ASSESSING THE GROWTH OF URBAN AGRICULTURE AND POTENTIALITY OF GREEN MANAGEMENT FOR GREEN CITY MODEL IN JHARGRAM MUNICIPALITY, WB, INDIA

Abstract

Urban agriculture, the practice of cultivating, processing, and distributing food within or around urban areas, is gaining momentum as cities grapple with challenges such as food insecurity, climate change, and rapid urbanization. As more than two-thirds of the global population is expected to live in urban settings by 2050 (United Nations, 2018), urban agriculture (UA) is increasingly seen as a sustainable response to urban food demands and environmental concerns. This practice serves multiple functions beyond food production, including improving food security, promoting sustainability, generating income, and strengthening communities. As urban populations grow, urban agriculture plays a vital role in ensuring access to fresh, nutritious food, especially in low-income neighbourhoods or food deserts. It reduces the environmental impact of food transportation by shortening supply chains and encourages the recycling of organic waste and use of eco-friendly practices like composting and rainwater harvesting. Jhargram is a scenic town located in the western part of West Bengal, India, known for its rich cultural heritage, royal history, and natural beauty. The primary objective of this research is to explore the emerging prospect and potentiality of urban agriculture in Jhargram town, with the broader aim of contributing to its transformation into a sustainable green city. The research begins by assessing the current urban landscape and land use pattern of the town, identifying underutilized or vacant spaces—such as rooftops, terraces, community plots, and public lands—that hold potential for conversion into productive agricultural zones. The survey across Jhargram Municipality highlights how people and institutions are embracing agriculture, even within urban limitations. In the domestic sector, an impressive 81% of households are involved in home gardening. This shows that many residents care about growing their own vegetables, herbs, or ornamental plants—whether for daily use, a hobby, or simply to keep their surroundings green.. Schools and colleges in Jhargram also contribute significantly to local greenery. Many institutions use large plots for growing vegetables, fruits, and even medicinal plants. In the health sector, gardening happens on a much smaller scale. Most people and institutions rely on simple hand-watering, which takes time and isn't always effective. The integration of smart technology will play a crucial role. Urban farmers should be encouraged to adopt automated irrigation systems, soil sensors, and mobile monitoring apps to optimize resource use and crop yield. In academic institutions, agriculture-based education programs should be introduced from the primary level to instil ecological values early. Research and innovation hubs can be set up in colleges to explore hydroponics, aquaponics, and urban composting methods. Additionally, training and capacity-building programs for residents, especially women and unemployed youth, can turn urban farming into a viable source of income. Rainwater harvesting and

wastewater recycling systems must be introduced and made mandatory in larger institutions like schools, hospitals, and industries. Another important recommendation is the integration of technology into urban agriculture. Tools such as automated irrigation systems, moisture sensors, and mobile-based plant monitoring applications should be encouraged to make farming more efficient and less labour-intensive.

Key Words: **Rapid Urbanization, Urban Agriculture, Rain Water Harvesting, Micro Irrigation, Green City**

1.1 Introduction :

As more than two-thirds of the global population is expected to live in urban settings by 2050 (United Nations, 2018), urban agriculture (UA) is increasingly seen as a sustainable response to urban food demands and environmental concerns. Urban agriculture, the practice of cultivating, processing, and distributing food within or around urban areas, is gaining momentum as cities grapple with challenges such as food insecurity, climate change, and rapid urbanization. This practice serves multiple functions beyond food production, including improving food security, promoting sustainability, generating income, and strengthening communities. As urban populations grow, urban agriculture plays a vital role in ensuring access to fresh, nutritious food, especially in low-income neighbourhoods or food deserts. It reduces the environmental impact of food transportation by shortening supply chains and encourages the recycling of organic waste and use of eco-friendly practices like composting and rainwater harvesting. Jhargram is a scenic town located in the western part of West Bengal, India, known for its rich cultural heritage, royal history, and natural beauty. The primary objective of this research is to explore the emerging prospect and potentiality of urban agriculture in Jhargram town, with the broader aim of contributing to its transformation into a sustainable green city. With rapid urbanization and the increasing demand for food and green spaces in urban settings, this study seeks to examine how integrating agricultural practices within Jhargram's urban fabric can enhance environmental sustainability, economic resilience, and social well-being. The survey across Jhargram Municipality highlights how people and institutions are embracing agriculture, even within urban limitations. In the domestic sector, an impressive 81% of households are involved in home gardening. This shows that many residents care about growing their own vegetables, herbs, or ornamental plants—whether for daily use, a hobby, or simply to keep their surroundings green. However, many families, especially those living in apartments, face challenges like tiny spaces and lack of proper soil. Most people use whatever space they can find—balconies, rooftops, or small yards—and mostly rely on tap water and manual watering to keep their plants alive. Schools and colleges in Jhargram also contribute significantly to local greenery. Many institutions use large plots for growing vegetables, fruits, and even medicinal plants. In the health sector, gardening happens on a much smaller scale. Hospitals and nursing homes mostly grow medicinal plants and

