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Roadmap for Green Cover Development in Jhansi City

ICAR-Central Agroforestry Research Institute
Jhansi 284003, Uttar Pradesh

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Foreword

Green cover and biodiversity are central to sustainable cities and are supporting the human well-being through provisioning of ecosystem services. This report highlights the green cover and biodiversity of the Jhansi city, Uttar Pradesh, India. From the green cover dimension, this report assessed area of various parks of Jhansi city and biodiversity was assessed through multiple indicators such as tree species, bird species, butterfly species, fungal species, freshwater fishes, and herpetofauna. This report is first of its kind in the ecologically challenged Bundelkhand region of India that experiences acute environmental degradation. The present report on green cover and biodiversity could therefore be useful for administrators, city managers, policy-makers, and academicians, as well as for other stakeholders like local people and visitors in comprehending smart city development. We hope this report would strengthen the existing precious green cover and biodiversity and add more greenspace across time and space. We would like to thank the local people of Jhansi city supporting during data collection and Jhansi Nagar Nigam aa well as Forest Department for support on various elements linked with green cover like list of parks, their area and location.

- Director, ICAR-CAFRI

Preface

Green cover and biodiversity are integral to the sustainable cities and play a pivotal role in human well-being. While green cover is largely important for improving quality of life in urban settlements, biodiversity plays a crucial role in sustaining human societies across the globe. We depend on green cover and biodiversity for a range of ecosystem goods and services such as food, water, timber, fuel wood, climate regulation, air purification, flood regulation, pollination, aesthetic value, recreation and tourism, spiritual and religious value, habitat provision and nutrient cycling. In short, our food and health are critically determined by the numerous varieties of flora and fauna including microorganisms on the planet earth.

We are living in an increasingly urban world. Currently, cities are the home of more than half of the global human population. This necessitates improving the quality of life in cities through several climate-smart, innovative and nature-based approaches. Sustainable management of green cover and biodiversity is the need of hour not only for improving urban well-being but also for mitigating and adapting to impacts of climate change. Various ambitious targets of Sustainable Development Goals (SDGs) cannot be achieved without incorporating the pivotal role of green cover and biodiversity. Green cover and biodiversity in urban area have strong linkages with many of the SDGs such as SDG-1 (No Poverty), SDG-2 (Zero Hunger), SDG-3 (Good Health and Well-being), SDG-6 (Clean Water and Sanitation), SDG-11 (Sustainable Cities and Communities), SDG-13 (Climate Action), and SDG-15 (Life on Land). Greenspace, a subset of green cover is fundamental for sustainable cities vis-à-vis smart cities. We have witnessed the significance of urban greenspace during COVID-19 pandemic. People across the world have perceived the potential of urban greenspace in enhancing mental and physical health.

The present report is an outcome of collaborative effort of several scientists, and project staff working in the ICAR-Central Agroforestry Research Institute, Jhansi. This report provides an overview of 'Green cover and Biodiversity' of Jhansi city located in Uttar Pradesh. The 'Green cover and Biodiversity' of Jhansi is presented under 6 chapters: (1) Introduction, (2) Green cover: An overview, (3) Facts and Figures on Green cover of Jhansi city, (4) Biodiversity of Jhansi, (5) CAFRI Initiatives and (6) Conclusion. The present document shall serve as the first comprehensive synthesis of scientific materials on green cover and biodiversity of Jhansi city. Although, green cover comprises the natural or planted vegetation covering a certain area. In this report green cover of Jhansi has been explained taking number and area of community parks in Jhansi city as an indicator. On the other hand, in this report biodiversity is enumerated through several indicators like tree species, bird species, butterfly species, fungal species, freshwater fishes, and herpetofauna. This report can be used as a reference for decision-and policy-makers on the status and significance of green cover and biodiversity. Green cover and Biodiversity Report of Jhansi city would be helpful in framing plans to sustainably manage greenspace. We hope it will encourage and inspire different stakeholders to take action to enhance the quality of urban life through nature-based solutions including green cover and biodiversity in Jhansi being developed as a Smart City.

- Authors

Executive Summary

This report summarises the green cover and biodiversity of Jhansi being developed as a smart city. Biodiversity enabled by the green cover in the city is important from social, cultural and ecological relevance. The contribution of urban trees in terms of carbon sequestration to cope up with global warming is minimal compared to natural forests, but there is a growing need to encourage planting trees in the cities (FAO, 2016), as they do contribute in attaining the three Sustainable Development Goals (SDG): (i) human health and well-being (SDG 3), (ii) creating sustainable cities (SDG 11) and (iii) conservation of terrestrial ecosystems (SDG 15).

Jhansi in Uttar Pradesh is considered as the gateway of the culturally rich Bundelkhand region. There are 89 greenspaces predominately parks managed as public entity by the Jhansi Nagar Nigam, Forest department, State Horticultural Board and other community welfare societies. Overall, 99.53 ha (approx. 1 km^2) area inside the Jhansi Municipal city limit falls under the greenspace which is seemingly the sufficient area under the city greenspaces in the Jhansi city prima facie. The per capita availability of parks is 0.497 m^2. There is ample scope for increasing the greenspaces as most of the existing spaces are publicly managed and given the city is being transformed under smart city program. Establishing PPP model for greenspace management would be an option.

Throughout this entire report, two terminologies - 'Green cover' and 'Greenspace' has been used with the meaning as described below:	
Green cover word has been used in broader connotation by encompassing all the vegetation (forest areas, parks, and roadside plantations)	Greenspace word represents any vegetated land adjoining an urban area and includes bushland, national parks, nature reserves, outdoor sports fields, school playgrounds and rural or semi-rural areas immediately adjoining an urban area

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1 Introduction

The term "smart city" is used frequently for holistic developmental processes enhancing quality of life, environmental preservation, public safety, and city services (Su et al., 2011). Typically, the smart city starts with the development of effective infrastructure, either from scratch (new urban development) or as part of the modernisation of an already existing environment. The implementation of contemporary information technology in the city including electronic payment systems for urban services, the integration of centralised systems for transportation monitoring and control, the electrification and automation of major communications area are some of the areas focused in the smart city concept. Science and business are becoming increasingly applicable in smart cities, and there are more and more international examples popping up all over the place.

India also started its own program to develop its smart cities under the Smart Cities Mission launched by the Hon' Prime Minister on 25 June, 2015. The main objective of this mission is to promote cities that provide core infrastructure, clean and sustainable environment and give a decent quality of life to their citizens through the application of 'smart solutions'. The mission aims to drive economic growth and improve quality of life through comprehensive work on social, economic, physical and institutional pillars of the city. The focus is on sustainable and inclusive development by creation of replicable models which act as lighthouses to other aspiring cities. 100 cities have been selected to be developed as Smart Cities through a two-stage process. Typically, there is no standard template for the smart city model. Nonetheless, the idea of smart city is implemented across the globe with vision of developing cities catering the needs of the future following six important principles (Figure 1).

Figure 1. Fundamental principles of smart cities (Source: https://smartcities.gov.in/)

Need for Smart Cities

Some noteworthy small cities around the world are Seoul, Amsterdam, Vienna, Dongtan, etc. are also known as Sustainable Cities. India has followed and implemented some of the criteria that could also address the local issues and situations leading to development of smart cities. (Table 1).

Table 1. Smart cities in Uttar Pradesh

S.No.	City Name	S.No.	City Name
1.	Agra	7.	Kanpur
2.	Aligarh	8.	Lucknow
3.	Prayagraj (Allahabad)	9.	Moradabad
4.	Bareilly	10.	Rampur
5.	Ghaziabad	11.	Saharanpur
6.	Jhansi	12.	Varanasi

The provision of basic infrastructure and services, such as water supply, sewerage, drainage, public health and sanitation, roads, streets, city transportation, elementary education, etc., has become more and more necessary as a result of the deterioration of infrastructure and services over time. This has resulted in a serious decline in the quality of service and, consequently, the quality of life. Reportedly, 80 million people live in slums with no basic facilities or amenities, and on average 38% of urban residents are below the poverty line (Jawaid and Khan, 2015).

The concept of "Smart Cities" is however an urban centre of the future that is safe, secure, environmentally friendly, and effective thanks to the use of advanced, integrated materials, sensors, electronics, and networks that are interfaced with computerised systems made up of databases, tracking, and decision-making algorithms. All structures, whether for power, water, transportation, etc., are designed, built, and maintained.

Jhansi city is being transformed into one of the many smart cities by the Government of India from 2016 onwards (https://smartcityjhansi.com/). Owing to its well connectedness with North-South and East-West Corridors of the country. Jhansi is located at the junction of National highways such as NH (27) from Gujarat to Assam and NH (44) from Jammu to Kanyakumari, and city is rapidly urbanizing.

Trees in Cities Challenge

Globally, trees are a viable and potential tool to ameliorate climate and weather. International agencies are now emphasizing the importance of trees in cities as well, for their invaluable ecosystem services. In this regard, the United Nations Economic Commission for Europe and FAO has launched the Trees in Cities Challenge (https://treesincities.unece.org/). This tree planting programme was launched at the UN Climate Action Summit in 2019 which encourage the mayors and district administration to join hands with organizations thereby formally committing to plant a pre-determined number of trees in their city and strengthening sustainable management practices of urban and peri-urban trees and forests. Over 20 cities from 16 countries pledged to plant a total of 11 million new trees and set tailored goals for improving their management of urban trees and forests. Jhansi is the only city in the India which is participating the Trees in Cities Challenge.

CAFRI enabled FAO-UNECE: Trees in Cities Challenge

The city of Jhansi, Uttar Pradesh has found a place in this challenge program, as facilitated by the ICAR-Central Agroforestry Research Institute that has been also designated as the focal point by the Jhansi Nagar Nigam for the '*Trees in Cities Challenge*' implementation. It is the only Indian city (Figure 2) that has been registered from India for this program. The city has now committed itself for the following sustainable urban forestry.

a) to encourage the tree planting amongst the residents and

b) to conduct plantation drives involving educational and public institutions, and common man.

Overall, it has been envisaged to increase the diversity of tree cover; while avoiding invasive and allergenic species. Keeping an eye on biodiversity and properly placing newly planted trees into the broader ecosystem of the city and also selective and choosing trees fit for purpose. The programme further ensures the geo-coordinates of each planted tree chosen for a specific reason (*i.e.* tackling air pollution, lack of green space in that part of the city, high temperatures etc.) and in line with the overall strategy for building urban resilience through this program eventually.

Ms. Olga Algayerova
United Nations Under-Secretary-General
Executive Secretary of the UNECE

[Jhansi and 18.05.2022]

Dear Ms. Algayerova,

Jhansi City is committed to the sustainable management of urban forests and green spaces to advance sustainable development, improve public health and wellbeing, and strengthen climate resilience.

Tree-planting is a simple, yet powerful solution that is key to unlocking climate action in our cities, as well as making them more healthy, resilient, and liveable.

The United Nations Economic Commission for Europe (UNECE) Trees in Cities Challenge is a global challenge in which it has been formally committed to plant a pre-determined number of trees in their city and to strengthen sustainable management of urban and peri-urban trees and forests. The challenge also provides an international platform for the exchange of best practices and experiences on urban forestry.

In this context, I am pleased to inform you that, as part of the Trees in Cities Challenge, Jhansi commits to plant 10000 trees by the end of 2024 and to strengthen sustainable management of urban forests. This includes 1500 trees planted between 23 September 2019 and 31 December 2021. Jhansi city also commits to the following sustainable urban forestry.

a) to encourage the tree planting among the residents and
b) to conduct plantation drives in educational and public institutions

I confirm that Jhansi city will keep the UNECE up to date on the progress as requested, as well as provide data required for measuring the result of our pledge. I designate Dr. A. Arunachalam, Director of the ICAR-Central Agroforestry Research Institute, Jhansi as the focal point for the Trees in Cities Challenge (director.cafri@gmail.com, +91-9212441230) and confirm Jhansi city will advise UNECE of any changes in the focal point in a timely manner.

I look forward to the outcome of the Challenge.

Yours sincerely,

[Shri Avanish Kumar Rai]
Municipal Commissioner
Jhansi City
Uttar Pradesh, India

Figure 2. Certificate of recognition to Jhansi under Trees in Cities Challenge Program

Overview of the Jhansi Municipal Area

Jhansi is a city (Figure 3) with over 0.5 million residents, located in the southernmost part of Uttar Pradesh (25° 26' 10.6728'' N and 78° 34' 2.4672'' E) gradient map (197-322 metre at sea level). It is a historic city established over 4 centuries ago as a town of Balwantnagar, and decades later it has become a milestone point in various military operations: there was a large fort built to protect the population of the city. It is still possible to see old walls of the fort, which is one of the main attractions of Jhansi, along with numerous temples and Christian churches, a large Governmental Museum, as well as a number of annual festivals and other cultural events.

Geography

The total area of the Jhansi city is 166.5 km^2. The historical remanence of the city - the Jhansi Fort is main landmark. Apart from that, the Jhansi cantonment board established for the normal function of the military force in the Jhansi City occupies a major share of the City i.e.~23 km^2. Compared to other municipal corporations in the state of Uttar Pradesh, Jhansi is medium sized City (Table 2). However, this is small compared to other municipal corporations in India (Ramaiah and Avtar, 2019).

