Project Statement

The TAZARA Railway, known as the "Freedom Railway", was once a vital transportation corridor and economic cooperation bridge in Africa but has faced stagnation since the 1990s. Issues such as environmental degradation and loss of landscape features have become increasingly severe. This project focuses on addressing the original and derivative landscape issues at the intersection of the TAZARA Railway and the East African Rift. This area is characterized by complex and varied natural landforms, rich historical and cultural resources, and 12 typical railway stations. The analysis and development of this project will serve as a model for the overall planning and landscape renewal of TAZARA.

To address the existing problems, we propose the vision of four "revivals" : ecological restoration, transportation revitalization, cultural diversity, and landscape optimization. Our core research method is linear landscape character recognition technology utilizing imaging data. Ten types of landscape character types (LCTs) have been identified through unsupervised hierarchical clustering and visualization methods. Optimization strategies have been proposed for each LCT, aiming to explore and maintain the integrated development of natural, production, and living scenes along the TAZARA Railway. By utilizing landscape governance and management techniques, our goal is to establish a "Revival Railway" in the East African Rift region.

Project Narrative and Contents

1. Location and Area

Our project belongs to the 10th category of **Analysis and Planning (Unbuilt Category)**. The research area focuses on the intersection area of **the TAZARA Railway** and the western branch of **the East African Rift**, specifically the section from Malamba station to Tunduma station along the TAZARA Railway and the surrounding area, with a length of about 189 km and an area of about 1273 km^2.

2. Site Background

The East African Rift (EAR), known as the "Valley of Life" in Africa, is renowned for its unique geographical features, ecological features, rich human cultural history, and abundant landscape resources.

The TAZARA Railway was completed and opened to traffic in 1976, serving as a crucial transportation corridor and economic link across the African continent, influencing the southeastern region of Africa. Known as the "Freedom Railway", its construction has played a significant role in the national, economic and construction development of southern Africa.

However, since the 1990s, the development of the TAZARA Railway has stagnated, facing a range of economic, social, and ecological issues. Its function as a strategic transportation artery in eastern Africa has gradually declined, and problems of **environmental degradation and loss of landscape characters** have become increasingly serious.

This project focuses on the issues of native and derivative landscape in the intersection area of the TAZARA Railway and the East African Rift. The area is characterized by its complex and varied natural landforms, rich historical and cultural resources, with 12 typical railway stations. The analysis and development of this project can serve as a model for the overall planning and landscape renewal of the TAZARA Railway.

3. Challenges and Future Vision

From the perspective of sustainable and high-quality development of modern landscapes, the TAZARA Railway is currently facing many problems such as land degradation and desertification, water resources pollution, habitat fragmentation, disappearance of traditional cultural landscapes, decrease in community cohesion and cultural identity. The project development is confronted with **4 challenges**: ecological degradation, species loss, landscape character loss, and settlement homogenization. Based on this, the vision of **4 Revivals** are proposed: ecological restoration, transportation revitalization, cultural diversity enhancement, and landscape optimization.

4. Research Methods: Identifying Landscape Character Types

Our primary research methodology relies on **linear landscape character identification technology** utilizing imaging data. Through the analysis of remote sensing images, Digital Terrain Models (DTM), and Digital Surface Models (DSM), we gather data on land use, topography, vegetation cover, hydrological features, and built environments, capturing natural and cultural landscape resources in the research area. We developed a landscape character identification indicator system and generated a landscape character data matrix for the research area.

Using R, we computed the distance matrix for the study area data, applying the Manhattan distance algorithm for continuous variable data and the Euclidean distance algorithm for categorical variable data. The Ward.D2 algorithm was used for unsupervised hierarchical clustering. The clustering results were visualized using the ggtreeExtra package, and the clustered landscape feature areas were intuitively mapped in GIS. Based on the Silhouette Coefficient, the mapping of landscape character types, and on-site photographs, **10 typical Landscape character types (LCTs)** were finally identified and clustered.