flowers to beautify their premises and create a calm environment for patients and staff. Although this is a good step towards promoting wellness, limited space, lack of water, and high upkeep make it hard to expand these green spots. The industrial sector shows the least agricultural activity. The integration of smart technology will play a crucial role. Urban farmers should be encouraged to adopt automated irrigation systems, soil sensors, and mobile monitoring apps to optimize resource use and crop yield. In academic institutions, agriculture-based education programs should be introduced from the primary level to instil ecological values early. Research and innovation hubs can be set up in colleges to explore hydroponics, aquaponics, and urban composting methods. Additionally, training and capacity-building programs for residents, especially women and unemployed youth, can turn urban farming into a viable source of income. Firstly, there is a strong need to promote vertical and rooftop gardening, especially in apartments and institutions with limited space. Rainwater harvesting and wastewater recycling systems must be introduced and made mandatory in larger institutions like schools, hospitals, and industries. This will address water scarcity and reduce pressure on bore wells and tap water. Another important recommendation is the integration of technology into urban agriculture. Tools such as automated irrigation systems, moisture sensors, and mobile-based plant monitoring applications should be encouraged to make farming more efficient and less labour-intensive.

1.2 Location and Destination

Jhargram is a culturally rich and ecologically significant town located in the western part of West Bengal, India. Positioned at the edge of the Chota Nagpur Plateau, it serves as a transition zone between the plains of Bengal and the forested uplands of eastern India. This geographical setting, marked by red lateritic soil, undulating terrain, and dense sal forests, makes Jhargram a suitable study area for researchers interested in geography, environment, and rural-urban dynamics. Jhargram Municipality is located between $86^0 59' 42''$E in the west to $87^0 1' 15''$E in the east and $22^0 25' 06''$ N in the South to $22^0\ 28'\ 55''$N in the north. It is set up in 1982 and comprises of 18wards which distance from the capital of Kolkata is around 170 km and passes the South Eastern Railways that the Kharagpur – Tata segment in the town. Jhargram town is situated on the Howrah-Mumbai railroad line and 160Km away from Kolkata and just 20 km away from the line of Jharkhand State and 15Km away from N.H.- 6, known as AH – 46. Jhargram town achieved its municipal status in 1982 adopting 25 mouzas of jhargram Panchyet samity . There are 18(eighteen) wards of municipality with one councilor each ward. This Municipality is situated in the central part of jhargram District. Jhargram Municipality was established in the year 1982. In that time municipality covered 21.40 sq km area and the population was 61682 only and at present about 95,000 (2025) It is surrounded by dense forests, hills, and rivers like the Subarnarekha, Kansabati and Dulung, which add to its serene

charm. Historically, Jhargram was a princely state ruled by the Malla Deb dynasty, and the Jhargram Raj Palace still stands as a testament to its royal past. This architectural marvel, partly converted into a heritage hotel, is a major tourist attraction. The region is home to several tribal communities, including the Santhals, Mundas, and Bhumijs, whose vibrant traditions, festivals, and crafts add to the cultural richness of the town.