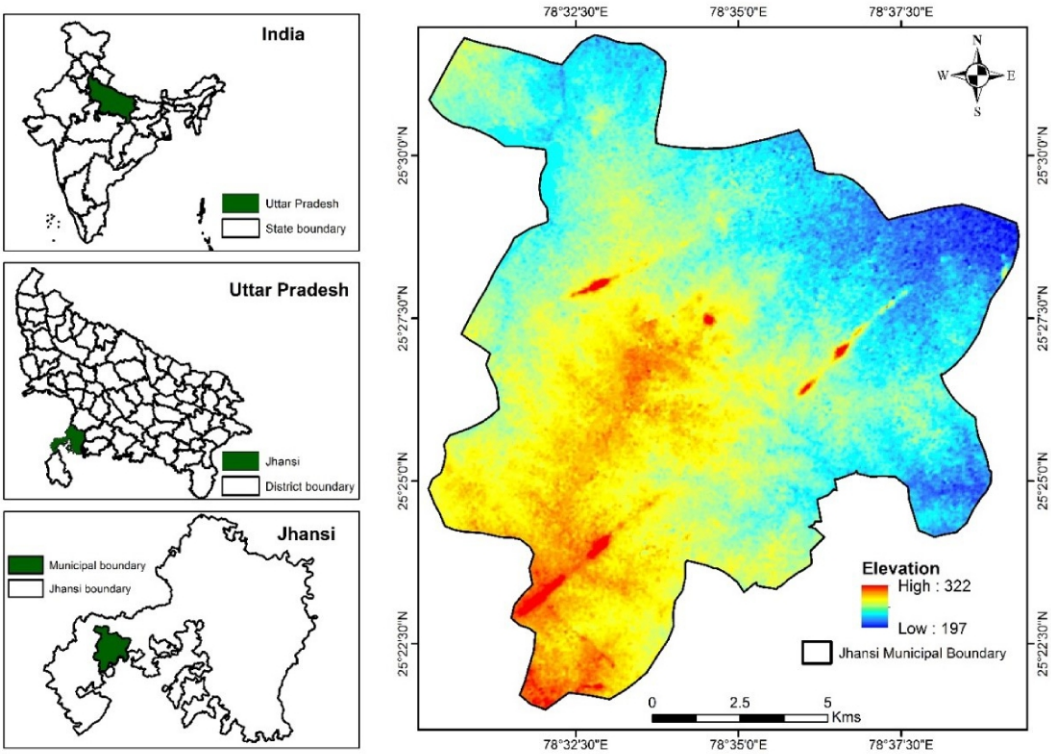


Figure 3. Jhansi City with elevation gradient map

Table 2. Overview of the Jhansi city

S.No.	Category	Area (km^2)
1.	Cantonment Area	23.24
2.	Green cover	68.64
3.	Other Land-uses	74.62
	Total	~166.5

*Based on LISS III data ((https://bhuvan-app3.nrsc.gov.in/data/download/index.php)

Climate

The climate of Jhansi city is sub-humid characterized by cold winter and hot dry summer (Gupta *et al.*, 2021). Annual average rainfall ranges between 75 cm to 125 cm, with relative humidity ranging between 70 and 80%. The monsoon season (June to September) brings temperatures down to around 22-25°C (Figure 4), with annual average monsoon rainfall of 884.6 mm.

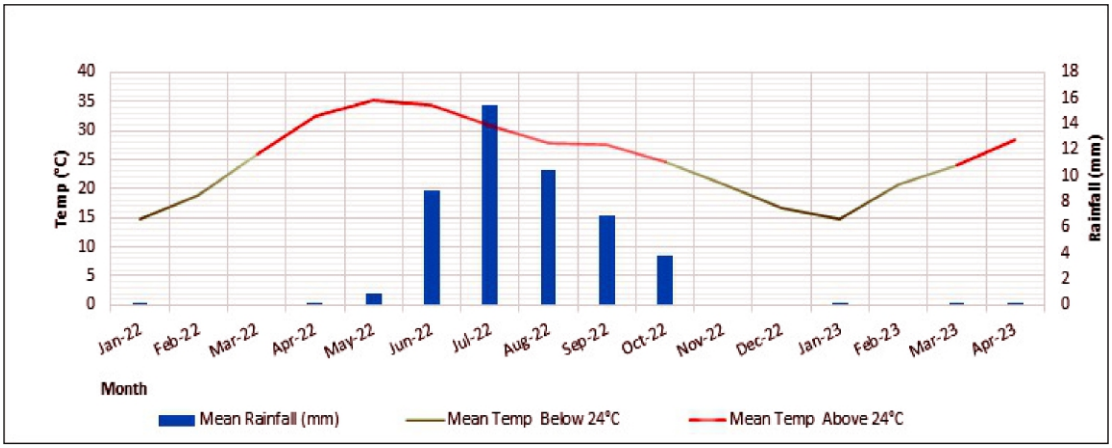


Figure 4. Mean Monthly Rainfall & Temperature of Jhansi municipal area for the year 2022-23, based on CHIRPS data (Source: /https://chc.ucsb.edu/data/chirps)

Demography

The city of Jhansi encompasses an area of 166.5 km^2 approximately. The entire city is divided into five sanitary circles and subdivided into sixty wards, and is governed by Jhansi Municipal Corporation. Until 2005, Jhansi was designated as a Nagar Palika with a total of 30 wards. In subsequent two municipal elections, the number of wards have increased to a total of 60 and it has been designated as Municipal Corporation. According to Census (2011), Jhansi city has a population of 505,693; male is 52% and female is 48%. The Literacy rate of male and female is 56% and 44%, sex ratio is 905, and child sex ratio is 866. Jhansi Urban Agglomeration has a population of 547,638. About 80% of the people follow Hinduism. Islam is the second most popular religious practices with approximately 16.5%. A few dwellers also practice Christianity (0.94%), Jainism (0.46%), Sikhism (0.52%) and Buddhism (0.52%) according to PRIA (2011).

Economy

The economy of Jhansi district is based on agriculture, some chief agricultural products are wheat, barley, gram, pea, paddy groundnut, and different type of pulses and oilseed. The new agricultural technologies adopted by farmers of the district helps to increase the production of various agricultural items. Under One District One Product (ODOP) of Ministry of Food Processing Industries, Basil (Tulsi) has been identified as economical crop for district. And, 'Soft Toys' have been identified as One district One product (ODOP) under the state government's (ODOP) scheme in Jhansi. Presently, there are over 50 soft toys manufacturing units in Jhansi which have led to the creation of jobs. Major industries in Jhansi include electrical Industry, petroleum industry, cement industry, thermal power plant and Ayurvedic Industry. Furthermore, several small industries of Jhansi play key role in the economy such as are soft toy manufacturing industry, stone manufacturing industry, agro-based industries, soda water/ beverages, textiles, wood/wooden based furniture, paper and paper products, leather based, chemical/chemical based, mineral based, metal based, and transport equipment. Notable industries of Jhansi are BHEL, Heidelberg Cement Factory, Baidyanath Factory, Government Cotton Mill, Parichha Thermal power plant, and Indian Hume Pipe Co. Ltd.

The district's gross domestic product in 2020-21 was Rs. 20, 19,873 lakhs at today's rates and Rs. 12, 74,704 lakhs at 2011-2012 constant prices. According to current exchange rates, the district's net domestic over the years 2020-21 was Rs. 17, 57,719 lakh and Rs. 10, 77,472 lakhs, respectively, in the 2011-2012 fiscal year. The district's per capita income or NDDP at factor cost, for the years 2020-21 was Rs. 79,852 at current prices and Rs. 48,949 at constant prices (https://www.indiastatdistricts.com).

The administrative set-up of the Jhansi city is managed by the following bodies.

Jhansi Nagar Nigam

Jhansi Nagar Nigam (JNN) was formed in accordance with the requirements of the Uttar Pradesh Municipal Corporations Adhiniyam of 1959, with relevant modifications made from time to time. This is the urban local authority in charge of urban planning and administration duties such as park creation and renovation. By the terms of the 74th Constitutional Amendment Act (1992), it has been classified as an urban local body, with the rights, duties, powers, and administration simplified as per the legislation. It spans 152 km^2, 5 tehsils, 8 blocks, and 437-gram villages, with spread throughout 60 wards. Jhansi city has a population density of 3,372 persons per sq.km, according to the 2011 Census. It has 91,150 residents (Census 2011). In Nagar nigam Jhansi works the nine department, tax, civil, health, light, birth and death registration, account, properties, water supply, garden and horticulture (https://jnnjhansi.com/)

Jhansi Development Authority

Jhansi Development Authority (JDA) is the primary agency of the Government of Uttar Pradesh in charge of continuing Jhansi's history of planned and sustainable development. The Jhansi Development Authority is in charge of developing and implementing the city's master plan. It is responsible for the development of infrastructure and basic amenities in Jhansi, as well as the conservation of the environment and the development of rural regions surrounding the mother city. JDA's goals and objectives are far-reaching, both in short and long-term. The major goal of the JDA is to minimize population congestion. A strategy to limit the number of people per acre has been presented (https://jdaup.in/.)

Jhansi Smart City limited (JSCL)

The Ministry of Urban Development (MoUD), Government of India, nominated Jhansi in Uttar Pradesh as one of the 100 cities for consideration in the third round. Jhansi Smart City Ltd, a Special Purpose Vehicle (SPV), was established on November 22, 2016, in accordance with instructions from the Government of India (GoI). In addition to having nominations from the Central Government, State Government, and Urban local bodies (ULB) on its Board, JSCL is led by a full-time Chief Executive Officer (CEO). Jhansi Nagar Nigam, which is responsible for housing and sanitation, road upkeep, and the provision of fundamental healthcare, educational, and other infrastructure amenities, oversees local government in the fast-developing Jhansi (https://smartcityjhansi.com)

Jhansi District

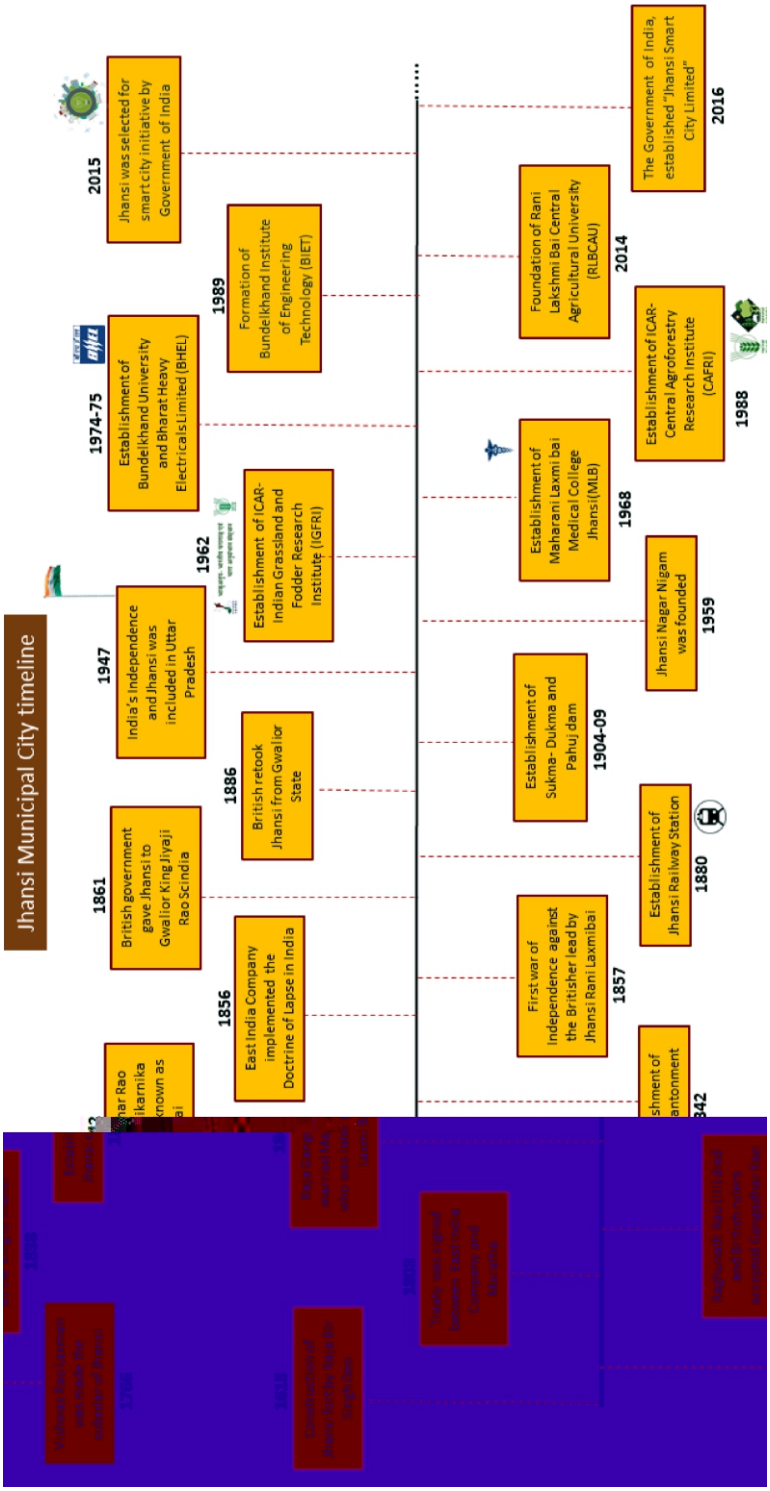
The Jhansi district is extended between 25° 7'' to 25° 47'' North latitude and 78° 10'' to 79°25'' East longitudes coving an area of 5024 km^2 (Kumar *et al.*, 2021). The land use of Jhansi can be differentiated into five classes i.e., cropland, fallow/barren land, forest area, water bodies and built-up area.