5. Revival Strategies of Ten Landscape Character Types

(1) Area with Safwa Culture and Expansive Farmland

This LCT is primarily inhabited by the Safwa community. The renewal strategy focuses on showcasing the cultural landscape of the Safwa through visual and interactive elements that highlight their music, dance, and crafts, emphasizing their role in significant events. The revival strategy also explores the preservation and transmission of cultural landscape of Safwa in a modern context, demonstrating how they strive to maintain their cultural identity in a changing societal landscape.

(2) Area with Extensive Meadows and Patches of Farmland

The renewal strategy for this LCT aims to create agricultural landscape corridors and agricultural experience tourism, leveraging the area's natural and agricultural resources. The plan includes reclaiming wasteland along the railway to form attractive agricultural landscape corridors. Visitors can actively participate in planting and harvesting crops, enriching their understanding of local agricultural culture.

(3) Area with Hilly Terrain and High Levels of Urbanization

The renewal strategy for this LCT aims to promote cultural interaction and preservation, enhance communication among different ethnic groups in the region and form a diverse cultural landscape. This includes regularly hosting cultural markets to showcase traditional crafts, food, music, and dance from various communities. Additionally, an online platform will be created to feature digital exhibitions of East African culture. Cultural exchange programs will foster visits and learning among individuals from diverse cultural backgrounds.

(4) Area with Complex and Diverse Topography and Developed Agriculture

This LCT has a well-developed road network, numerous built-up areas, and a high population density, making the ecosystem relatively fragile. To address this challenge, an ecological restoration strategy can be implemented, involving the planting of locally representative tree species such as Eucalyptus spp, and Pinus patula. By reintroducing native vegetation and planting trees, we can increase vegetation coverage and restore damaged ecosystems.

(5) Area with a Developed Agricultural Industry and Abundant Water Resources

This LCT has developed agriculture, but the farmland faces water scarcity due to seasonal rainfall variations. The strategy is to introduce the water-saving irrigation method "Tasa" to help restore lost soil fertility, aiding steady agricultural yield growth. In this way, local agriculture can better cope with drought challenges and promote sustainable agricultural development.

(6) Area with High Landscape Benefits and Rich Cultural Resources

This LCT is densely populated, primarily in urban areas, with a diverse ethnic composition. Based on the landscape potential for developing the tourism industry, tourist trains will be added and service facilities along the route will be upgraded to attract tourists and drive development in the areas.

(7) Area with Low Urbanization but Rich Ethnoculture

This LCT is densely populated with a diverse ethnic distribution. The strategy focuses on promoting existing ethnic cultures by establishing ethnic markets and cultural festivals, encouraging the import and export of ethnic crafts and agricultural products. Additionally, for cultures that are fading or have disappeared, digital technology will be used to revive and preserve them.

(8) Area with Sparse Population but Well-found Agricultural Base

This LCT is characterized by vast land and a sparse population, with rich agricultural resources. The strategy is to further develop circular agriculture based on the existing sisal plantations. Through waste recycling and composting techniques, the area's water, soil, biological resources, and climatic conditions can be scientifically and rationally utilized to achieve sustainable agricultural development.

(9) Area with Rich Culture but Sparse Population

This LCT has a rich ethnic culture but a sparse population. The strategy focuses on the Nyiha community's folk culture and lifestyle by establishing cultural markets and museums, and holding various religious ceremonies and festivals. Additionally, due to the area's distance from railway stations and underdeveloped infrastructure, a temporary loading and unloading method for train carriages is proposed to address this issue and enhance cultural vibrancy along the route.

(10) Area with Rich Water Resources and Agricultural Resources

This LCT has abundant agricultural land and water resources, but a sparse population has led to large areas of fallow land. Given its potential for developing specialized agricultural production and deep processing, the strategy leverages the experts, materials, and equipment brought by the TAZARA Railway. Focusing on Tanzania's traditional industries—cashew cultivation and sisal production—the strategy aims to optimize production cycles and planting methods, develop deep processing industries, and achieve agricultural revitalization in the region.