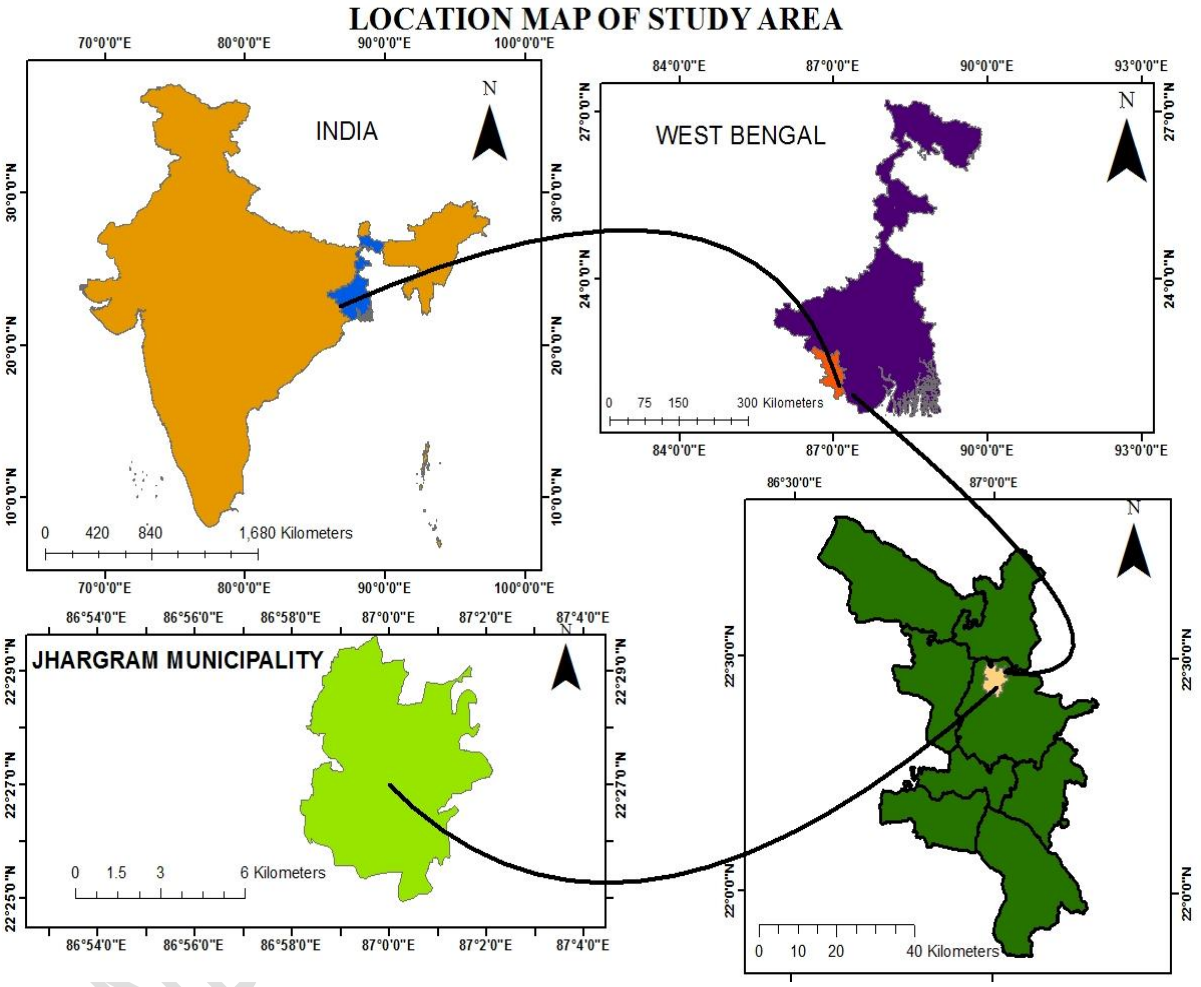
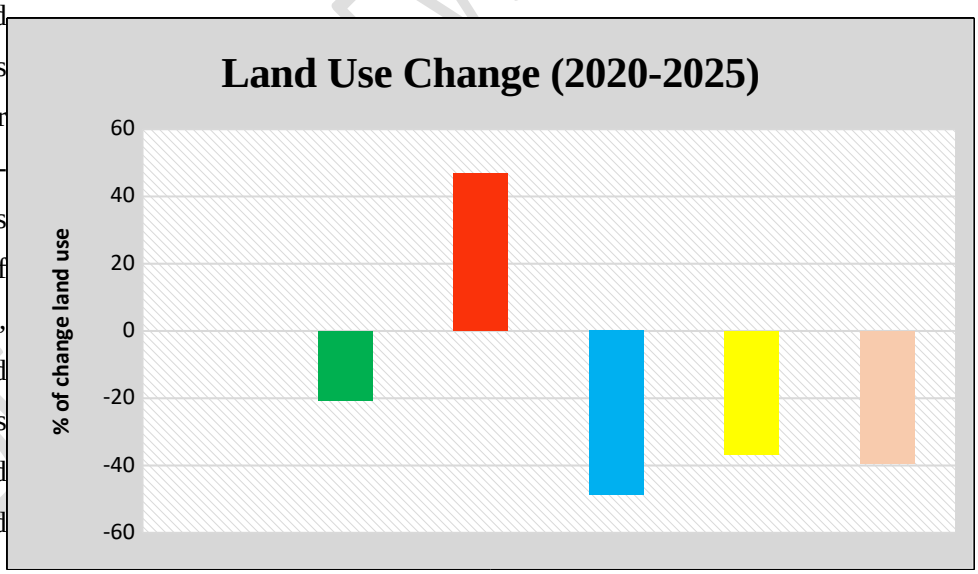


Fig: 1.1 Location Map of the Study Area

1.3 Background and Present Status of the Study Area

The study area, Jhargram, represents a unique confluence of cultural heritage, ecological significance, and socio-economic complexity, making it a fitting context for urban agriculture research. Located in the western part of West Bengal on the edge of the Chota Nagpur Plateau, Jhargram lies within the historical "Jungle Mahal" region, characterized by its dense forests, red lateritic soil, and undulating terrain. The name "Jhargram," meaning "village within the forest," aptly reflects its natural setting and historical connection with the tribal communities such as the Santhals, Mundas, Bhumijs, and Lodhas, whose traditions, festivals, and folk practices enrich the region's cultural landscape. Historically, Jhargram transitioned from being a princely state under the Malla Raj family to integration into independent India, carrying forward a legacy of education, art, and infrastructure initiatives set by its rulers. The Jhargram Palace, a symbol of its architectural heritage, and the establishment of institutions like Jhargram Raj College have strengthened its position as a regional educational hub. The region's involvement in India's freedom struggle and local tribal uprisings also reflect its resilience and community spirit. Economically, Jhargram has remained predominantly agrarian, with rice as the principal crop, supplemented by forest-based livelihoods and traditional crafts like dokra, terracotta, and handloom weaving. In recent years, its scenic beauty and cultural richness have fueled a growing tourism sector, supported by government initiatives to promote eco-tourism and heritage tourism, which offers employment opportunities to the local youth. However, the district has faced challenges such as deforestation, water scarcity, and socio-political disruptions during periods of Maoist insurgency, which highlighted deep-seated issues of poverty, land rights, and underdevelopment.



Restoration of peace and subsequent infrastructural improvements in education and healthcare have helped in the gradual socio-economic development of the region. Today, Jhargram stands at a transitional point, balancing tradition with aspirations for sustainable development. The region's biodiversity, cultural diversity, and improving civic amenities make it an ideal ground for integrating urban agriculture within its development plans. Urban agriculture holds potential to enhance food security, livelihood opportunities, and environmental resilience, aligning with Jhargram's vision to emerge as a sustainable green city while celebrating its rich cultural and ecological heritage.