S No.	Land Use Type	Area (km^2)	% of Land Use
1.	Cropland	3411.29	67.9
2.	Barren/Fallow land	165.56	23.2
3.	Built-up area	50.24	1
4.	Forest area	291.39	5.8
5.	Water bodies	100.48	2.0
	Total	5024	100

Source: Kumar *et al*. (2021)

History of Jhansi in National Platform

- In the revolution of 1857 against the British, the contribution of Jhansi and the Queen of Jhansi was very important. Swaraj was demanded with slogan ''Angrez bharat chodo''
- Another important personality from the Jhansi who played hockey for India and known as the magician of Hockey is Major Dhyan Chand.
- *Rastra kavi* Maithili Sharan Gupt, who has written a lot of literature in the field of poetry is also from Jhansi these are the some of the literatures are (Jaydrathvadh, Saket, Panchavati, Sairandhri, Bak Sanhar, Yashodhara, Dwapar, Nahusha, Jayabharat, Hidimba, Vishnupriya and Ratnavali).
- Siyaram Sharan Gupt was the famous Hindi poet and the younger brother of Rastra kavi Maithili Sharan Gupt.


Jhansi Municipal City timeline
1856
East India Company implemented the Doctrine of Lapse in India
1861
British government gave Jhansi to Gwalior King Jiyaji Rao Scindia
1947
India's Independence and Jhansi was included in Uttar Pradesh
1974-75
Establishment of Bundelkhand University and Bharat Heavy Electricals Limited (BHEL)
2015
Jhansi was selected for smart city initiative by Government of India
1857
First war of Independence against the Britisher lead by Jhansi Rani Laxmibai
1880
Establishment of Jhansi Railway Station
1904-09
Establishment of Sukma- Dukma and Pahuj dam
1959
Jhansi Nagar Nigam was founded
1968
Establishment of Maharani Laxmi bai Medical College Jhansi (MLB)
2014
Foundation of Rani Lakshmi Bai Central Agricultural University (RLBCAU)
2016
The Government of India, established "Jhansi Smart City Limited"
1886
British retook Jhansi from Gwalior State
1962
Establishment of ICAR-Indian Grassland and Fodder Research Institute (IGFRI)
1989
Formation of Bundelkhand Institute of Engineering Technology (BIET)
1988
Establishment of ICAR-Central Agroforestry Research Institute (CAFRI)

2 Green cover: An overview

Green cover provides the information on the vegetation cover overall. It constitutes forest, shrubs, trees, pasture land, cropland, etc. (UNECE, 2023). Trees are integral component in the green cover. In SDG (Sustainable Development Goal)-15 (Life on land), sub-indicator 15.4.2a, land cover is used to categorize land into green and non-green cover areas. Green cover includes areas covered by both natural vegetation and vegetation resulting from anthropogenic activity. It includes croplands, grasslands, tree-covered areas, shrub-covered areas, and shrubs and/or herbaceous vegetation, aquatic or regularly flooded (UNDESA, 2023). Non-green areas include non-vegetated areas such as bare land, water, permanent ice/snow, urban areas and sparsely vegetated areas. In much wider connotation, we can include trees, orchards and grooves in agricultural area lands under green cover. The ideal representation of green cover and green space is provided in the Figure 5.

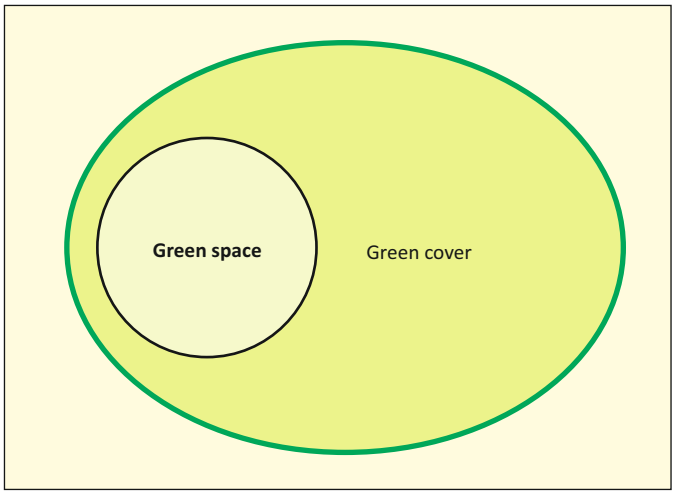


Figure 5. Ideal representation of Green cover and Green space

Green cover also include the closely related term like 'greenspace'. Green cover protection is important for ecosystem balance. It offers a variety of ecosystem services that can enhance public health, increase the comfort of living in cities, and improve the socio-economic well-being (Handley, 2007). Indian philosophy believes that human body is created from the important components of the environment like earth, water, fire, air and sky. The *Kalpavriksha* emerged from the churning of the ocean as a representative of the tree race for the green nature. Green cover conserves soil maintains soil structure. Green cover exhibits higher evapo-transpiration than bare soil thus increases water retention capacity. Going green is a term for finding a way to live your life in an environmentally friendly way and

changing your behaviour and spending habits in a way that helps preserve the planet and limit your personal impact on it (Richards, 2019).

Green cover improves the carbon content in the soil which is integral to soil structure. It provides habitat for fauna. A green ground cover provides a habitat for birds, butterflies, and insects, especially in cities where concrete and asphalt predominate. It contributes to biodiversity conservation (Zhao, 2017). By covering the soil with plants, green cover reduces erosion. Green cover is also important for reducing the groundwater pollution. Green cover offers innovation approaches to increase the quality of urban green space, enhances local resilience and promotes sustainable lifestyles, improving both the health and the well-being of urban residents (Zhongming, 2010). Green cover is also used strategically on industrial sites for organic wastewater filtering via helophyte filters, an application that also serves to reduce peak intensity (Twesigye, 2011). Green cover plays a crucial role in biodiversity conservation and maintenance of habitats contributing to sustainable development (Sun, 2022).

In this context, it would be pertinent to narrate about another term - 'green space' which has also been used in similar content to green cover. However, it can be contemplated that the green cover is much broader term than the green space. Green space is usually, but not always, consists of vegetation and associated with natural elements (Taylor and Hochuli, 2017). Warren (1973) defined green space as “land covered with some form of vegetation”. It is defined as any vegetated land adjoining an urban area and includes bushland, national parks, nature reserves, outdoor sports fields, school playgrounds and rural or semi-rural areas immediately adjoining an urban area” (Chong *et al.*, 2013). Green space can include a range of vegetation such as parks, forests, street trees, sparsely-landscaped streets, tree-lined walk-ways, playfields, forested parks, urban agricultural land, farms, peri-urban woodland, public or domestic gardens, and green roofs (Akmar *et al.*, 2011; Almanza *et al.*, 2012; Lo and Jim, 2012; Shwartz *et al.*, 2013). Zhao *et al.* (2010) divided green spaces into six categories including park green space, protection green space, institutional green space, residential green space, street green space, and vacant land space.

Urban green space that are forests, trees, parks, allotments or cemeteries deliver a wide range of ecosystem goods and services for human society in cities (Bastian *et al.*, 2012). Green infrastructure is a term related to 'green space' and refers to a network of green space with scales of city or landscape level and functions are associated to urban inhabitants (Tzoulas *et al.*, 2007). According to WHO (2016), 'urban green space may include places with 'natural surfaces' or 'natural settings'. They may also include specific types of urban greenery, such as street trees, and may also include 'blue space' which represents water elements ranging from ponds to coastal zones (WHO, 2016). Typical green spaces in urban areas are public parks, private gardens, woodlands, children's play areas, non-amenity areas (such as roadside verges), riverside footpaths, beaches, and so on. Green space provide adequate opportunities to urban residents for exposure to nature. They play a crucial role through delivering a broad range of ecosystem services such as maintenance of biodiversity, reduction, of environmental hazards, regulation of extreme weather events, and thus improve the quality and well-being of urban communities (WHO, 2017). Urban green space are pivotal for enhancing physical health, mental health and social well-being of local people.

3 Facts and Figures on Green cover of Jhansi city

Vegetation Cover Assessment

In this report, the green cover includes all the vegetation (forest areas, parks, and roadside plantations). The green cover assessment in the city was to provide the changes in the spatial and temporal changes in the vegetation cover of the study from 2015 to 2019. The maps indicate the spatial distribution of vegetation in 2015, 2017, and 2019 for two categories dense vegetation and scattered vegetation.

In year 2015, the dense vegetation cover was found to be 29.22 km^2 whereas the scattered vegetation (which includes vegetation on roadsides, and parks) was 38.07 km^2 (Figure 6). In the year of 2017, the dense vegetation cover was found to be 26.99 $km^{2,}$ and scattered vegetation cover was found to be 38.75 km^2 (Figure 7). In the year of 2019, the dense vegetation cover was found to be 21.43 $km^{2,}$ and scattered vegetation cover was found to be 47.21 km^2 (Figure 8).

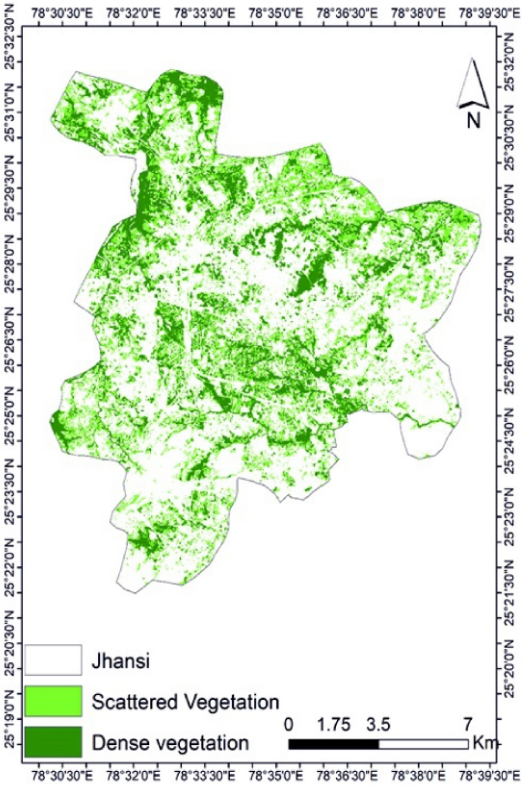


Figure 6. Spatial representation of Jhansi city green cover in 2015

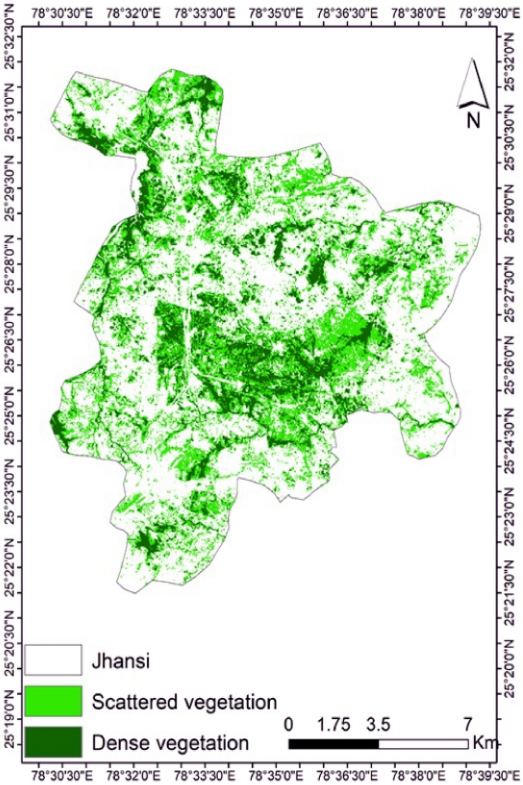


Figure 7. Spatial representation of Jhansi city green cover in 2017

For the sake of better clarity, the data has been presented in the form of bar graph which pertinently points out that the scattered vegetation has increased about 21.83% in 2019. While the dense vegetation decreased about 26.66% from 2015 (Figure 9). It is assumed that the development activities carried out in the city has impacted the dense vegetation. In urban context, the scatter vegetation offers better ecosystem services and it should be noted the overall increase in green cover of the city. In 2015, the total green cover of the city was 67.29 km^2 and it increased to 68.64 km^2. These statistics indicate the benefit of afforestation and green development activities such as park development, campus planting etc. The land cover dynamics revealed that there is a significant decrease in the dense vegetation cover in the Jhansi city area while there is an increase in the scattered vegetation cover area. It is also pertinent to mention that the overall green cover of the Jhansi city has seen rapid changes in the recent year.