6.Future Outlook

With the development of agricultural civilization and industrialization, the relationship between humans and nature has shifted from dependence to conquest. The symbiotic nature of original landscape resources has transformed into productive attributes and has been continuously destroyed over time. This has become a common regret for humanity. As a symbol of the "Freedom Railway" and once the "Progress Railway" for Tanzania and Zambia, the TAZARA Railway needs to restore the landscape values, protect and develop the diverse landscape characters along the railway line, promote the green development of infrastructure, and maintain the natural evolution of regional landscapes in the East African Rift region. Our work today aims to explore and maintain the integrated development of natural scenes, production scenes, and living scenes along the TAZARA Railway in order to shape a **"Revival Railway"** on the land of the East African Rift by relying on landscape architecture governance and control methods.

REVITALIZING THE "FREEDOM RAILWAY" —— RENEWAL OF 10 LANDSCAPE CHARACTER TYPES IN THE EAST AFRICAN RIFT SECTION OF TAZARA

HISTORY AND BACKGROUND

WORLD SCALE MAP

East Africa is characterized by diverse landscapes, including vast savannas, highlands, and the Great Rift Valley, and it experiences a range of climates from arid deserts to tropical rainforests.

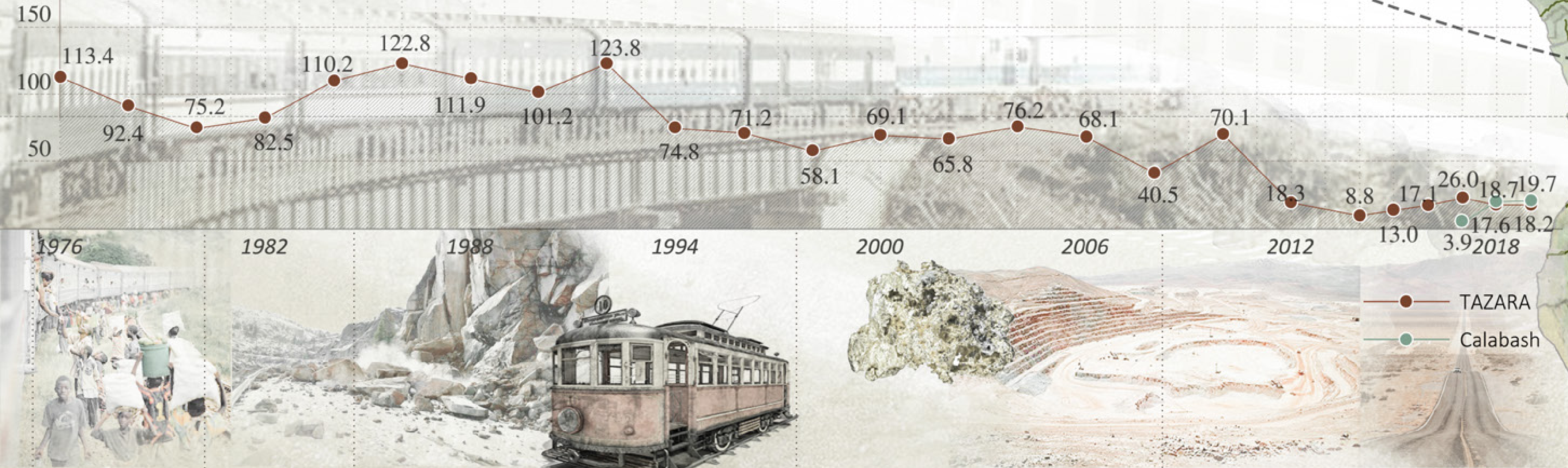
CONTINENT SCALE MAP

An Essential Railway in East Africa linking the port of Dares Salaam in east Tanzania with the town of Kapiri Mposhi in Zambia's Central Province.

BAISC DATA

Population of 2 Countries (million) 78.0	Area of the Affected Region (1000km^2) 15.5	Population Density (/km^2) 24.7
Total Length (km) 1860	Construction Investment (CNY/billion) 5.01	Proportion of Main Transported Goods (%) 34.6
Recent Freight Volume (ton) 18.2	Total Travel Time (hour) 46.2	Maintenance Costs (billion/Y) 41.7

FREIGHT VOLUME OF TAZARA



1976
officially put into operation

1979
suspension for 2 months
due to landslides

the first 10 years
insufficient number of vehicles

1995-1996
loss of freight volume because of
the reopened South Corridor;
economy declines of Tanzania and Zambia;

loss of freight volume because of
the improved highway network

18.2 ton

Decline of Freight Volume

In recent years, the freight volume of TAZARA has continuously declined, dropping to 18.2 tons.