2.1 Objectives:

The primary objective of this research is to explore the emerging prospect and potentiality of urban agriculture in Jhargram town, with the broader aim of contributing to its transformation into a sustainable green city. With rapid urbanization and the increasing demand for food and green spaces in urban settings, this study seeks to examine how integrating agricultural practices within Jhargram's urban fabric can enhance environmental sustainability, economic resilience, and social well-being. Others prime objectives of the research are;

I. To assess the current urban landscape and land use pattern of the town, identifying underutilized or vacant spaces—such as rooftops, terraces, community plots, and public lands—that hold potential for conversion into productive agricultural zones.

II. To analyse the satellite imagery, field surveys, and municipal records, the study aims to pinpoint specific areas where urban farming initiatives can be practically introduced. Another important objective is to evaluate the feasibility of different urban agriculture models suited to Jhargram's unique geographical and climatic conditions.

III. To enquiry the critical factors such as soil fertility, water availability, rainfall patterns, waste generation, and temperature variation, all of which influence the viability of techniques like rooftop gardening, vertical farming, hydroponics, and container farming.

IV. To encourage among urban people for food security through local food production, reducing dependency on food transported from distant areas, creating employment and entrepreneurial opportunities—especially for women and youth—and improving nutritional intake among marginalized communities.

V. To recommend and future planning for environmental benefits such as increased green cover, reduced urban heat island effect, improved air quality, and the recycling of organic waste through composting are also investigated to showcase how urban agriculture contributes to the larger green city vision.

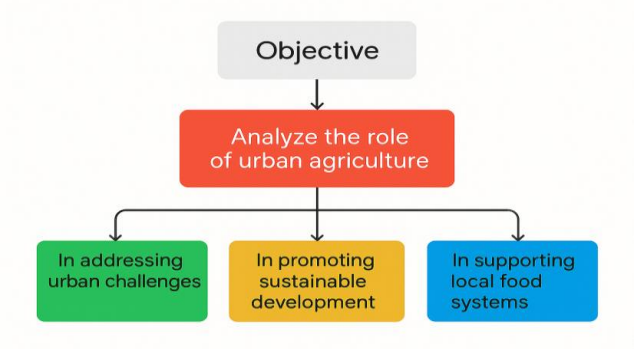


Fig: 2.1 Flow chart of Objectives

2.2 Study Materials and Methodology:

In the research on urban agriculture in Jhargram Municipality, the use of diverse study materials played a critical role in ensuring comprehensive and realistic findings. The study effectively combined structured questionnaires, field observations, interviews, and focus group discussions, enabling the collection of both quantitative and qualitative data. This approach allowed the researcher to capture detailed information about the types of crops grown, the extent of cultivation, water and soil sources, irrigation practices, and challenges faced by practitioners across domestic, academic, health, and industrial sectors.

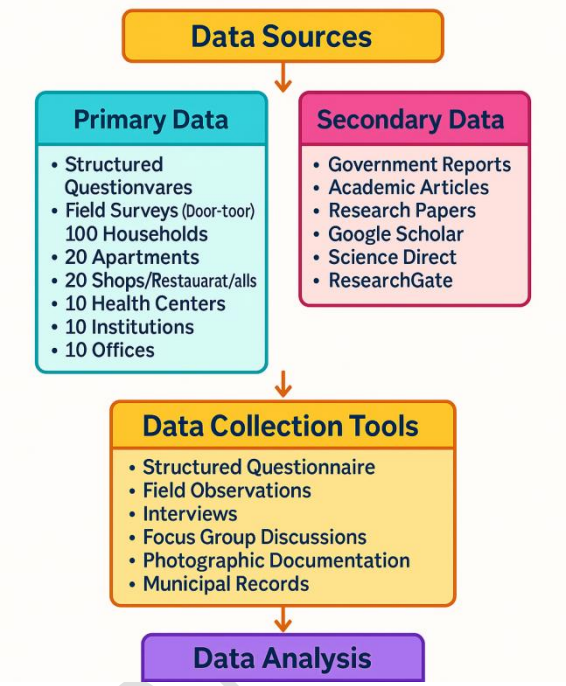


Fig: 2.3 Flow chart of Data Source

The questionnaires served as the backbone for quantitative analysis, systematically documenting participation levels, the scale of cultivation, and the methods adopted by households, institutions, and industries. Field observations were crucial for validating the questionnaire data, providing a visual understanding of the agricultural setups in apartments, rooftops, school campuses, and hospital gardens, thus highlighting real-time practices and limitations such as space constraints and irrigation challenges.

Interviews and focus group discussions added depth to the findings, revealing the motivations, awareness levels, and aspirations of local residents, teachers, health workers, and industry staff regarding urban agriculture. These materials helped to identify the socio-cultural perspectives and willingness of the community to engage with urban farming

initiatives, which is essential for designing participatory strategies for Jhargram's green city planning.

Methodology

Data Sources: A survey was conducted in all 18 wards of Jhargram district. The total population of Jhargram is 61,682 (2011 Census) (at present about 95,000) with a density of 2900/km² (at present 4440/ km²) and , and there are 18,101 households. The study area focuses on Flow charts, Pie diagrams, and Technical analysis. The study uses primary and secondary data collected from Jhargram Municipality. A structured questionnaire was used for field studies in the wards. Secondary data was collected from reports, documents, and platforms like Google Scholar, Science Direct, and Research Gate.