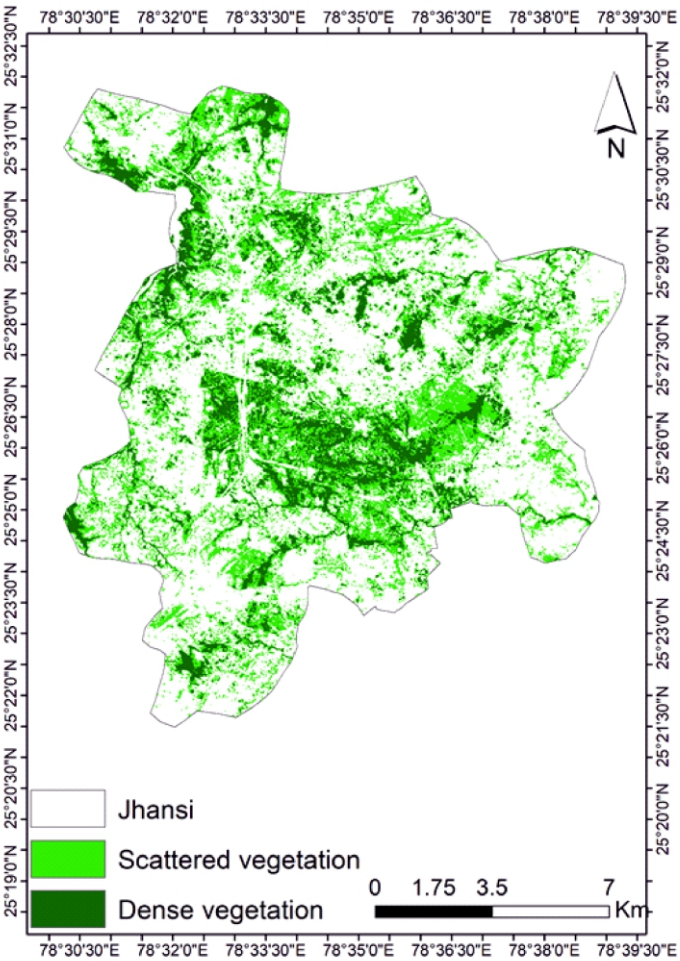


Figure 8. Spatial representation of Jhansi city green cover in 2019

Green Space Inventory

Often, particularly in urban contexts, green space are purposefully designated for their recreational or aesthetic merits (Barton and Rogerson, 2017). Here in our study, we are referring all the parks within the municipal limit as green space as nature reserves/protected areas, zoological and botanical parks are not present within the Jhansi municipal limit. The green space within the Jhansi municipal City limit is presented (Table 3).

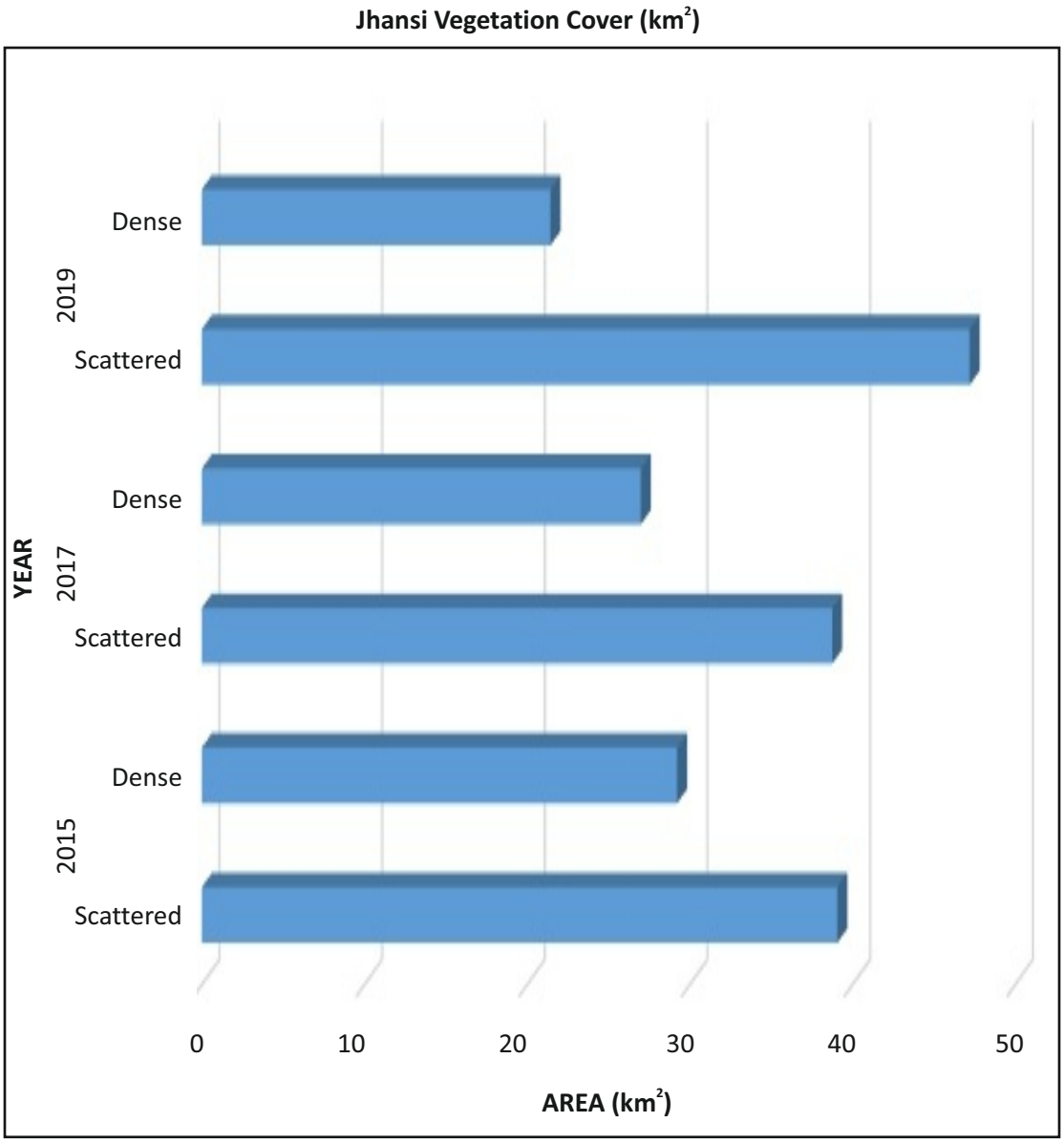


Figure 9. Temporal representation of Jhansi city green cover

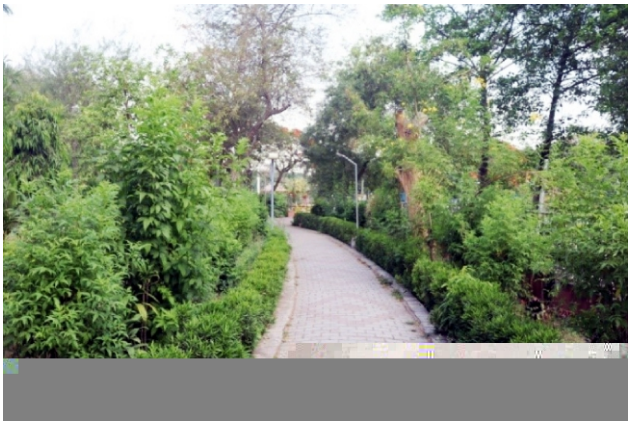
Table 3. Summary of the greenspaces within the Jhansi City

S. No.	Parks name	Area (ha)	Latitude (N)	Longitude (E)
1.	Subhash Chandra Park	0.11	25.454	78.6036
2.	Indra Prastha Nagar Park	0.1	25.4469	78.5834
3.	Sahnibihar Park 1	0.21	25.4607	78.5445
4.	Sahnibihar Park 2	0.1	25.4599	78.5447
5.	Durga Park	0.09	25.4521	78.5328
6.	Gajanan Park	0.38	25.4512	78.5332
7.	Shri Chote Lal Park	0.07	25.4549	78.5542
8.	Tatya Tope Park	0.09	25.4537	78.5351
9.	The Green Park	0.01	25.4556	78.5337
10.	Shaheed Rajguru Park	0.12	25.4748	78.5515
11.	Gauri Shankar Hanuman Park	0.18	25.4553	78.5353
12.	Rajendra Agnihotri JDA Park	0.1	25.4764	78.5696
13.	Gulam Goos Khan Park	3.64	25.4693	78.5715
14.	Children Park (IGFRI)	0.5	25.5133	78.5349
15.	Kashi Ram Colony Park 1	1.41	25.5271	78.513
16.	Kashi Ram Colony Park 2	0.14	25.5297	78.5119
17.	Kashi Ram Colony Park 3	0.17	25.529	78.5117
18.	Kashi Ram Colony Park 4	0.43	25.5302	78.5131
19.	Veerangna Moti Bai Park	0.02	25.4685	78.5756
20.	Veerangna Park	0.07	25.4593	78.6077
21.	Bharat Mata Park	0.08	25.4486	78.5412
22.	Shivaji Nagar Park	0.16	25.4541	78.6036
23.	Ansal Palm Court Park	0.4	25.4701	78.6104
24.	Kids Land Park	0.07	25.4542	78.6363
25.	Abbat Market Park	0.1	25.4447	78.5864
26.	Tulsi Park	0.04	25.4529	78.5341
27.	Major Dhyanchand Park	0.35	25.4358	78.5826
28.	Lord Buddha Park	0.03	25.4967	78.5475
29.	Kashiram Park	1.62	25.458	78.5402

S. No.	Parks name	Area (ha)	Latitude (N)	Longitude (E)
30.	Khati Baba Park	0.03	25.4803	78.5543
31.	Parilok Park	0.08	25.4551	78.6031
32.	A Block Park	0.08	25.4539	78.5356
33.	Maharaja Hardol Park	0.2	25.4359	78.5695
34.	Children Park (Kailash Residency)	0.05	25.4506	78.5875
35.	Traffic Park	0.05	25.4483	78.5702
36.	Lahargird Park	1.15	25.4601	78.528
37.	Shaheed-E-Ajam Bhagat Singh Park	0.19	25.4586	78.6092
38.	Dr. Shyama Prasad Mukharji Park	0.06	25.4577	78.6105
39.	General Bipin Rawat Shahid Park	2.55	25.4565	78.5738
40.	Sanfran Park	0.69	25.4858	78.5969
41.	Lal Bahadur Shahstri Park	0.27	25.4776	78.5703
42.	Maharaja Gangadhar Rao Park	0.34	25.458	78.5902
43.	Balaji Park	0.05	25.457	78.6094
44.	Chatrapati Shivaji Park	0.07	25.4581	68.6095
45.	Shaheed-E-Ajam Bhagat Singh Park	0.16	25.4586	78.6092
46.	Buddha Garden	0.25	25.4578	78.6125
47.	White Tiger Herbal Garden Club	3.26	25.4327	78.5912
48.	Nehru Park-1	0.4	25.4579	78.5489
49.	Nehru Park -2	0.05	25.4476	78.5888
50.	Chhoti Lal Field Park	0.2	25.4607	78.5493
51.	Gandhi Park	0.27	25.3147	78.5238
52.	BHEL to Live Park	5.77	25.3204	78.5322
53.	Chitragupt Park	0.04	25.45381	78.53334
54.	Kargil Shaheed Park	0.05	25.45415	78.52999
55.	BU Library Park	0.05	25.45256	78.60856
56.	Basant Bihar Park	0.06	25.47004	78.543
57.	Rani Lakshmi Bai Park	0.09	25.46664	78.62609
58.	Nagar Nigam Park	0.09	25.47838	78.57139
59.	DLS Park	0.10	25.4294	78.55215

S. No.	Parks name	Area (ha)	Latitude (N)	Longitude (E)
60.	Shaheed park	0.12	25.45014	78.57726
61.	YGB Park	0.13	25.45969	78.61859
62.	Friends Parks	0.16	25.45274	78.60758
63.	Gautam Buddha Park	0.17	25.4518	78.53415
64.	Awas Vikas Main Park	0.21	25.45484	78.53431
65.	New BU Park	0.22	25.45244	78.60887
66.	Fountain Park	0.22	25.4351	78.5833
67.	Abdul Kalam Park	0.25	25.45727	78.54887
68.	School Children Park	0.32	25.4211	78.5826
69.	Jhansi Fort Park	0.32	25.45795	78.57124
70.	Rajganj Park	0.34	25.46406	78.54832
71.	Balidan Park	0.34	25.45394	78.55427
72.	Kalicharan Varma Park	0.38	25.45976	78.61084
73.	Lal Kurti Park	0.40	25.427	78.5656
74.	BU Lakshmibai Park	0.44	25.4538	78.60861
75.	Jokhan Bag	0.72	25.45135	78.57759
76.	Circuit House Park	0.92	25.45427	78.55983
77.	Unnao Gate Park Nagar Nigam	0.96	25.4843	78.57722
78.	Public Park	0.98	25.4188	78.5843
79.	Cantt.Public Park	1.03	25.4353	78.5871
80.	Kashiram Park	1.27	25.45791	78.54068
81.	Veerangna Lakshmi Bai Park	1.39	25.45471	78.57148
82.	VeerangnaChalkaribai park	1.52	25.45347	78.57101
83.	Major Dhayandchand Park	1.61	25.4358	78.5826
84.	Vijayant Park	2.08	25.4208	78.568
85.	Maithili Sharan Gupt Park	2.95	25.45496	78.5737
86.	Dr. Vrindawan Lal park	3.01	25.45563	78.57429
87.	Atal Ekta Park	6.51	25.45352	78.57239
88.	Panchtantra Park	15.18	25.45404	78.55762
89.	Narayan Park	27.89	25.45837	78.59613

There are 89 green space predominately parks managed by public entity like the Jhansi Nagar Nigam, State Horticultural Board and other community welfare societies. Overall, 99.53 ha of area inside the Jhansi Municipal limit falls under the greenspace. Depending on the size of the park, three categories could be identified. For instance, there were 55 small sized parks (<0.3 ha); 16 of medium sized park (0.3-1.0 ha) and 18 larger parks (>1.0 ha).