Loss of Local Culture

The population of urban settlements within the study area has significantly increased, with the most densely populated areas reaching 180 people per hectare.

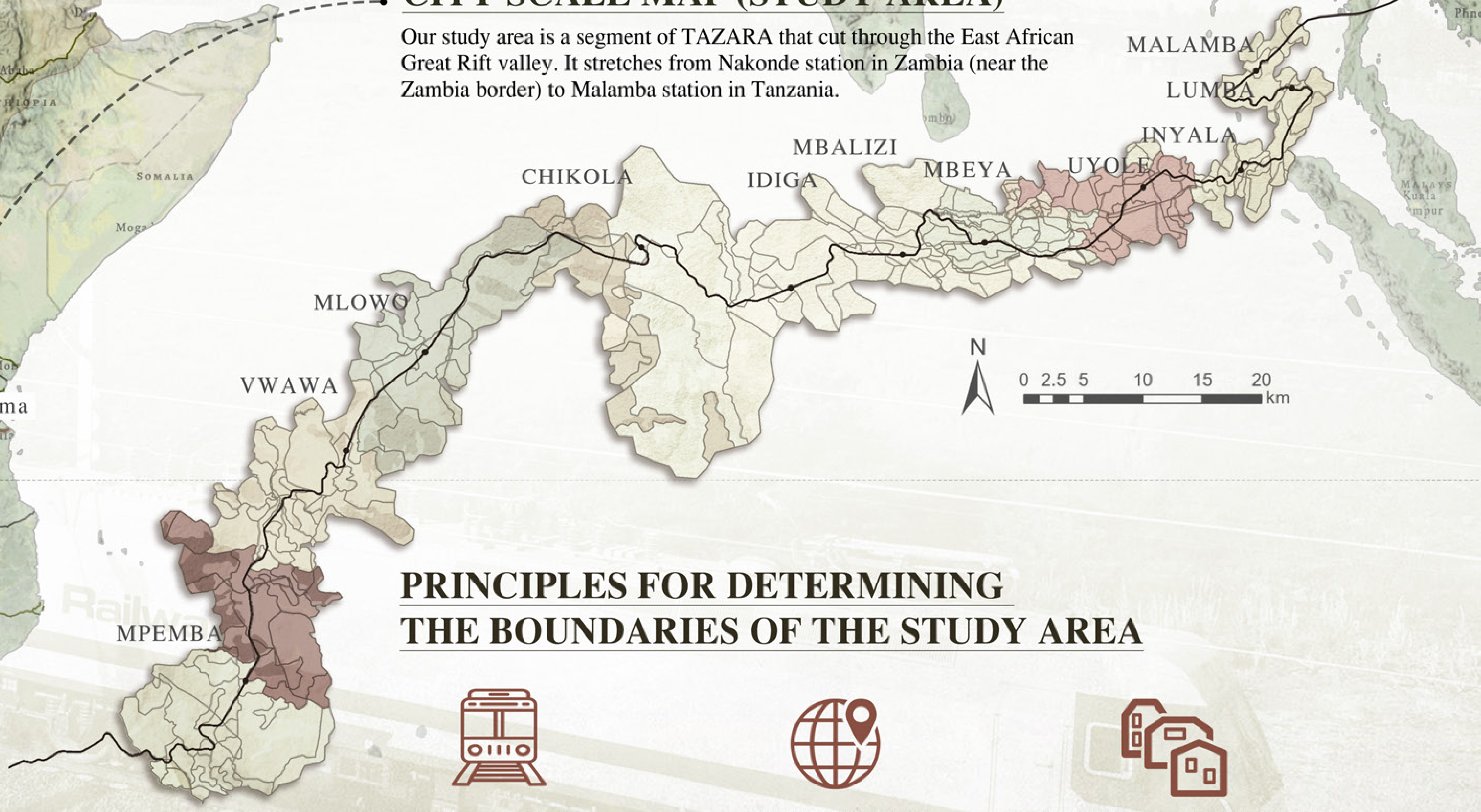
180 p/ha

Lack of Infrastructure 0.0208 km/ha

The research area lacks infrastructure, and the road network construction is not adequate. The road network density in the most densely populated urban area is only 0.0208 km/ha

CITY SCALE MAP (STUDY AREA)

Our study area is a segment of TAZARA that cut through the East African Great Rift valley. It stretches from Nakonde station in Zambia (near the Zambia border) to Malamba station in Tanzania.