Primary Data: A total of 100 Households, 20 Apartments, 20 Shops, Restaurant and Malls, 10 Health Center, 10 Institutions and 10 Offices in Jhargram District were surveyed to assess their agriculture status using random sampling. Data was collected through door-to-door structured questionnaires, primary surveys. All statistical data are represented and analysed by the Quantitative Techniques and Cartographic Tools and Techniques.

Different Maps are produced and analysed with the help of Geospatial Techniques and AI Methods:

a. **Vegetation indices:**

Vegetation indices are essential tools for monitoring plant health, density, and distribution across landscapes. Among these, the **Normalized Difference Vegetation Index (NDVI)** is one of the most widely used and effective. Originally developed by NASA scientists in 1985 (Tucker et al., 2001),

The NDVI is calculated using the following formula:

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

Where,

NIR represents reflectance in the near-infrared band.

Red represents reflectance in the red (visible) band.

Equation:1

b. **Urban indices:**

Urban indices several indices—Normalized Difference Built-up Index (NDBI), Built- up Index (BI) —have been utilized to delineate urban built-up areas and examine their relationship with land surface temperature. The NDBI, refined by Zha et al. in 2003, is calculated using the formula (Zha et al. 2003),

$$NDBI = \frac{SWIR - NIR}{SWIT + NIR}$$

Where,

SWIR = reflectance in the Shortwave Infrared band

NIR = reflectance in the Near-Infrared band

The Built-up Index (BI) developed by He et al. (2010) is used for mapping urban expansion and assessing urbanization levels, respectively. Their formulas are

Equation:2

$$BI = NDBI - NDVI$$

Where:

NDVI = Normalized Difference Vegetation Index

NDBI = Normalized Difference Built-up Index

Equation:3

c. **Water index:**

As suggested by Xu in 2006, the Modified Normalized Difference Water Index (MNDWI) has been assessed in the examination of the water bodies in the research region. This index efficiently reduces interference from soil, plant, and built-up regions, improving the identification of open water features. The following formula is used to determine the MNDWI (Xu.,2006).

The index is calculated using the following formula:

$$MNDWI = \frac{Green - SWIR}{Green - SWIR}$$

Where:

Green = reflectance in the green band

SWIR = reflectance in the shortwave infrared band

Equation:4

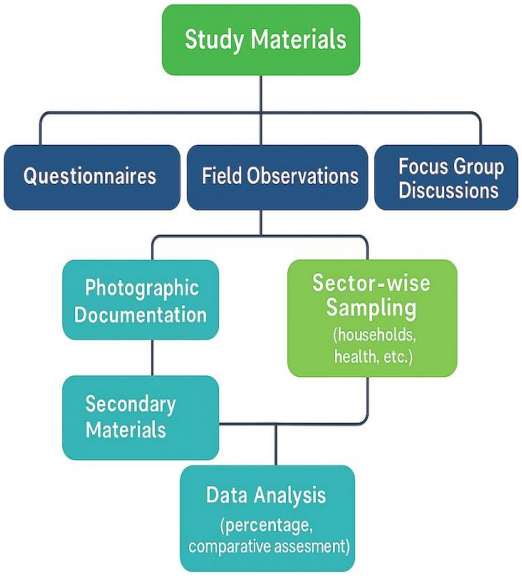


Fig: 2.4 Flow chart of Methodology

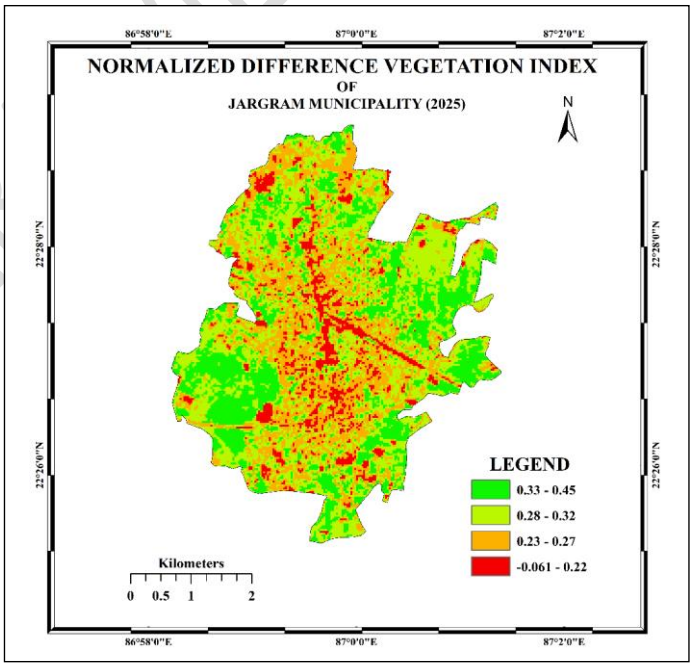


Fig: 2.5 Existing vegetation Map & Vegetation Index

3. Finding and Assessment:

The survey reveals that a significant 81% of households in Jhargram Municipality actively engage in domestic agriculture, indicating a strong inclination toward home-based plant cultivation. This suggests that urban residents value sustainable practices, possibly for household consumption, hobby, or environmental benefits. The high participation rate reflects growing awareness about food security, health, and eco-friendly living. Despite challenges like limited space or water, the majority's involvement highlights domestic agriculture as an integral part of urban lifestyle in Jhargram.