Nehru Bal Udhyan

Rani Laxmibai Park

General Bipin Rawat Shahid Park

Rani Laxmibai Park *Prima facie*, there was sufficient area under the green space in the Jhansi City at glance. However, the population of Jhansi City was 1998603 as per 2011 census. Therefore, the per capita area availability of parks is 0.497 km^2.

Moreover, there is potential for increasing the green space including parks within the Jhansi City. As of now, more than 90% of the parks and other green space within the Jhansi City is managed public inhibition (Figure 10) and there is no entry fee for most of the parks. This implies that the city administration is spending a significant fiscal allocation in maintaining these parks.

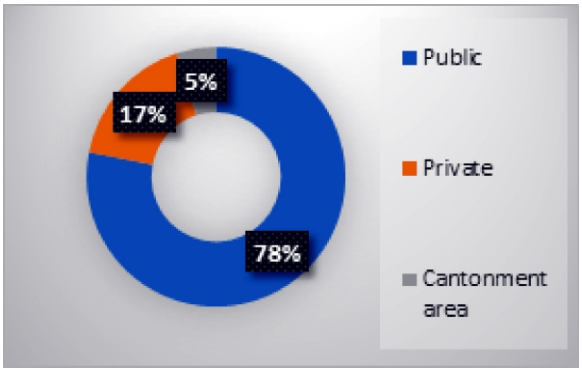


Figure 10. Proportional representation of managing entity of parks

It was evident that extensive tree plantations activities have been carried out in the past and there needs a systematic effort to protect the old trees. These old trees can be iconic green-hubs of the Jhansi City. Similar such reports on the need for the protection of old trees outside the avenue lanes and public parks has been reported in Nagpur Chandigarh and Bengaluru cities (Chaudhry and Tewari, 2010; Lahoti *et al*., 2020; Sudha and Ravindranath, 2000). Overall, there is a need to increase green space, empirically when Jhansi is being develop as a 'smart city' under government policy.

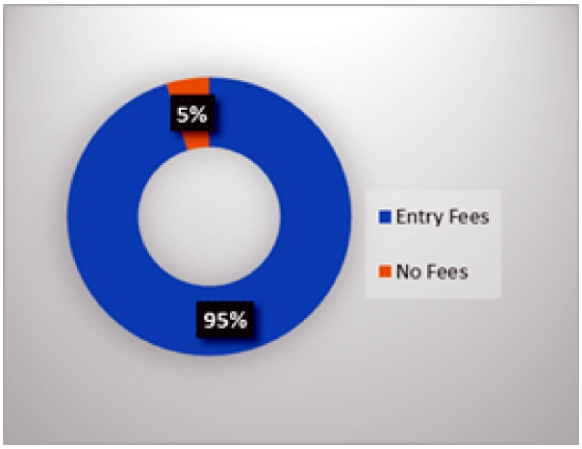


Figure 11. Overview of greenspaces in Jhansi based on access fee

Theme 1

'Nagar Van' Scheme in Uttar Pradesh ('Ek Kadam Hariyali ki Aur')

In India, forest is the first line of defence against pollution caused by economic activities, whether agricultural or industrial. India's forest cover and to combat the dangers of climate change. Urban forests, known as "nagar vans," are a type of green infrastructure in urban areas where trees and other plants provide a variety of environmental functions such air purification, enhancing the local environment, and adding aesthetic and recreational value. On the occasion of World Environment Day, the Nagar Van Yojana was put into place as a pilot programme by the Ministry of Environment, Forests & Climate Change for a period of five years (starting in 2015-16). Warje Urban Forest in Pune (Maharashtra) was its source of inspiration as a role model for the Scheme. The Pilot Nagar Van Yojana (NVY) Program shall be continued from 2020-2021 to 2024-2025 with the aim of enhancing the quality of life of city people while also considerably increasing the number of trees and greenery, biodiversity, and ecological advantages in urban and peri-urban regions.

Vision

To establish/develop at least one CITY FOREST in every city with a municipal corporation or Class I city in order to provide a healthy living environment and to aid in the development of smart, clean, green, sustainable, and healthy cities.

Objectives

- To establish 200 city forests around the country. Each municipality will create a City Forest in collaboration with the Municipal Council.
- Creating natural space and an attractive atmosphere in an urban setting
- Raising awareness about flora and biodiversity.
- Conservation education on the region's valuable flora and animals, including danger perception.
- Forests, the green lungs of cities, will help to environmental improvement of cities through pollution reduction, cleaner air, noise reduction, water harvesting, and heat island effect reduction.
- Biodiversity conservation *In-situ*.
- Citizens will benefit from health benefits that accrue through greenspace.
- Making cities more robust to climate change.

Components of City Forests

- Fencing as appropriate.
- Wooded blocks with emphasis on locally appropriate species.
- Plants to include shrubs, climbers, medicinal plants, seasonal flowering plants etc. to represent floral biodiversity.
- Irrigation/ rain water harvesting facility.
- Open-air conservation education displays, signages, brochures etc.
- Public convenience, drinking water facilities, benches etc.
- Walkways/ footpath, Jogging and cycle track.

Strategy

The Ministry supports the building of a City Forest by the responsible agencies of the respective cities through one-time development and non-recurring expenditure. In order to reap the most possible ecological and environmental benefits, city authorities will be urged to establish City Forests, which can range in size from 10 to 50 hectares within 5 km limits of Municipal Corporation/Municipal Council/Municipality and 6,500 indigenous plants will be planted.

Key features of the Scheme

- ***Objective***: Creating urban forest in the cities all over the country.
- ***Monitoring***: The city forest will be created under the supervision of the municipality.
- ***Awareness creation***: Awareness among the people of the urban area regarding the biodiversity of the area.
- ***Educating people***: With the project the environment department will observe the flora and fauna of a particular region and it will help to identify the threat.
- ***Rejuvenating the city***: Due to the urbanization the cities had lost forest and through the scheme it is to restore the ecology of the city.
- ***Pollution control***: Control the pollution of the city and also help in *in-situ* conservation.
- ***Health benefit***: The nagar vans will make the climate of the urban area resilient; so, it will provide lots of health benefit to the resident's people.

Target of the scheme

The scheme envisaged development of 400 Nagar Vans and 200 Nagar Vatikas across the country during the period 2020-21 to 2024-25. An endeavor would be made to identify 400 such Nagar Vans/ Vatikas by 2023 as a part of 'Azadi Ka Amrit Mahotsav'. Efforts to spread the Nagar Van/Nagar Vatika concept in each city of the country was also envisaged. The Nagar Van/Nagar Vatika is generally located inside the boundaries of municipalities on property that is forested or otherwise suitable for landscaping or tree planting with a goal to safeguard forest lands within and around cities that are being affected/degraded and are at risk of invasion as well as increase the density of vegetation by carefully combining a variety of regionally acceptable shrub and tree species according to local site requirements. Nagar van/Nagar vatika may be built on forest or non-forest public land. The purpose of increasing the amount of green space in urban areas, Nagar Van should have at least a minimum of 2/3 of its area covered by trees or other types of vegetation. Under the advice of the state government, implementing bodies such as municipalities, may also be taken into consideration for the development of Nagar Van/Nagar Vatika. In addition, educational institutions, Universities, Government agencies, Nonprofit organizations, and Urban Local Bodies (ULBs) have been permitted to build Nagar vans or Vatikas on their own property. In Uttar Pradesh, Agra was the first city to have had the Nagar Van and recently the scheme got implemented in Bhagwantpura village nearby the Jhansi city.

Outcome of the scheme

Increased air quality, pollution reduction, carbon sequestration, temperature decrease and urban heat island effect, water and soil conservation are some of the benefits. The creation of a

greenspace with aesthetic value has a cooling and relaxing influence on people's thoughts. In addition to these ecosystem benefits, the development of green areas may help cities become more climate resilient. Indirectly these become spots for education and tourism, thereby strengthening the local economy.

Nagar Van in Jhansi

Theme 2

Heritage Trees in Jhansi

A heritage tree is a tree that has biological, cultural, ecological, or historical value due to its age, size, or condition. As among the oldest living things in the nation, heritage trees are an essential and priceless component of our country's natural and cultural environment. They can be found inour natural forests, ancient parklands and estates, in close proximity to human habitation, along roadsides and in hedgerows, in agricultural fields, and even as lone examples in the center of housing estates or building projects. “A notable specimen because of its size,form, shape,

beauty, age, colour, rarity, genetic constitution, or other distinctive features; a living relic that displays evidence of cultural modification by native or non-native people, including strips of bark or knot-free wood removed, test hole cut to determine soundness, furrows cut to collect pitch or sap, or blazes to mark a trail; a prominent community landmark; a specimen associated with a historic person, place, event or period; a representative of a crop grown by ancestors and their successors that is at risk of disappearing from cultivation; a tree associated with local folklore, myths, legends or traditions; a specimen identified by members of a community as deserving heritage recognition".

In the Bengaluru city, a 150 feet tall new Caledonian pine or Cook pine is alive. The tree is said to have been brought to the city from New Caledonia in the late eighteenth century stand tall and easily identifiable in the Lal Bagh garden in the centre of the city. The Dodda Aalada Mara (*Ficus benghalensis*) is an estimated 400-year-old tree with a canopy sustained by aerial roots that stretches over 4 acres. The Nallur Amarai grove, which is located in peri-urban Bengaluru near the international airport, has an area of 53 acres. This grove has about 300 trees that are said to have been established during the historic Chola era. The oldest tree in the grove currently is roughly 400 years old. This grove is the country's first Biodiversity Heritage site, as designated under National Biodiversity Act in India. Many such historic trees are at danger of being lost in Indian cities because they are unlabelled and unregistered. But we need to safeguard the heritage trees for their values linking the nature with human well-being.

Uses and value of Heritage trees

- Heritage trees are also living cultural artefacts that connect the city's history to the present, and so have a tourism value.
- An ancient tree is also an invaluable gene bank of a tree species.
- The trees give shade, aid in keeping the environment cool, and serve to mitigate the impacts of the urban heat island.
- The trees assist to minimize soil erosion by binding the soil, particularly beside urban water bodies.
- Trees provide habitat for varied biological diversity.

The state of Uttar Pradesh took an initiative to identify and protect these heritage trees across the state. The Government Order no: 859/81-5-2019-07/93 vol-II dt 08.11.2019, unveils the selection of heritage trees in the state in collaboration with the Uttar Pradesh Biodiversity Board. The idea is to identify trees located on the community lands i.e. typically non-forest area as well as forest area with ancient and historic impediments. There are 948 trees listed in the Document Heritage trees in Uttar Pradesh and in the Jhansi district have 30 (3.16%) heritage trees. *Ficus religiosa* and *Ficus benghalensis* species are dominant in Jhansi because they have own spiritual character and people are also worship these trees. The species like *Ficus religiosa* and *Ficus benghalensis* is always associated with the spiritual and religious value in India and thus these trees thrived for decades despites the urbanisation (Singh et al., 2022).

Heritage trees of Jhansi District

S. No.	Common Name	Scientific Name	Years*	Location
1.	Peepal	*Ficus religiosa*	200	Sukba Range, Babina
2.	Banyan	*Ficus benghalensis*	120	Sukba Range, Babina
3.	Peepal	*Ficus religiosa*	170	Sukba Range, Babina
4.	Peepal	*Ficus religiosa*	170	Sukba Range, Babina
5.	Banyan	*Ficus benghalensis*	105	Lathwara Range, Gursarai
6.	Peepal	*Ficus religiosa*	101	Pandwaha Range, Gursarai
7.	Peepal	*Ficus religiosa*	102	Jashwant Range, Gursarai
8.	Peepal	*Ficus religiosa*	105	Jashwant Range, Gursarai
9.	Banyan	*Ficus benghalensis*	106	Purana pura gao Range, Gursarai
10.	Banyan	*Ficus benghalensis*	110	Khadora Range,Gursarai
11.	Peepal	*Ficus religiosa*	108	Katra Gursarai Range, Gursarai
12.	Peepal	*Ficus religiosa*	105	Katra Gursarai Range, Gursarai
13.	Peepal	*Ficus religiosa*	105	Katra Gursarai Range, Gursarai
14.	Peepal	*Ficus religiosa*	108	Purana pura gao Range, Gursarai
15.	Peepal	*Ficus religiosa*	110	Shamsherpur Range, Bamor
16.	Peepal	*Ficus religiosa*	108	Kakarwai Range, Bamor
17.	Banyan	*Ficus benghalensis*	115	Kakarwai Range, Bamor
18.	Peepal	*Ficus religiosa*	110	Chakara Range, Mauranipur
19.	Peepal	*Ficus religiosa*	120	Tikamgarh Road, Mauranipur
20.	Banyan	*Ficus benghalensis*	115	Tikamgarh Road, Mauranipur
21.	Imli	*Tamarindus indica*	150	Hanuman Mandir, Mauranipur
22.	Banyan	*Ficus benghalensis*	115	Hanuman Mandir, Mauranipur
23.	Banyan	*Ficus benghalensis*	140	Talab Range, Mauranipur
24.	Banyan	*Ficus benghalensis*	100	Katera Range, Mauranipur
25.	Peepal	*Ficus religiosa*	100	Jhansi Fort Range, Jhansi
26.	Peepal	*Ficus religiosa*	500	Baral Range, Chirgaon
27.	Banyan	*Ficus benghalensis*	1000	Nari Range, Chirgaon
28.	Banyan	*Ficus benghalensis*	520	Madgua Range, Chirgaon
29.	Neem	*Azadirachta indica*	150	Bhujond Range, Moth
30.	Banyan	*Ficus benghalensis*	150	Amrokh Range, Moth

* Years depict the age of trees as per documents available.