PRINCIPLES FOR DETERMINING THE BOUNDARIES OF THE STUDY AREA

VISIBLE AREAS FROM RAILWAYS
Delineate the landscape areas visible from railway routes based on topography.

ADMINISTRATIVE BOUNDARIES
Comply with the third-level administrative divisions from the Tanzanian government.

CULTURAL AND NATURAL SETTLEMENTS
Respect local settlements formed by natural landscapes and cultural history.

THE TAZARA RAILWAY IN THE OPERATION

TAZARA Railway, a railway artery crossing the Great Rift Valley in East Africa, shows the rich present situation of resources in East Africa. The areas along the line are rich in resources, and the tropical rain forest and grassland ecosystem in the rift zone also bring rich biodiversity and ecotourism resources to the local area.

CAUSES OF THE POOR OPERATION OF THE TAZARA RAILWAY

- ECOLOGICAL DESTRUCTION
- FUNCTIONAL HOMOGENIZATION
- TRANSPORT COMPETITION
- UNSCENTED LANDSCAPE FEATURES

TRANSPORT COMPETITION

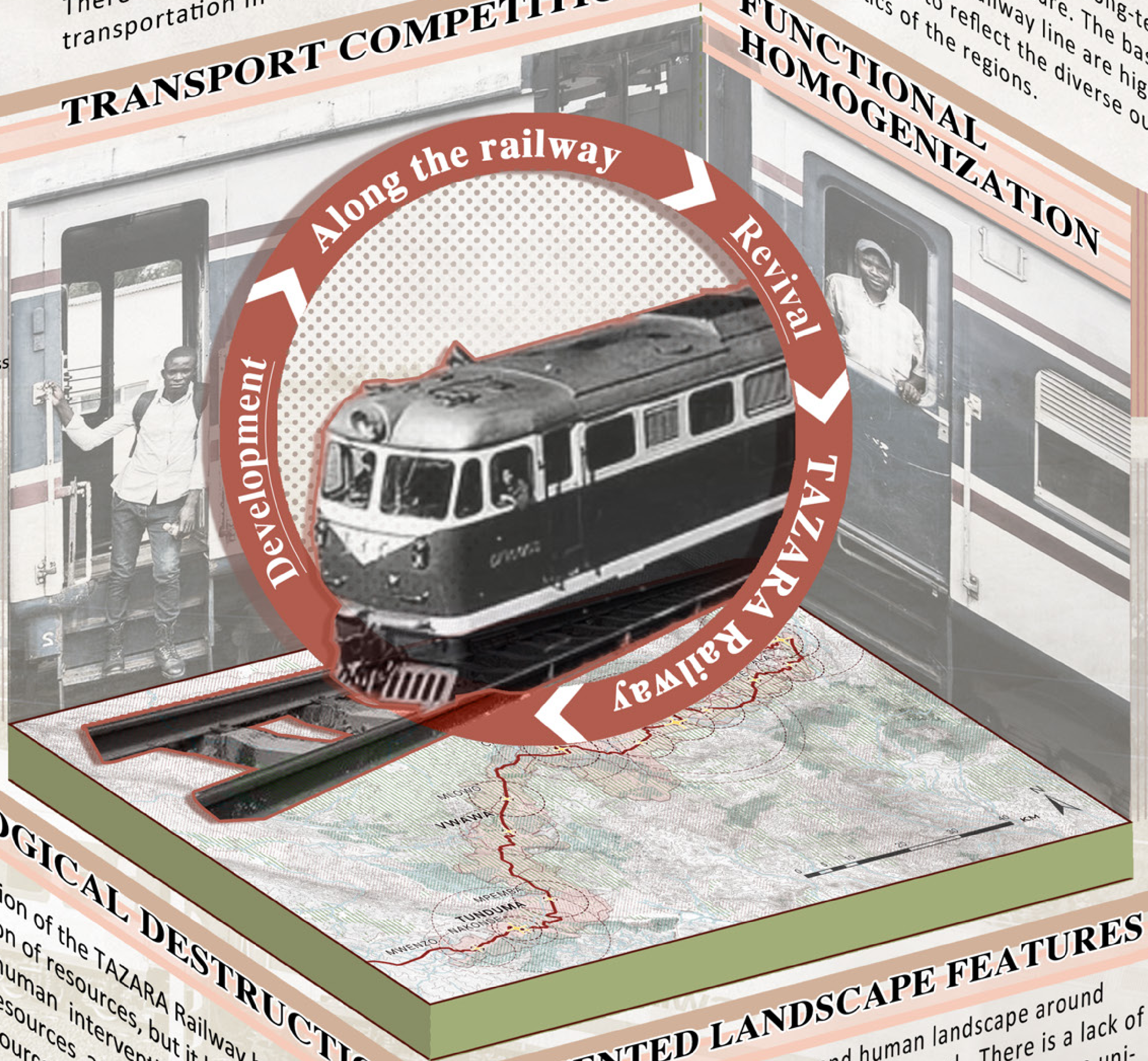
There is fierce competition in railway and road transportation in Tanzania and Zambia.