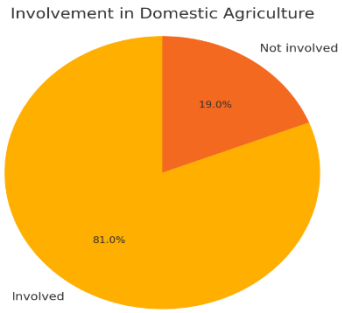


Fig: 3.1 Pie Chart of Involvement in Domestic Agriculture

3.1 Total Agricultural Area

The surveyed data on domestic agriculture in Jhargram Municipality reveals varying land utilization for plant cultivation. A significant portion of households (47%) dedicate less than 100 sq ft, indicating a prevalence of small-scale gardening. However, a substantial number also utilize larger areas, with 21% using 100-300 sq ft and 23% using 300-600 sq ft. farming. This suggests a clear distinction in agricultural space availability between independent households and apartment residents.

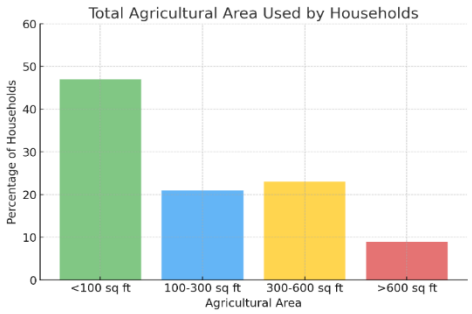


Fig: 3.2 Bar Graph of Total Agricultural Area Used By Households

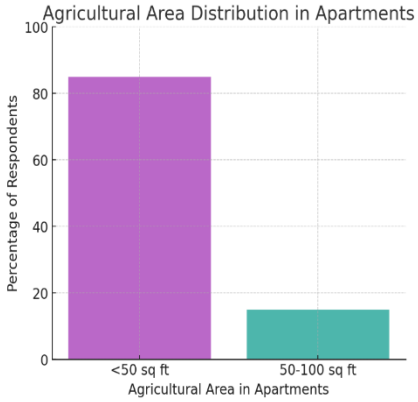


Fig: 3.3 Bar Graph of Agricultural Area Distribution in Apartments

3.2 Type of Plants

In domestic agriculture, a diverse range of plants are cultivated across different living situations. Households in Jhargram Municipality grow vegetables, fruits, herbs, flowers, and ornamental plants, indicating a varied approach to home gardening. Similarly, apartment residents also cultivate vegetables, fruits, herbs, flowers, and ornamental plants, with the addition of indoor air-purifying plants, suggesting an adaptation to indoor environments and potentially smaller spaces.

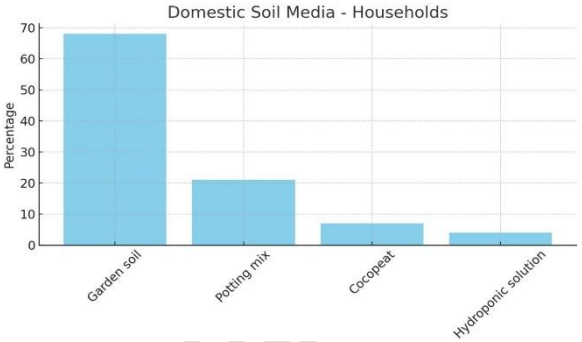


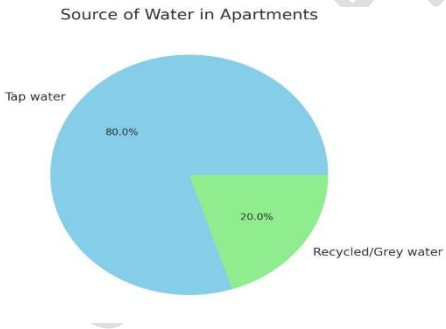
Fig: 3.4 Bar Graph of Soil Media Used by Households

3.3 Soil Media

In domestic agriculture, the choice of soil media differs notably between households and apartments, reflecting adaptations to different gardening environments. Households predominantly utilize garden soil (68%), suggesting access to outdoor spaces or larger quantities of natural soil. Potting mix is the second most common at 21%. In contrast, apartment dwellers show a greater reliance on potting mix (35%), followed closely by garden soil (30%) and cocopeat (25%).

3.4. Source of Water for Agriculture

In both domestic and apartment agriculture, tap water is the primary source of irrigation, used by 80% of respondents. Manual watering dominates as the preferred irrigation method, reflecting the small-scale nature of urban gardening. While households occasionally rely on borewell and recycled water, apartments show some use of wastewater (20%).



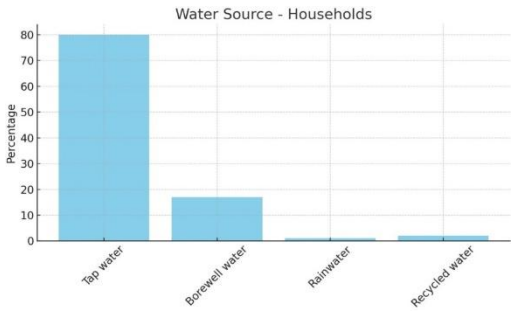


Fig: 3.5 Bar Graph of Water Source Used by Households

Fig: 3.6 Pie Chart of Water Source Used by Apartments

3.5 Irrigation System

In both domestic (household) and apartment agriculture, manual watering is overwhelmingly the most common irrigation technique. For households, 92% use manual watering, with drip irrigation at 6% and sprinkler systems at 2%. Similarly, in apartments, 95% rely on manual watering, and 5% use drip irrigation. This indicates a strong preference for traditional, hands-on watering methods in residential urban farming, likely due to factors such as cost-effectiveness, simplicity, and the relatively small scale of these operations.