Theme 3

Healthy Streets Policy

Streets are recognized as the lifeline of a city and play a fundamental role in moving different groups of people through multiple modes of transport every day. The city streets also act as important public spaces that provide different socio-economic and recreational opportunities for local people, including children, older and the disabled. In Jhansi, everyday about 60% of trips are made on foot, cycle, and public transport. Recently, streets of Jhansi city have been limited to a more restricted role of serving as conduits for the movement of automobiles. There is an urgent need to modify streets to a place where people comfortably walk, talk, cycle, shop, and perform various social activities. The COVID-19 pandemic has highlighted the need for better streets and transport systems to provide benefits for all users, particularly the most vulnerable. Jhansi has battled the pandemic by converting streets for walking and cycling through pilot initiatives. Nonetheless, there are many actions still required to inspire and ensure all-round change. Through creating Healthy Streets, Jhansi envisions a city that is liveable, resilient, and one that is created by the people, for the people. The Healthy Streets Policy is a guiding vision that will enable Jhansi to carry out strategic changes to make our streets and cities better for everyone. In future, Jhansi will lead the path for different government departments and citizens to act together for a cleaner, greener, and safer transport environment.

What is the vision?

Jhansi's vision for the future is to transform its streets into 'Healthy Streets' which are designed for the people-where everyone can move around with ease. A city which is well-connected, where people prefer to walk, cycle, and use public transport over cars. It is a city with pleasant streets and vibrant public spaces where citizens can linger, socialise, and visit local businesses.

How will Healthy Streets benefit the city?

The Healthy Streets concept which places safety, vibrancy, and comfort at the core of its interventions provides multiple benefits for the urban residents. In New York, pedestrian-friendly streets have reduced 26% injuries from crashes. These streets have also fostered neighbourhood interaction. Pedestrianisation can also lead to reduction in crime rates. In Mexico City, pedestrianisation of the city centre led to a drop in 96% of violent crime. Walking and cycling improvements also reduce traffic congestion and noise pollution, and lower carbon emissions. For instance, in Paris a car free day in September 2015 reduced exhaust emissions by 40%. Healthy streets also provide economic benefits. A Transport for London report highlights that improving streets for walking and cycling can boost retail sales by up to a staggering 30% by enhancing the opportunity to interact with local businesses.

What is the Healthy Streets Policy?

The Healthy Streets Policy sets out the vision, goals, and the steps required to transform Jhansi's streets into safe, attractive, and comfortable spaces. This policy lays out various initiatives that citizens can expect from the city in the coming days to achieve this vision. The policy indicates a change in the city's focus by committing to a long-term strategy to transform its streets by participation of its citizens.

The Healthy Streets Policy is based around 3 main principles.

- ***Equity***: To include all groups of people, particularly the vulnerable and the marginalised.
- ***Sustainability*:** To meet the needs of the present without compromising the needs of future generations.
- ***Quality of Life***: To promote dignity and improve the quality of life.

Healthy Streets are streets where...

1. Every citizen gets a fair share of road space
2. Everyone breathes clean air
3. No lives are lost
4. Walking and cycling are attractive
5. Public transport is easily accessible
6. Everyone moves around the city seamlessly
7. Women, children, and the elderly feel safe at all times
8. People enjoy street life
9. Local businesses flourish
10. The design adapts to climatic changes

Approach

Jhansi commits to the following approach to achieve 'Healthy Streets'-

1. ***By the people, for the people***

   Jhansi can only achieve its dream of Healthy Streets with citizens' support, feedback, and participation. The city will inform and engage citizens from different groups throughout the process of planning, designing, testing, and implementation.

2. ***Test-Learn-Scale***

   Before finalising designs and making substantial investments, Jhansi will first test the design through low-cost and temporary means, learn from them to refine the design, and finally make it permanent and scale it up across the city.

3. ***Data-driven decision-making***

   Jhansi will collect and share appropriate data on the performance of infrastructure and services to government agencies, policy makers, and citizens, for data-driven decision-making on initiatives, investments, research, and communication strategy.

Key Steps to achieve Healthy Streets

Jhansi commits to take the following steps to achieve Healthy Streets. These steps will help to make walking, cycling, and public transport attractive across the city.

1. ***Foundation***

   Institution and processes, Policies and guidelines, Capacity development will be required for foundation.

2. ***Action***

   Plan, budget, implementation, monitoring and evaluation are key actions to achieve healthy streets.

3. ***Communication***

   Information, participation and inspiration are central to the communication step.

4 CAFRI Initiatives

Large-scale plantation

To meet the objectives of National Agroforestry Policy and promote agroforestry for augmenting farmer's income and achieve climate resilience, a dedicated scheme "Sub-Mission on Agroforestry" was launched with the slogan of "*HAR MED PAR PED*" during 2016-17. ICAR-CAFRI initiated Nationwide Tree Plantation Campaign under the theme “Har Med Par Ped” on the 16 July, 2021 to celebrate the of 93th Foundation Day of the Indian Council of Agricultural Research (ICAR). Under this campaign. Under this Nation-wide Tree Planting Campaign, 954793 seedlings/saplings were planted.

Vatikas

Vatikas are gaining popularity for conserving tree species and enhancing green cover particularly in towns and urban areas. The ICAR-Central Agroforestry Research Institute has been promoting the inclusion of trees and woody perennials in farmlands for diversification as well as building resilience in farms. In this regard, a variety of thematic plantations are established in CAFRI campus with a focus on the woody perennials associated with Indian Almanac-based

Navagraha, twelve zodiac signs and the twenty-seven horoscope stars of Indian culture, Navagraha Vatika, Rasi Vatika (Zodiac Vatika), and Nakshatra Vatika, respectively. The Rasi Vatika comprises 12 specific trees, wherein each tree is specific for one zodiac sign. While the Navagraha Vatika (Solar Vatika) has a 360° layout with eight perennial plants (including trees and shrubs) and one perennial plant representing the Sun at the centre. The Nakshatra Vatika has 27 woody perennial plants representing the 27 horoscope stars of the Indian culture. Culturally, tree planting has been promoted in similar forms like sacred grooves and temple trees thought out India and other south-east countries like Thailand and Cambodia. Associating trees to the ethnic and religious sentimental values of the people can serve as means for conserving tree genetic resources and increasing the tree cover area of the country. These thematic plantations also serve as tree arboretum, which is the scientific assemblage exclusively for trees.

Quality Planting Material (QPM)

Quality Planting Material (QPM) may be defined as 'the production of uniform, healthy, disease-free planting material raised through seed or vegetative methods with an overall goal to raise the physiological and phytosanitary quality of the plant available to stakeholders to increase productivity'. Quality Planting Material (QPM) like seeds, seedlings, clones, hybrids, improved varieties, etc. of healthy, resilient and adaptable nursery stock is pivotal for promoting agroforestry and tree plantation. ICAR-Central Agroforestry Research Institute (CAFRI) is now the nodal agency for providing technical support, capacity building, setting up of nurseries, production, and certification of QPM etc.

फ्रेंकलिन एल. खोबुंग
FRANKLIN L. KHOBUNG
संयुक्त सचिव
Joint Secretary

सत्यमेव जयते

आज़ादी का अमृत महोत्सव

भारत सरकार
कृषि एवं किसान कल्याण मंत्रालय
कृषि एवं किसान कल्याण विभाग
Government of India
Ministry of Agriculture & Farmers Welfare
Department of Agriculture & Farmers Welfare

No 3-1/2021-NRM-SMAF

05th April,2023

To

Dr. A. Arunachalam,
Director (ICAR),
Central Agroforestry Research Institute, Gwalior Road,
Jhansi-284 003, Uttar Pradesh.
E-mail: director.cafri@icar.gov.in

As your are aware that in view of restructured scheme of AGROFORESTRY to be implemented as one of the components of *Rashtriya Krishi VikasYojana* (RKVY) for its continuation during 15th Finance Commission period from 2021-22 to 2025-26, ICAR-Central Agroforestry Research Institute (CAFRI), Jhansi has been designated as Nodal agency for providing technical support for supply of Quality Planting Material (QPM) and its certification as well as Accreditation of nurseries as given in the Operational Guidelines of Agroforestry which is as below :-

i. CAFRI shall extend support through its All India Coordinated Research Project (AICRP) centres on agroforestry situated at various locations around the country and also coordinate activities with other agencies/ institutes like ICFRE, CIFOR-ICRAF, FAO-India, SAUs, CAUs, Private Partners, etc. while facilitating the implementation of the scheme.
ii. CAFRI will ensure that all nurseries set up under the scheme comply with the registration and accreditation requirements as laid down by it
iii. Certification of QPM from accredited nurseries shall be done as per guidelines laid down by CAFRI in association with empaneled agencies/experts.
iv. CAFRI shall provide the standards and modalities for Registration, Certification and Accreditation of Nurseries as well as Certification of QPM from such Registered/Accredited nurseries.
v. ICAR-CAFRI will act as Nodal Agency for repository of agroforestry related works with a preamble note to states for providing all related information to CAFRI.
vi. CAFRI may undertake project-based activities including transfer of agroforestry technology in various agro-climatic zones, business incubation and training to stakeholders.

2. In view of above, it is requested that CAFRI as the nodal agency may coordinate with the implementing agencies of the States/UTs in providing technical support while implementing the scheme. As the main thrust of the scheme is on supply of QPM, it is important that the nurseries set up by the States/UTs under the scheme conform to the quality standards prescribed by CAFRI and the nurseries developed under the scheme are registered/accredited and the seedlings produced are certified for QPM standards.

3. Further, ICAR-CAFRI as Nodal Agency for repository of all agroforestry related works may coordinate with the State/UT Governments for obtaining necessary information related to the subject.

Yours faithfully,

(Franklin L Khobung)

Copy to:-

The Pr. Secretary/ Commissioner D/o of Agriculture (All States/UTs).

Office : Krishi Bhawan, New Delhi-110001, दूरभाष / Phone : 23382508
E-mail : franklin.l@nic.in

CAFRI shall extend support through its All India Coordinated Research Project (AICRP) centres on agroforestry situated at various locations around the country. Further, ICAR-CAFRI shall coordinate activities with other agencies/ institutes like ICFRE, CIFOR-ICRAF, FAO-India, SAUs, CAUs, Private Partners, etc. while facilitating the implementation of the scheme. CAFRI will ensure that all nurseries set up under the scheme comply with the registration and accreditation requirements as laid down by it. More importantly, certification of QPM from accredited nurseries shall be done as per guidelines laid down by CAFRI in association with empaneled agencies/experts. CAFRI shall provide the standards and modalities for Registration, Certification and Accreditation of Nurseries as well as Certification of QPM from such Registered/Accredited nurseries. ICAR-CAFRI will act as nodal agency for repository of agroforestry related works. Additionally, ICAR-CAFRI may undertake project-based activities including transfer of agroforestry technology in various-agroclimatic zones, business incubation and training to stakeholders.

Tree Census and Capacity Building

ICAR-CAFRI conducts the Tree census program with collaboration of different universities and colleges in Jhansi. This program is aimed to provide participants understanding of tree measurement such as tree height, tree diameter and species level identification and knowledge.

ICAR-CAFRI also provides students of different universities and institutes of Jhansi and other areas in India, to complete their dissertation on various topics related to agroforestry and agricultural science such as agronomy, plant pathology, fruit science, carbon and climate change research, agroforestry extension and soil science.

Plant a Tree Yojana

ICAR-CAFRI always encourage tree plantation in rural as well as urban landscapes. 'Ganga Haritima Abhiyan' an initiative of Uttar Pradesh Government was flagged off in 2018 with an objective to improve and maintain forest/vegetation cover in the buffer zone along the Ganga River and its tributaries. This campaign encouraged plantation activities by ensuring people's participation through '*One Person One Tree*' scheme. In the same lines, local people are encouraged to take active participation in tree plantation activities. Each person is advised to plant at least one tree to improve green cover and health of environment.

JHANSI PLUS

Make the most of where you live | COMPLIMENTARY TO THE READERS OF THE TIMES OF INDIA IN JHANSI CITY & BADIYA | Sunday | July 14, 2024

ADVERTORIAL AND PROMOTIONAL FEATURE

PICS: ARINDAM GHOSH

TREES, THE SAVIOURS OF LIFE

ALMOST EVERY YEAR, NUMEROUS SAPLINGS ARE PLANTED AS PART OF THE MASSIVE PLANTATION DRIVE, WHICH TAKES PLACE DURING THE MONSOON SEASON. BUT MANY OF THEM PERISH TOO FAST. JP FINDS OUT WHY...