Railway Transportation
High Transport Volume
Path Parallelism

Highway Transportation
Flexibility and Conveniengerce
Broad Coverage

Economic Development Level and Industrial Structure
A balanced industrial structure, with a mix of traditional and high-tech sectors, indicates a healthy economy.

Infrastructure and Policy Environment
Robust infrastructure like roads, ports, and power grids supports economic growth. Favorable policies encourage investment, create jobs, and foster a competitive business environment.



FUNCTIONAL HOMOGENIZATION

The TAZARA Railway has suffered from long-term neglect, with outdated infrastructure. The basic service facilities along the railway line are highly homogenized and fail to reflect the diverse cultural characteristics of the regions.

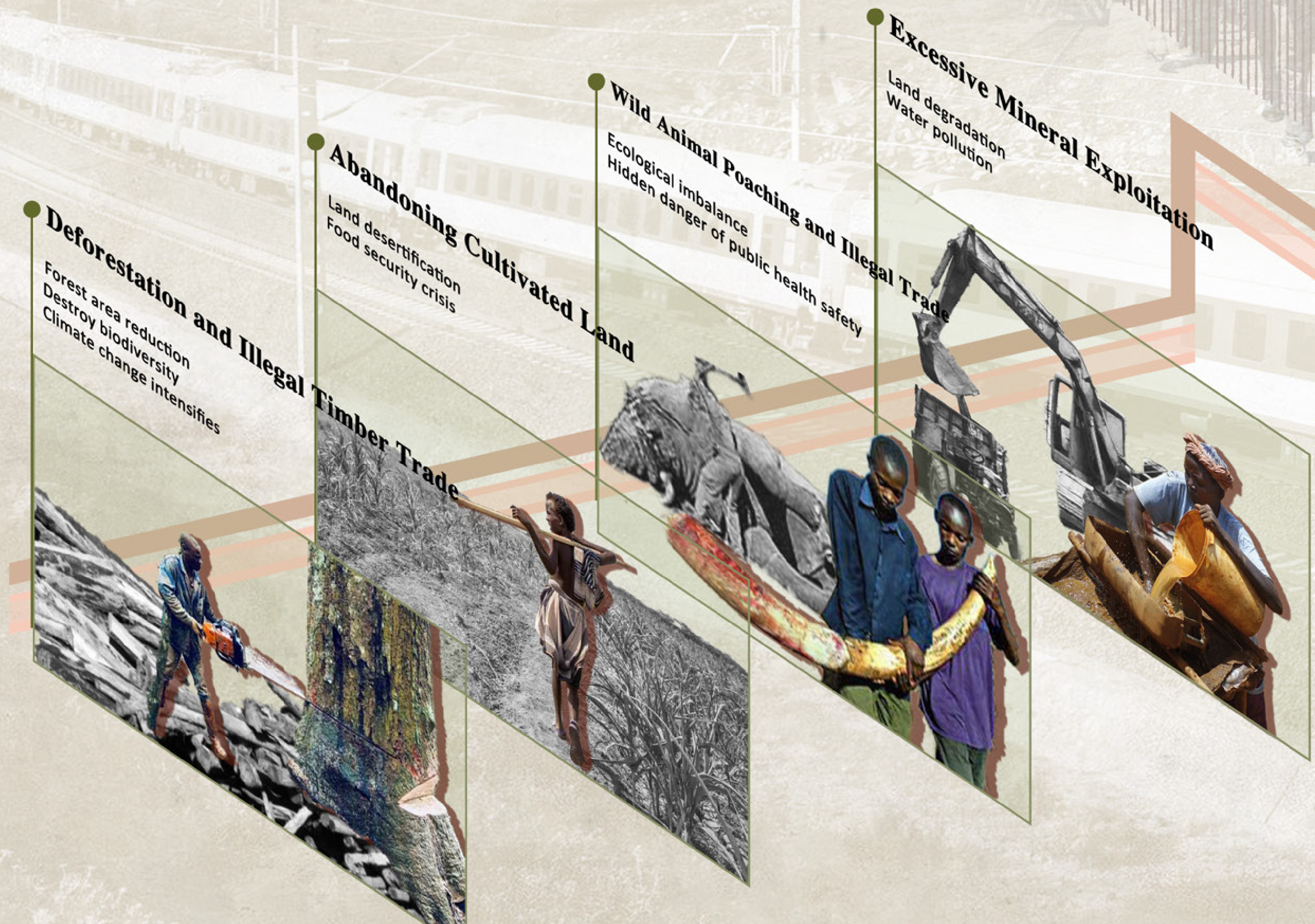
Minerals 29.3%
Metallic Minerals and Nonmetallic Minerals
Energy Minerals: Oil and Natural Gas