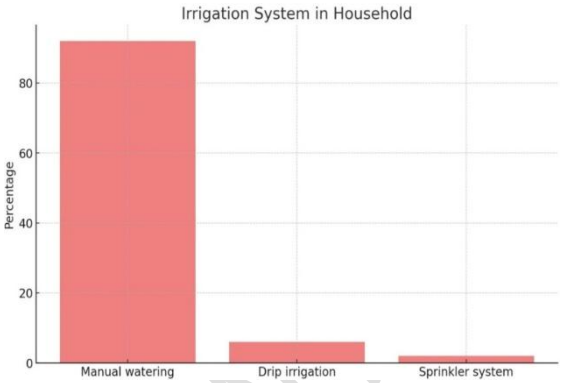
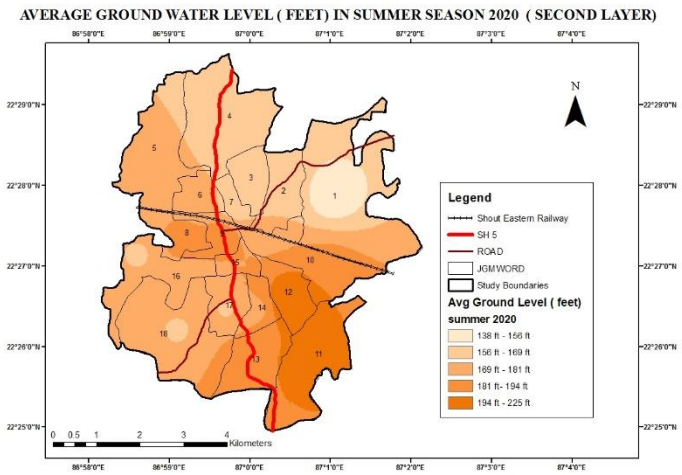


Fig: 3.7 Bar Graph of Irrigation System Used by Households



4. Challenges in This Agriculture

Both domestic (household) and apartment agriculture face several common challenges. A significant hurdle for households is the lack of garden soil, small area, and insufficient water. Similarly, apartment agriculture is significantly impacted by small spaces, lack of soil, and water scarcity. High maintenance is a shared problem for both, with households also citing lack of time and nutrients as issues, and apartments adding lack of direct sunlight and nutrients to their list of challenges. These commonalities highlight the constraints of urban environments on agricultural practices.

5. Assessment

- The academic sector in Jhargram shows significant involvement in agriculture, with both schools and colleges actively cultivating a variety of plants, including vegetables, fruits, and medicinal species. These efforts primarily serve educational, training, and environmental

purposes. Institutions dedicate substantial space to cultivation and use natural soil and organic compost.

- The total agricultural area in the academic sector of Jhargram is notably substantial, with 40% of institutions using over 2000 sq ft and another 40% utilizing between 500 to 1000 sq ft. Only 20% cultivate on 1000 to 2000 sq ft.

- The purpose of agriculture in the academic sector of Jhargram is primarily centered around education, training, and environmental beautification. Institutions use agricultural activities to enhance students' practical knowledge, promote ecological awareness, and improve campus aesthetics. While research is a lesser priority, the educational benefits are significant, integrating theoretical concepts with hands-on experience.

- In the academic sector of Jhargram, borewell water is the primary source of irrigation, used by 90% of institutions, while 10% utilize recycled or reused water.

- Notably, drip irrigation—known for its water efficiency—is not utilized at all. The reliance on manual systems suggests simplicity and cost-effectiveness but may not be sustainable for larger areas. The use of sprinklers in some institutions indicates partial modernization.

6. Potentiality of Urban Agriculture in Jhargram City

I. One of the biggest opportunities lies in promoting rooftop farming under green nets. Many houses have unused rooftops that can be turned into productive gardens. Green nets provide shade and protect plants from harsh weather, pests, and excessive heat, making rooftop gardening more feasible throughout the year. Such spaces can be used to grow vegetables, herbs, and ornamental plants, reducing dependence on market produce and improving household nutrition.

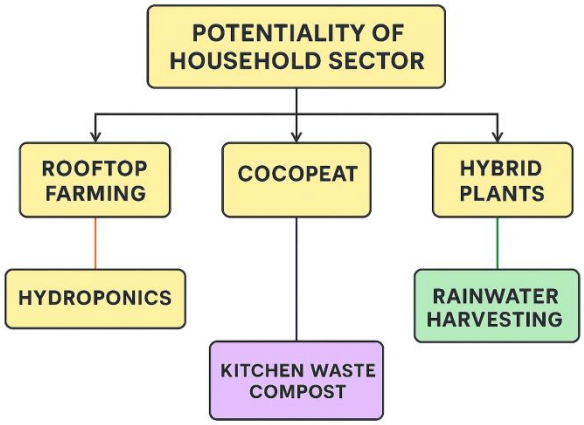


Fig: 6.1 Flow Chart of Potentiality of Household Sector

II. Hydroponics is another modern method that households can adopt. This soilless farming technique allows plants to grow in nutrient-rich water, making it ideal for balconies, rooftops, or small indoor corners. It uses less water than traditional gardening and eliminates the need for heavy soil, which is often a challenge in urban homes.

