,20µg,50µg,100µg	20µg, 50µg, 100µg
Dexamethasone	10nM, 20nM	10nM, 20Nm
Vitamin C & Dexamethasone	10µg+10nM 20µg+20nM 100µg+10nM 100µg+20nM	10µg+10nM 20µg+20nM

Morphological analysis:

Every day the stem cells were observed for sheet formation under inverted microscope and representative images were taken for all samples.

MTT Assay:

3-(4,5-dimethythiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) is used to assess cell viability. Actively respiring cells reduces the water-soluble MTT to an insoluble purple formazan. DMSO was used to solubilise formazan and its concentration was standardised and measured by optical density (OD). After the induction, 96 well plate was subjected to MTT assay at 48th hour. The proliferation / survival of the cells were evaluated for Vitamin C, Dexamethasone and combination of both treatments. Culture plates were incubated for a minimum of 4 hours at 37°C after the culture medium was replaced with 5 mg/ml MTT solution. The precipitate was extracted with DMSO and optical density was measured at the wavelength of 490 nm.

RESULTS:

Mesenchymal stem cells were isolated successfully from the amniotic membrane (Fig 1). They were cultured for 4-6 days in complete media at 37^{o}C, 5% CO2; the number of adherent fibroblast-like-shaped cells rapidly proliferated and reached about 60%-70% confluence on day 3-4, and then 80-90% confluence on day 5, respectively. Cells were subcultured.

Vitamin C, though known widely for its antioxidant activity, at higher dose (50µg/mL, 100µg/mL) showed dose dependent toxicity towards amniotic membrane derived MSCs (Fig 2 and Fig 3). Significant and interesting observation was the confluent monolayer of passage 3 MSCs started to form cell sheets at 20µg/ml concentration of Vitamin C on day 4(Fig 7) , but in the control dish only the full monolayer confluency were attained and cell sheet formation was not observed .

Dexamethasone showed a dose dependent effect on proliferation of mesenchyaml stem cells. When passage 3 cells were exposed to dexamethasone at the concentration of 20nM/ml(Fig 5), significant increases in the proliferation of MSCs were observed when compared to 10nM/ml concentration of dexamethasone (Fig 4)and control. In this study the combination of Vitamin C and dexamethasone (100µg/ml of Vitamin C and 10nM/ml of dexamethsone) also failed to form stable cell sheet (Fig 6).

Proliferation and survival of the MSCs were noted in all treated cells with different

concentration of Vitamin C, dexamethasone and their combination were assayed using MTT assay which is done in the 96 well plate and seeded at the cell density of $5x10^3$ cells per well. MTT assay result showed that number of viable cells was significantly higher at 50µg/ml than at 100µg/ml of Vitamin C. In contrast, for dexamethasone, the number of viable cells was higher at 20nM/ml than 10nM/ml. The group treated with Vitamin C and Dexamethasone at different concentrations showed significant increase in cell viability when compared to the viability of the cells treated with Vitamin C alone or dexamethasone alone. Among the two concentration of dexamethasone tested in combination with Vitamin C (100µg/ml), as tested alone higher concentration of dexamethasone (20nM/ml) showed higher viability of cells than its lower concentration (10nM/ml) (Fig 8).

MTT assay was also completed for the MSCs treated with lower concentration of Vitamin C, 10µg/ml of Vitamin C and 20µg/ml of Vitamin C. Vitamin C treated MSCs showed significantly higher number of viable cells at 10µg/ml than at 20µg/ml and control. In contrast, for dexamethasone, the quantity of viable cells was high for 20nM/ml than 10nM/ml. For the group treated with Vitamin C and Dexamethasone, the viability of cells was higher at the concentration of 20µg/ml Vitamin C and 10nM/ml dexamethasone (Fig 9).