Arindam Ghosh

Looking at the drastic climate change, leading to surging temperature and increasing instances of heat-waves, we must ensure that every sapling planted grows into a full bloom tree, thus giving respite in the future.

Every year the government and the local administration takes a lot of pain to ensure mass plantation as part of 'Van Mahotsav' during monsoons. Months of long planning and awareness programmes are conducted to sensitise people to plant more and more saplings and ensure that they survive.

Despite the efforts, it has been observed that a major portion of these saplings seize to grow. Some of the reasons are neglection of saplings after plantation, exposure to stray animals, no proper irrigation facilities and extreme heat conditions result in non-development of these saplings to become self-sustainable trees.

As per MP Gautam, district forest officer (DFO), the forest department data reveals that in 2019 24.61 lakh saplings were planted in Jhansi district against the target of 24 lakh. In 2020, 50 lakh saplings were planted against the target of 49.78 lakh. In 2021, 60 lakh saplings and in 2022, 69.83 lakh saplings were planted. On the other hand, in the current year the target is almost to the tune of one crore saplings.

Experts feel that unless each person comes forward taking it as an individual responsibility to rear these plants by nurturing and protecting them, the noble and much-needed 'green movement' will not be successful. Even though trees are the most needed thing in the era of drastic climate change and global warming.

As per RK Singh, chief conservator of forest, Bundelkhand region, in this region, 65% of plantation is done through seed sowing and 35% by planting saplings. For seeds, contoured trenches are prepared, which helps in providing long-lasting moisture to the seeds. He also observed that by overcoming the challenges of plant protection, irrigation deficiency and stray cattle, the survival rate of these plants can be increased.

Jhansiplus
@timesgroup.com

OFFICIAL SPEAK

For better results for the survival of the saplings being planted at a mass level each year during the 'Van Mahotsava', there is a need for proper monitoring system. Selection of the right tree for the right place is also essential while using quality planting material. ICAR-Central Agroforestry Research Institute, Jhansi has been notified as nodal agency for certification and accreditation of nurseries by the Ministry of Agriculture.

- A Arunachalam,
director, ICAR CAFRI, Jhansi

FOR POSITIVE RESULTS, DO THE FOLLOWING:

- Choose the location of plantation very carefully suitable for the saplings to be planted
- Get the right tree in the right place and ensure quality over quantity. This approach may require more initial investment per tree, but will yield larger-growing, healthier, long-lived trees that provide environmental, social and health benefits
- Prioritise education, training, and community engagement of the individuals to be involved in the plantation drive
- Regular monitoring of the plants

-Naresh Kumar,
principal scientist, ICAR CAFRI, Jhansi

5 Biodiversity of Jhansi

Cities are the sites of creativity, innovation and learning where biodiversity and its interaction inter-alia adds fragrance to the urban fabric. The way cities develop definitively influences biodiversity conservation and the distribution of its benefits among different groups in society, as cities are the consumption centres of the world's resources. There are a variety of species living within city boundaries, the so-called 'urban biodiversity', including those species well adapted to urban life, such as rats or pigeons. This urban biodiversity can influence the form of the city as well as its inhabitants. The development of a city also impacts the urban biodiversity and their distribution establishing a mosaic of environmental setting linked to human well-being.

The city of Jhansi is in the course of implementation of various projects funded by government agencies as part of Smart City development like park rejuvenation, water supply and sewerage, viable and electric public transport facilities. The city is also partnering with NGOs like Waste Warriors and Foundation and public institutions for undertaking tree plantation activities and promoting organic farming through vocational and training programmes. As such, there are numerous independent but sporadic studies pertaining to the biodiversity of the city. Various lifeforms including trees, birds, butterfly, fungi, freshwater fishes, herpetofauna, etc. have been compiled and presented in the (Tables 4-9) from available secondary sources leaning further scope for addition.

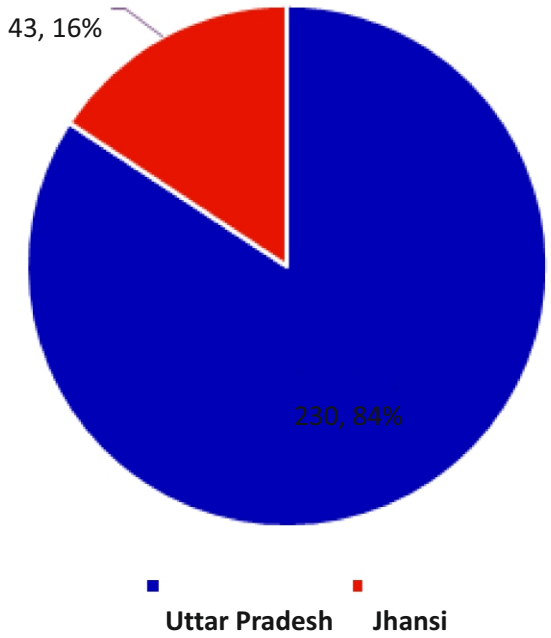


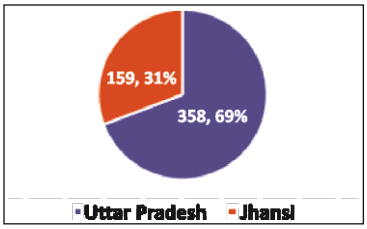
Table 4. Trees in Jhansi city

S No	Vernacular name	Botanical name
1.	Babool	*Acacia nilotica* (L.) wild.
2.	Adusa	*Adhatoda vasica* Nees.
3.	Piyaz	*Allium cepa* L.
4.	Gheekunvar	*Aloe barbadensis* Mill.
5.	Kalmegha	*Andrographis paniculata* (Burm.f.) Nees
6.	Sitaphal, Sharifa	*Annona squamosa* L.
7.	Satavar	*Asparagus racemosus* Wild.
8.	Peelikateli	*Argemone maxicana* L.
9.	Nim	*Azadirachta indica* A. Juss.
10.	Bach	*Acorus calamus* L.
11.	Brahmi	*Bacopa monnieri* (L.) pennel.
12.	Aak, Madar	*Calotropis procera* (L.) R. Br.
13.	Sanaya	*Cassia angustifolia* Vahl.
14.	Hadjod	*Cissus quadriangularis* L.
15.	Sadabahar	*Catharanthus roseus* (L.) G. Don.
16.	Aparajita	*Clitoria ternatea* L.
17.	Haldi	*Curcuma domestica* Valet
18.	Amarbel	*Cuscuta reflexa* Roxb.
19.	Sisam	*Dalbergia sissoo* Roxb.
20.	Sadah-datura	*Datura metel* L.
21.	Amla	*Emblica officinalis* Gaertin.
22.	Bargad	*Ficus benghalensis* L.
23.	Peepal	*Ficus religiosa* L.
24.	Gulmohar	*Gymnema sylvestre* (retz) R. Br.
25.	Jasum	*Hibiscus rosa-sinensis* L.
26.	Chameli	*Jasminum grandiflorum* L.
27.	Ghaneri, Kirmirch	*Lantana camara* L. Moldenke
28.	Mehandi, Hena	*Lawsonia inermis* Linn.
29.	Chandrasur	*Lepidium sativum* L.
30.	Mohva	*Madhuca indica* J.F. Machr.
31.	Aam	*Magnifera indica* L.
32.	Mitha neem	*Murraya koengii* (L.) Spreng

S No	Vernacular name	Botanical name
33.	Tulsi	*Ocimum sanctum* L.
34.	Isabgol	*Plantago ovato* Forssk.
35.	Chitrak	*Plumbago zylanica* Linn.
36.	Babchi	*Psoralea corylifolia* L.
37.	Anar	*Punica granatum* L.
38.	Sarpaghandha	*Rauvolfia serpentina* (L.) Benth. Ex Kurz
39.	Ajwain	*Trachyspermum ammi* (L.)
40.	Gokharu	*Tribulus terristris* L.
41.	Nirgundi	*Vitex negundo* L.
42.	Ashwaghanda, Asghand	*Withania somnifera* (L.) Dunal
43.	Ber	*Ziziphus jujuba* Mill.

Source: Rather *et al*. (2017)

Table 5. Birds of Jhansi city



Rain Quail

Indian Cormorant

ANSERIFORMES: Anatidae	
Fulvous Whistling Duck	*Dendrocygna bicolor*
Lesser Whistling Duck	*Dendrocygna javanica*
Bar-headed Goose	*Anser indicus*
Greylag Goose	*Anser anser*
Ruddy Shelduck	*Tadorna ferruginea*
Red-crested Pochard	*Netta rufina*
Common Pochard	*Aythya ferina*
Tufted Duck	*Aythya fuligula*
Garganey	*Spatula querquedula*
Northern Shoveler	*Spatula clypeata*
Falcated Duck	*Mareca falcata*
Gadwall	*Mareca strepera*
Eurasian Wigeon	*Mareca penelope*
Indian Spot-billed Duck	*Anas poecilorhyncha*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Common Teal	*Anas crecca*
Comb Duck	*Sarkidiornis melanotos*
Asian Pygmy Goose	*Nettapus coromandelianus*
GALLIFORMES: Phasianidae	
Indian Peafowl	*Pavo cristatus*
Common Quail	*Coturnix coturnix*
Rain Quail	*Coturnix coromandelica*
Jungle Bush Quail	*Perdicula asiatica*
Rock Bush Quail	*Perdicula argoondah*
Black Francolin	*Francolinus francolinus*

Painted Francolin	*Francolinus pictus*
Grey Francolin	*Francolinus pondicerianus*
Red Spurfowl	*Galloperdix spadicea*
Painted Spurfowl	*Galloperdix lunulata*
PHOENICOPTERIFORMES: Phoenicopteridae	
Greater Flamingo	*Phoenicopterus roseus*
PHOENICOPTERIFORMES: Podicipedidae	
Little Grebe	*Tachybaptus ruficollis*
COLUMBIFORMES: Columbidae	
Rock Dove	*Columba livia*
Oriental Turtle Dove	*Streptopelia orientalis*
Eurasian Collared Dove	*Streptopelia decaocto*
Red Collared Dove	*Streptopelia tranquebarica*
Spotted-necked Dove	*Streptopelia chinensis*
Laughing Dove	*Streptopelia senegalensis*
Yellow-legged Green Pigeon	*Treron phoenicopterus*
PTEROCLIFORMES: Pteroclidae	
Chestnut-bellied Sandgrouse	*Pterocles exustus*
Painted Sandgrouse	*Pterocles indicus*
CAPRIMULGIFORMES: Caprimulgidae	
Grey Nightjar	*Caprimulgus indicus*
Sykes's Nightjar	*Caprimulgus mahrattensis*
Large-tailed Nightjar	*Caprimulgus macrurus*
Indian Nightjar	*Caprimulgus asiaticus*
Savanna Nightjar	*Caprimulgus affinis*
CAPRIMULGIFORMES: Apodidae	
Asian Palm Swift	*Cypsiurus balasiensis*
Little Swift	*Apus affinis*
CUCULIFORMES: Cuculidae	
Greater Coucal	*Centropus sinensis*
Sirkeer Malkoha	*Taccocua leschenaultii*
Jacobin Cuckoo	*Clamator jacobinus*
Chestnut-winged Cuckoo	*Clamator coromandus*
Common Koel	*Eudynamys scolopaceus*
Banded Bay Cuckoo	*Cacomantis sonneratii*
Grey-bellied Cuckoo	*Cacomantis passerinus*

GRUIFORMES: Rallidae	
Western Water Rail	*Rallus aquaticus*
Brown Crake	*Zapornia akool*
White-breasted Waterhen	*Amaurornis phoenicurus*
Watercock	*Gallicrex cinerea*
Purple Swamphen	*Porphyrio porphyrio*
Common Moorhen	*Gallinula chloropus*
Common Coot	*Fulica atra*
GRUIFORMES: Gruidae	
Siberian Crane	*Leucogeranus leucogeranus*
Sarus Crane	*Antigone antigone*
Demoiselle Crane	*Grus virgo*
OTIDIFORMES: Otididae	
Great Indian Bustard	*Ardeotis nigriceps*
Lesser Florican	*Sypheotides indicus*
PELECANIFORMES: Ciconiidae	
Greater Adjutant	*Leptoptilos dubius*
Lesser Adjutant	*Leptoptilos javanicus*
Painted Stork	*Mycteria leucocephala*
Asian Openbill	*Anastomus oscitans*
Woolly-necked Stork	*Ciconia episcopus*
Black-necked Stork	*Ephippiorhynchus asiaticus*
PELECANIFORMES: Pelecanidae	
Great White Pelican	*Pelecanus onocrotalus*
Spot-billed Pelican	*Pelecanus philippensis*
PELECANIFORMES: Ardeidae	
Eurasian Bittern	*Botaurus stellaris*
Black Bittern	*Ixobrychus flavicollis*
Black-crowned Night Heron	*Nycticorax nycticorax*
Striated Heron	*Butorides striata*
Indian Pond Heron	*Ardeola grayii*
Cattle Egret	*Bubulcus ibis*
Grey Heron	*Ardea cinerea*
Purple Heron	*Ardea purpurea*
Great Egret	*Ardea alba*