III. In addition, the use of cocopeat as a growing medium can make home gardening cleaner and more efficient. Cocopeat is lightweight, retains moisture well, and provides excellent aeration for plant roots. It is perfect for container gardening, especially for apartments where soil handling can be messy and impractical.

IV. To address water scarcity, households can adopt rainwater harvesting unit of Basutirtha RRR Model for micro irrigation and Basutirtha Rack Cultivation for water conservation. Collecting and storing rainwater can provide an extra source of irrigation, reduce dependency on tap or borewell water, and promote a self-sustaining gardening system. This is especially important during dry months when water shortage becomes a major hurdle.

V. Cultivating low-maintenance and hybrid plants can further enhance the success of household agriculture. Hardy plants that require less frequent care and hybrid varieties that give higher yields in small spaces can maximize output with minimal effort.

VI. Households can also manage organic waste wisely by creating kitchen waste compost. Using vegetable peels, leftover food, and other biodegradable scraps to make homemade fertilizer not only reduces waste going to landfills but also enriches the soil naturally.

VII. Many schools and colleges have flat, underused roofs that can be converted into productive green spaces. Rooftop gardens can expand cultivation area without occupying precious ground space and help insulate buildings, reducing energy costs. Complementing this, hydroponic systems can enable soil-less farming, making it possible to grow high-value vegetables and herbs with minimal water and space, while teaching students about cutting-edge agricultural science.

VIII. [redacted]ritical opportunity. Currently, institutions depend heavily on [redacted]on of local groundwater. Installing rainwater harvesting systems can collect and store rainwater for irrigation, ensuring a sustainable water supply and promoting water conservation awareness among students. Additionally, increasing the use of recycled or grey water can further reduce pressure on fresh water sources and demonstrate practical circular resource management.

IX. The health sector in Jhargram, despite facing space and resource constraints, holds immense potential to become a vibrant example of smart, sustainable urban agriculture. With thoughtful planning and the adoption of modern techniques, hospitals, clinics, and nursing homes can turn small plots and building corners into lush, healing green zones that promote wellness for patients and staff alike.

X. One effective strategy is the use of hanging pots and tower pots, which make vertical gardening possible even where ground space is minimal. Such vertical structures can host flowering plants, medicinal herbs, and indoor air-purifying plants like money plant, snake plant, and peace lily, which improve air quality and create a calming environment within hospital premises.

Basutirtha Wall Garden and Micro Irrigation system at RKM

XI. The industrial sector in Jhargram, though currently limited in agricultural engagement, holds significant potential to expand and transform its role in sustainable green practices. Presently, only 40% of industries participate in agricultural activities, mainly for beautification using ornamental and flower plants. However,

with proper planning and intervention, the sector can evolve into a model for eco-friendly development and environmental stewardship.

XII. One major area of improvement is the adoption of advanced irrigation systems. Introducing drip irrigation can greatly enhance water efficiency, particularly crucial in areas facing water scarcity. It ensures targeted water delivery, reduces wastage, and supports the healthy growth of plants even in small plots. Alongside, rainwater harvesting systems can be implemented to reduce dependency on borewells, conserve groundwater, and promote long-term sustainable.

7. Recommendations and Future Planning

I. Firstly, there is a strong need to promote vertical and rooftop gardening, especially in apartments and institutions with limited space. Government and local authorities should offer incentives and subsidies for setting up rooftop gardens, installing drip irrigation systems, and purchasing organic soil media.

II. Secondly, rainwater harvesting and wastewater recycling systems must be introduced and made mandatory in larger institutions like schools, hospitals, and industries. This will address water scarcity and reduce pressure on bore wells and tap water.

III. Another important recommendation is the integration of technology into urban agriculture. Tools such as automated irrigation systems, moisture sensors, and mobile-based plant monitoring applications should be encouraged to make farming more efficient and less labor-intensive. Further, training and awareness programs should be conducted at the community level, focusing on composting, crop planning, and eco-friendly practices. Schools and colleges can serve as centers for practical agricultural education, teaching student's sustainability through hands-on experience.

IV. In the long term, urban agriculture should be included in city development plans and municipal policies. Designated zones for community gardens, green corridors, and agricultural demonstration parks should be created. Urban farming cooperatives should be formed to share resources, tools, and knowledge among local residents. Special focus should be given to involving women, unemployed youth, and senior citizens in these cooperatives to promote inclusive growth and livelihood opportunities.

V. Industries should be encouraged to use unused open spaces for ornamental and medicinal plant cultivation, supported under their Corporate Social Responsibility (CSR) activities. Health institutions can also expand therapeutic gardens to improve patient well-being and

environmental quality. In the academic sector, research initiatives on hydroponics, aquaponics, and organic pest control should be promoted.

VI. In conclusion, the future of urban agriculture lies in a collaborative, sustainable, and technologically integrated approach. With proper planning, investment, and community involvement, cities like Jhargram can become models of eco-friendly urban living, ensuring food security, environmental balance, and improved public health for future generations.

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