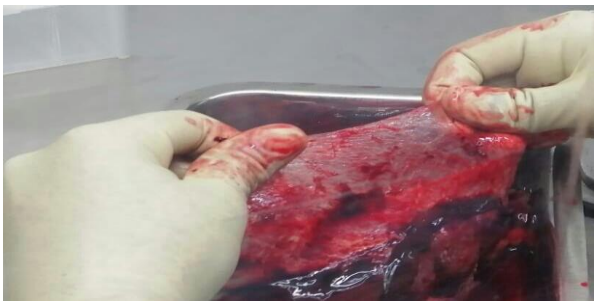

Fig 1: Isolation of MSCs from Amniotic membrane

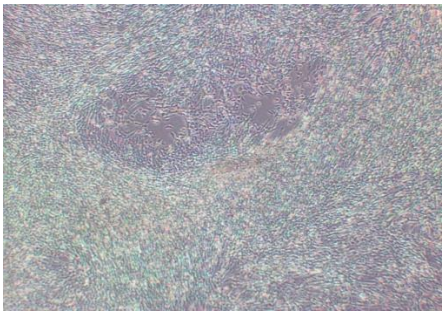

Fig 2: MSCs treated with Vitamin C 50µg/ml after 24hrs in passage 3 cells

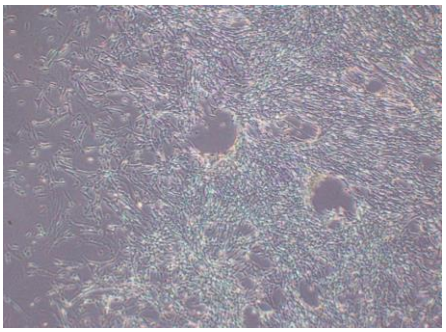

Fig 3: MSCs treated with Vitamin C 100µg/ml after 24hrs in passage 3 cells

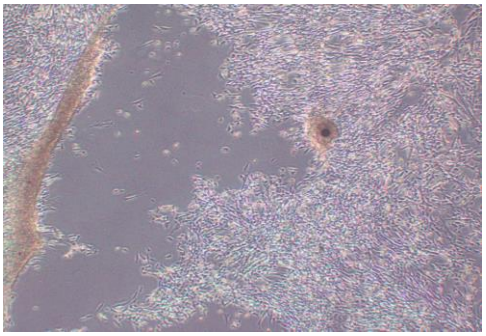

Fig 4: MSCs treated with Dexamethasone 10nM/ml after 24hrs in passage 3 cells

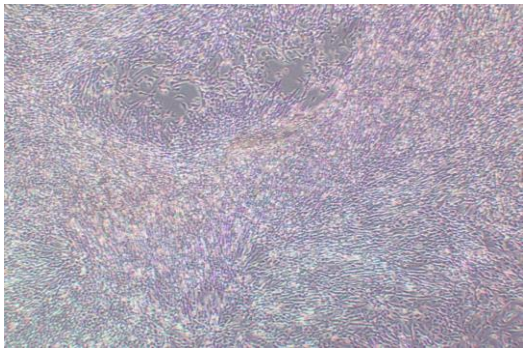

Fig 5: MSCs treated with Dexamethasone 20nM/ml after 24hrs in passage 3 cells

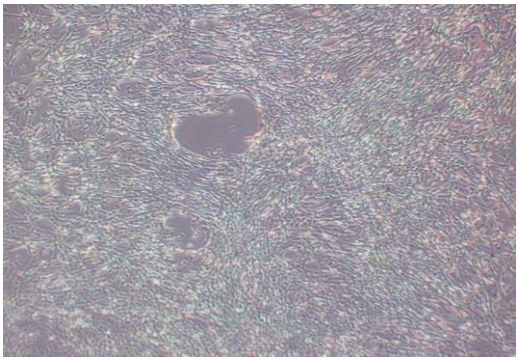

Fig 6: MSCs treated with Vitamin C 100µg/ml and dexamethasone 10nM/ml after 24hrs in passage 3 cells

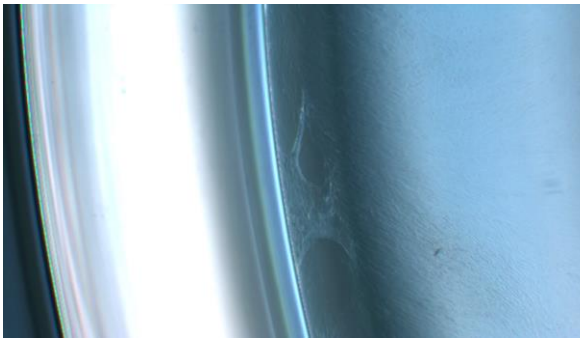

Fig 7: Cell sheet begins to form in cultured passage 3 MSCs treated with Vitamin C 20µg/ml after 4days

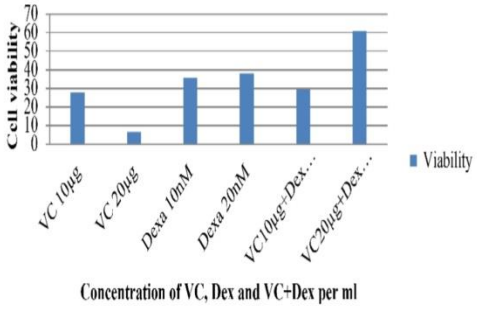

Fig 8: MTT assay of Passage 3 MSCs treated with lower concentration of Vitamin C, Dexamethasone and in combination after 24 hours.

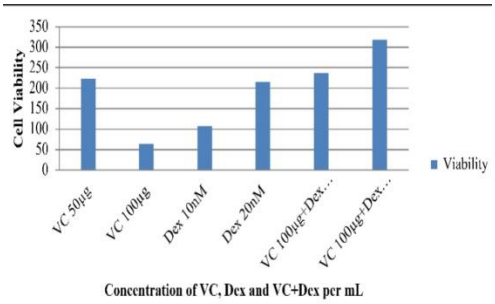

Fig 9: MTT assay of Passage 3 MSCs treated with higher concentration of Vitamin C, Dexamethasone and in combination after 24 hours.