Intermediate Egret	*Ardea intermedia*
Little Egret	*Egretta garzetta*
PELECANIFORMES: Threskiornithidae	
Black-headed Ibis	*Threskiornis melanocephalus*
Eurasian Spoonbill	*Platalea leucorodia*
Indian Black Ibis	*Pseudibis papillosa*
Glossy Ibis	*Plegadis falcinellus*
PELECANIFORMES: Phalacrocoracidae	
Little Cormorant	*Microcarbo niger*
Great Cormorant	*Phalacrocorax carbo*
Indian Cormorant	*Phalacrocorax fuscicollis*
PELECANIFORMES: Anhingidae	
Oriental Darter	*Anhinga melanogaster*
CHARADRIIFORMES: Burhinidae	
Eurasian Thick-knee	*Burhinus oedicnemus*
Great Thick-knee	*Esacus recurvirostris*
CHARADRIIFORMES: Recurvirostridae	
Pied Avocet	*Recurvirostra avosetta*
Black-winged Stilt	*Himantopus himantopus*
CHARADRIIFORMES: Charadriidae	
Little Ringed Plover	*Charadrius dubius*
Kentish Plover	*Charadrius alexandrinus*
River Lapwing	*Vanellus duvaucelii*
Yellow-wattled Lapwing	*Vanellus malabaricus*
Grey-headed Lapwing	*Vanellus cinereus*
Red-wattled Lapwing	*Vanellus indicus*
Sociable Lapwing	*Vanellus gregarius*
CHARADRIIFORMES: Rostratulidae	
Greater Painted-snipe	*Rostratula benghalensis*
CHARADRIIFORMES: Jacanidae	
Pheasant-tailed Jacana	*Hydrophasianus chirurgus*
Bronze-winged Jacana	*Metopidius indicus*
CHARADRIIFORMES: Scolopacidae	
Eurasian Curlew	*Numenius arquata*
Black-tailed Godwit	*Limosa limosa*

Temminck's Stint	*Calidris temminckii*
Dunlin	*Calidris alpina*
Little Stint	*Calidris minuta*
Pintail Snipe	*Gallinago stenura*
Common Snipe	*Gallinago gallinago*
Jack Snipe	*Lymnocryptes minimus*
Common Sandpiper	*Actitis hypoleucos*
Green Sandpiper	*Tringa ochropus*
Common Greenshank	*Tringa nebularia*
Common Redshank	*Tringa totanus*
Wood Sandpiper	*Tringa glareola*
CHARADRIIFORMES: Turnicidae	
Common Buttonquail	*Turnix sylvaticus*
Yellow-legged Buttonquail	*Turnix tanki*
Barred Buttonquail	*Turnix suscitator*
CHARADRIIFORMES: Glareolidae	
Indian Courser	*Cursorius coromandelicus*
Oriental Pratincole	*Glareola maldivarum*
Little Pratincole	*Glareola lactea*
CHARADRIIFORMES: Laridae	
Indian Skimmer	*Rynchops albicollis*
Brown-headed Gull	*Chroicocephalus brunnicephalus*
Pallas's Gull	*Ichthyaetus ichthyaetus*
Caspian Tern	*Hydroprogne caspia*
Whiskered Tern	*Chlidonias hybrida*
River Tern	*Sterna aurantia*
Black-bellied Tern	*Sterna acuticauda*
ACCIPITRIFORMES: Pandionidae	
Osprey	*Pandion haliaetus*
ACCIPITRIFORMES: Accipitridae	
Black-winged Kite	*Elanus caeruleus*
Oriental Honey Buzzard	*Pernis ptilorhynchus*
Egyptian Vulture	*Neophron percnopterus*
Crested Serpent Eagle	*Spilornis cheela*
Short-toed Eagle	*Circaetus gallicus*

Red-headed Vulture	*Sarcogyps calvus*
White-rumped Vulture	*Gyps bengalensis*
Indian Vulture	*Gyps indicus*
Griffon Vulture	*Gyps fulvus*
Cinereous Vulture	*Aegypius monachus*
Changeable Hawk Eagle	*Nisaetus cirrhatus*
Indian Spotted Eagle	*Clanga hastata*
Greater Spotted Eagle	*Clanga clanga*
Tawny Eagle	*Aquila rapax*
Steppe Eagle	*Aquila nipalensis*
Eastern Imperial Eagle	*Aquila heliaca*
Bonelli's Eagle	*Aquila fasciata*
Booted Eagle	*Hieraaetus pennatus*
Western Marsh Harrier	*Circus aeruginosus*
Hen Harrier	*Circus cyaneus*
Pallid Harrier	*Circus macrourus*
Montagu's Harrier	*Circus pygargus*
Crested Goshawk	*Accipiter trivirgatus*
Shikra	*Accipiter badius*
Eurasian Sparrowhawk	*Accipiter nisus*

Source: Lepage (2023)

Indian Skimmer

Great Indian Bustard

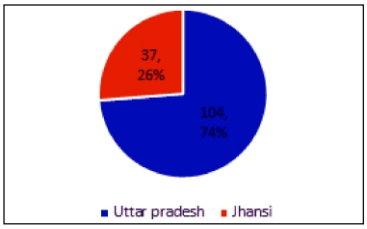
Siberian Crane

Red-headed Vulture

Indian Peafowl

Painted Francolin

Table 6. Butterflies of Jhansi city



Lemon Pancy

The Indian fritillary

The Baronet

Common Mormon

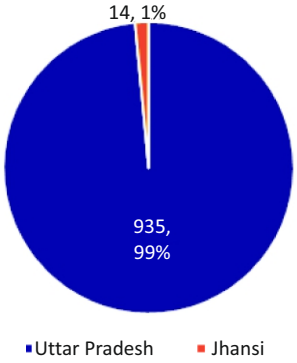
Forget-me-not

S.No.	Common Name	Name of Species
1	Common leopard or spotted rustic	*Atella phalanta*
2	Lemon Pancy	*Precis lemonias*
3	Blue pansy	*Precis orithya*
4	The yellow pansy	*Precis hierta*
5	The grey pansy	*Precis atlites*
6	The Danaid eggfly	*Hypolimnas missipus*
7	Common Eggfly or Great Eggfly	*Hypolimnas bolina*
8	The Indian fritillary	*Argynnis hyperbius*
9	*The Baronet*	*Euthalia nais*
10	Spotted joker	*Byblia ilithyia*
11	The white orange tip	*Ixias marianne*
12	Mottled emigrant	*Catopsilia pyranthe*
13	Common vagran	*Catopsilia florella*
14	The small grass yellow	*Eurema brigitta*
15	Lemon emigrant	*Catops iliacrocale*
16	Pioneer White	*Anaphaeisaurota*
17	Common gull	*Ceporanerissa*
18	*The large salmon Arab*	*Colotis fausta*
19	*The Spotless Grass-yellow*	*Terias laeta*

S.No.	Common Name	Name of Species
20	*The common grass yellow*	*Terias hecabe*
21	The small Cupid	*Chilades parrhasius*
22	Lesser grass blue	*Zizinaotis*
23	Forget-me-not	*Catochrysops strabo*
24	Long-tailed pea-blue	*Lampides boeticus*
25	The rounded Pierrot	*Tarucus extricatus*
26	African babul blue	*Azanus jesous*
27	Striped tiger	*Danaus genutia*
28	*The plain tiger*	*Danaus chrysippus*
29	Blue tiger	*Tirumala limniace*
30	The common Indian crow	*Euploea core*
31	Grass Demon	*Udaspes folus*
32	Dark Palm-Dart	*Telicota ancila*
33	Common grass dart	*Tatractrocera maevius*
34	*Chinese dart*	*Potanthus confucius*
35	Lime swallowtail	*Papiliodemoleus*
36	Common Mormon	*Papilio ploytes*
37	Common rose	*Pachliopta aristolochiae*

Source: Kumar (2012)

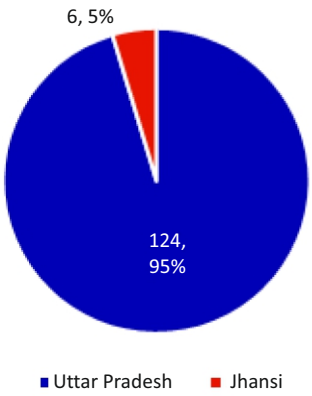
Table 7. Fungal of Jhansi city



S. No.	Fungi Name
1.	*Aspergillus niger*
2.	*Aspergillus fumigates*
3.	*Aspergillus flavus*
4.	*Penicillium chrysogenum*
5.	*Penicillium sp.*
6.	*Fusarium oxysporum*
7.	*Fusarium sp.*
8.	*Curvularialunata*
9.	*Curvularia sp.*
10.	*Trichoderma harzianum*
11.	*Trichoderma viride*
12.	*Trichoderma virens*
13.	*Rhizopus stolanifer*
14.	*Rhizopus sp.*

Source: Sinha *et al* (2018)

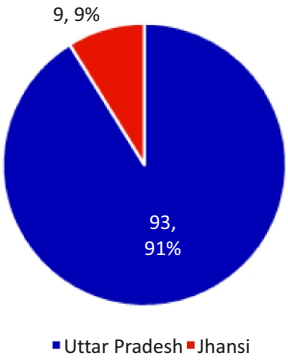
Table 8. Freshwater fishes of Jhansi city



S.No.	Common name	Scientific name
1	Bighead	*Hypophthalmichthys nobilis*
2	Rohu	*Labeo rohita*
3	Catla	*Labeo catla*
4	Indian Salamon	*Eleutheronema tetradactylum*
5	Magur	*Clarias batrachus*
6	Pabda	*Ompok bimaculatus*

Source: Survey of Local market, https://www.fishbase.se/search.php

Table 9. Herpetofauna of Jhansi city



S.No.	Common name	Scientific Name
1.	Common Sand Boa	*Eryx johni*
2.	Red Sand Boa	*Gongylophis conicus*
3.	Condanarus sand snake	*Psammophis condanarus*
4.	Common Trinket Snake	*Coelognathus helenahelena*
5.	Common Vine Snake	*Ahaetulla nasauta*
6.	Russell's Kukri Snake	*Oligodon taeniolatus*
7.	Yellow-speckled Wolf Snake	*Lycodon jara*
8.	King Cobra	*Ophiophagus hannah*
9.	Spectacled Cobra	*Naja naja*

Source: Kanaujia (2017)

6 Strategic Recommendations by ICAR-CAFRI

Nagar Nigam

Jhansi Nagar Nigam, the local urban body of the city is required to identify, enlist, and map the available open space for tree plantation. This local body can finalize the priority parks for plantation based on their available green cover and needs of surrounding community. Additionally, Jhansi Nagar Nigam can initiate the campaigns in collaboration with ICAR-CAFRI to aware local people for protecting and enhancing green cover.

Forest Department

This green cover reports recommends the forest department of Uttar Pradesh government to conduct tree plantation and census in collaboration of different stakeholders such as local people, colleges and universities, local urban and rural bodies, and policy and decision-makers. Further providing quality planting material by forest department could strengthen the ambitious target of enhancing green cover in Jhansi.

The Administration

At administration level, the Government of Uttar Pradesh in collaboration with the Central Government can support the tree plantation and green cover in Jhansi through formation and implementation various policies and plans. However, increasing attention on plantation through various schemes (MGNREGs, Rashtriya Krishi Vikas Yojana, National Horticulture Mission, Bamboo Mission, and special plantation drives. Plans and policies aiming enhancing green cover through tree plantation should be in consultation with local people, their needs and priorities and consideration of agro-climatic conditions of area.

Citizens

Local people should actively participate in different activities and initiatives focused on tree plantation in Jhansi. Local residents are ultimate custodian of the trees in their surrounding environment, and therefore their responsibility is not only to plant trees but protect them.

राशि वाटिका
Zodiac Plantation

7 Conclusion

This report clearly indicates that the green cover of the Jhansi city is 68.64 km^2 (dense cover - 21.43 km^2 and scattered cover - 47.21 km^2) in 2019 registering a little increase over 2015 when it was 67.29 km^2. All the parks within the municipal limit were regarded as green space because there are no nature reserves/protected areas, zoological and botanical parks within the Jhansi municipal limits. In total, there were 89 parks covering 93.53 ha within the city limit that accounted for a greenspace of approx. 1 km^2 which is low for a city with total geographical area of 166.5 km^2. Eventually, there is an urgent need to enhance the green space in the city for improving the sustainability and human well-being of the urban residents. These green space (parks) are vital for the physical and mental well-being of the residents as well as to ensure ecological security of the city. Nonetheless, the green space area like parks, garden and botanical areas are very less compared to the recommended level. For instance-, the per capita recommendation of green space area as per UN recommendation is 9 m^2. Thus, there is ample scope for increasing the green space as most of the existing spaces are publicly managed and also being transformed under smart city programme, promising PPP mode of green space management.

Besides growing urbanization and built-up area in Jhansi city, there is ample space for plantation such as gardens, parks, roadsides, lakes and dams, railway lines, educational institutes (e.g., schools, colleges, and universities), and other barren and wastelands. Furthermore, like Jhansi district, municipal area of Jhansi also constitutes wasteland/barren land as a significant land use. This barren/wasteland provides opportunities for tree plantation. Therefore, it would be apt to increase the tree cover (i.e., green cover) of the city to the maximum extent possible as a futuristic action for reaping ecosystem services and also to help comprehend climate resilience of Jhansi as a smart city.

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