Agricultural Product 33.4%
Grain Crops
Commercial Crop
Horticultural Products
Tea, Sisal

Petroleum 33.2%
Light Oil
Heavy Oil
Crude Oil

The functional business sphere primarily revolves around agricultural and sideline products, encompassing diverse commodities from crops to livestock. Additionally, it encompasses the extraction and trade of minerals, gasoline, and other essential commodities, along with importing and exporting goods to meet global market demands.

ECOLOGICAL DESTRUCTION



Deforestation and Illegal Timber Trade
Forest area reduction
Destroy biodiversity
Climate change intensifies

Abandoning Cultivated Land
Land desertification
Food security crisis

Wild Animal Poaching and Illegal Trade
Ecological imbalance
Hidden danger of public health safety

Excessive Mineral Exploitation
Land degradation
Water pollution

The completion of the TAZARA Railway has accelerated the circulation of resources, but it has also increased the intensity of human intervention in landscape resources. Landscape resources are mainly used in the form of production resources, but it has caused a series of harm to the relationship between environment, resources and people and land.

UNSCENTED LANDSCAPE FEATURES

The diversity of natural landscape and human landscape around TAZARA Railway has not been fully demonstrated. There is a lack of iconic natural attractions along the route, which fails to form a unique visual and cultural experience in culture. These problems make the TAZARA Railway unattractive in tourism and cultural promotion, and limit its comprehensive value as a transnational traffic artery.