DISCUSSION:

Vitamin C, is essential in biosynthesis of collagen and other ECM constituents, and acts as a cofactor in many biological reactions throughout the human body especially immune system [24]. Vitamin C plays an important role in the regular maintenance of collagen in humans (anti-scurvy properties) and its important role is to by prevent the auto-inactivation of two key enzymes in collagen biosynthesis namely lysyl and prolyl hyroxylase [15]. Vitamin C leads to the increased secretion of collagen type I, which in turn leads to increased Col1/$\alpha_2\beta_1$ integrin-mediated intracellular signalling [16]. Vitamin C is used in stem cell culture to produces the

cell sheet that help in regeneration of tissue and wound healing. Vitamin C supply in the cell culture in different sources of mesenchymal stem cells such as adipose derived stem cell [17], bone marrow stem cell [18], placental stem cell [19], periodontal ligament stem cell [20], umbilical cord stem cell [21] to produces stem cell sheets.

Cell sheet formation is the cultured cells are connected through cell–cell junctional proteins and are harvested as an intact single layer of cell sheet containing locally deposited extracellular matrices. These cell sheet manipulation techniques can be applied to various cells and tissue structures for tissue regeneration purpose [22]. The cell sheet has extracellular matrix and is a is a complete intact layer and has vital cell surface proteins and receptor proteins for growth factors. The MSC sheets have numerous applications in the field of tissue engineering and regenerative medicine [23]. Pluripotent stem cells generation is also improved by Vitamin C. It has been suggested and disputed as an anti-cancer agent [25].

Vitamin C has powerful antioxidant properties as it inhibit the production of free radicals and protects the cells from oxidative damage. Vitamin C. However, increasing levels of Vitamin C shows cellular toxicity especially on cancerous cells through generating excessive ROS and blocking the energy homeostasis. Kim *et al* showed that high-dose Vitamin C selectively induces DNA damage on cancer stem cells and not on differentiated tumour cells, raising an opportunity that Vitamin C may be used to target cancer stem cells [26]. Vitamin C, enhances induced Pluripotent Stem Cells (iPSC) generation. In addition, Vitamin C speed up the gene expression changes and promotes the transition of pre-iPSC colonies to a fully reprogrammed state [27].

In the current study Vitamin C at higher concentration (50µg/ml and100µ/ml) showed dose dependent toxicity toward amniotic membrane derived MSCs and failed to form cell sheet. But at lower concentration (10µg/ml and 20µ/ml) toxicity was not observed and also promoted the formation of cell sheet. Another interesting finding is toxicity effect of Vitamin C is ameliorated by dexamethasone at the concentration of 10nM/ml and 20nM/ml. Dexamethasone is a glucocorticoid compound with potent anti-inflammatory activities. It represses a large set of pro-inflammatory genes by arresting NF-kB and MAPK activation. Dexamethasone is an important regulator of cellular proliferation and differentiation but contradictory effects have been noted in a variety of culture systems [28].

Clinically, Dexamethasone has been utilized as an anti-inflammatory drug and it can also induce osteoporosis and even pathological fracture, while Dexamethasone in vitro promotes osteoblast differentiation and bone mineralization. In fact, Dexamethasone has been routinely used to induce the differentiation of MSCs and is a key component in osteogenic differentiation medium [31]. Different concentrations of Dexamethasone exert various effects on MSC proliferation and apoptosis. Dexamethasone was also able to change the pattern of cytokine expression of MSC. Dexamethasone at low doses was found to protect against apoptosis by supporting the MSC expansion *in vitro*. It is not suitable for MSC to be pre-treated with Dexamethasone when they are to be used to treat immunologic disease. However, when MSC are useful to promote angiogenesis, it is beneficial for them to be pre-treated with 10^{-9} mol/L Dexamethasone [30].

In the present study, increasing concentration of dexamethasone increases the viability of cells and showed profound dose dependent effect on proliferation of mesenchyaml stem cells and thus

dexamethasone acts as a growth factor in cell culture. But, dexamethasone at 10nM/ml as well as 20nM/ml concentration does not help in cell sheet formation. Similar to our results, Bailly et al., reported that, dexamethasone was found to help in prolonged cell viability, inhibited the development of an apoptotic structure, and stabilised the expression of procaspase-3. The inhibition of apoptosis strongly correlated with a decrease of caspase-3-like protease activity [32]

CONCLUSION:

This study assessed the effect of Vitamin C alone, dexamethasone alone and combination of both, on mesenchymal stem cell growth, proliferation, sheet formation and toxicity assessment in a dose dependent manner and evaluated the amelioratory mechanism of dexamethasone towards the effects of Vitamin C. Significantly at higher concentration (50µg/ml and100µ/ml) Vitamin C showed dose dependent toxicity toward amniotic membrane derived MSCs. At lower concentration, Vitamin C (10µg/ml and 20µ/ml) showed no toxic effect and less amount of cell sheet formation. For all the concentration of dexamethasone studied, toxic effect was not observed. Increasing concentration of dexamethasone increased the viability of cells and showed profound dose dependent effect on proliferation of MSCs. Toxicity effect of Vitamin C is ameliorated by dexamethasone at 10nM/ml and 20nM/ml concentration. This preliminary study to assess the supportive role of dexamethasone in reducing toxicity of high concentration Vitamin C is highly significant because the sheet formation occur only in the higher concentration of Vitamin C. Further studies to evaluate the role of Dexamethasone in stable sheet formation induced by Vitamin C are in pipeline.

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