Insufficient Highlighting of Cultural Resources

Lack of Protection for Natural Resources

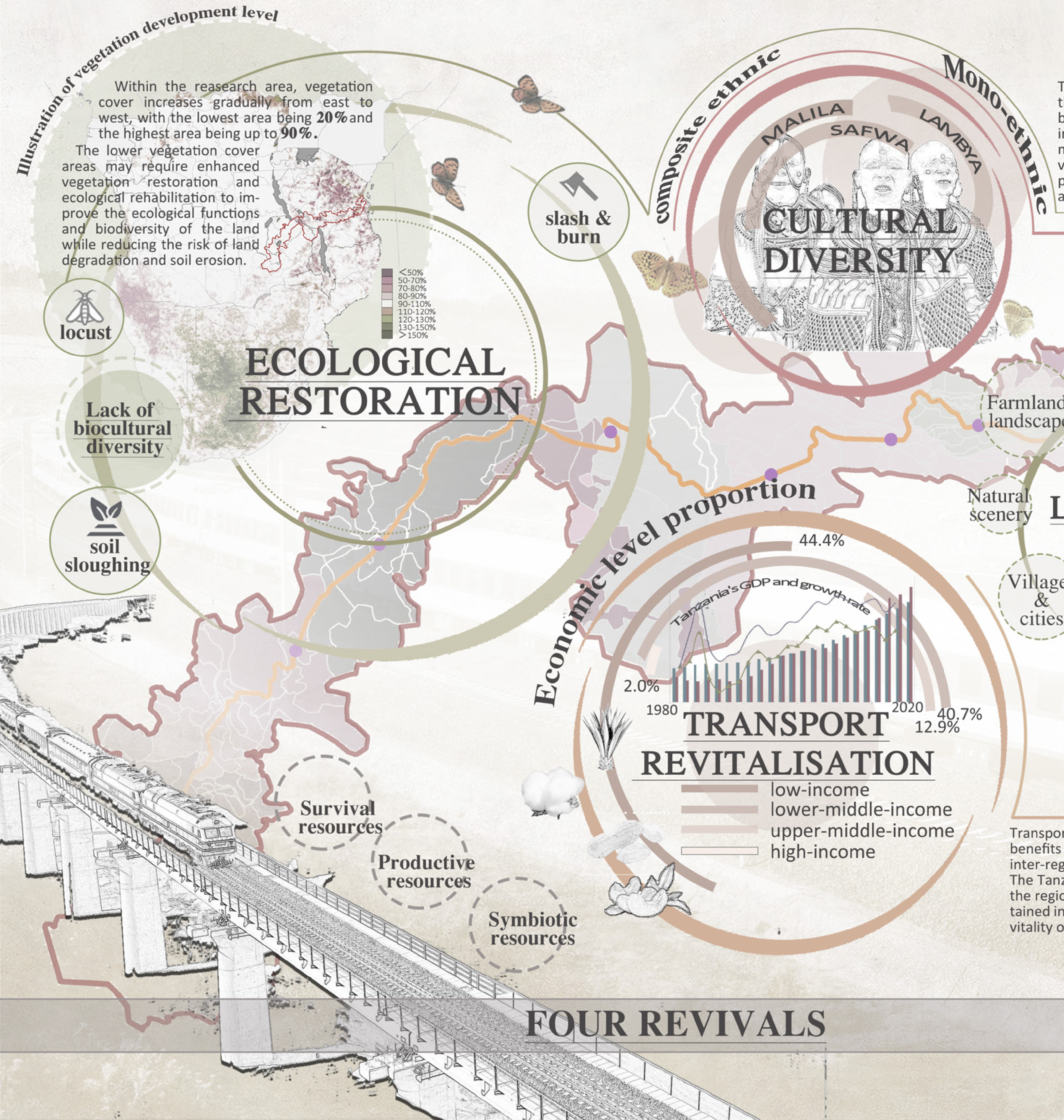
Unclear Visual Characteristics of the Landscape Along the Railway

Inadequate Biodiversity Conservation

OVERALL VISION: FOUR REVIVALS

Within the reasearch area, vegetation cover increases gradually from east to west, with the lowest area being **20%** and the highest area being up to **90%**. The lower vegetation cover areas may require enhanced vegetation restoration and ecological rehabilitation to improve the ecological functions and biodiversity of the land while reducing the risk of land degradation and soil erosion.

There are mainly eight ethnic communities in the reasearch area, but exchanges and links between the ethnic groups are poor, resulting in the obstruction of economic development and the disappearance of cultural diversity. it is necessary to take measures to promote cultural exchanges and integration among the ethnic groups



Through landscape feature identification, we can more accurately understand the local topographic and geomorphological features, thereby improving the landscape benefits along the research area and providing a basis for planning and management.

Transport development has brought good economic benefits to the local economy, while also facilitating inter-regional communication and understanding. The Tanzanian railway, which has brought vitality to the region, now needs to be rehabilitated and maintained in order to reawaken the economic and social vitality of the region along its route.

FOUR REVIVALS

Through landscape feature recognition, we can more accurately understand and analyse the topography, vegetation, hydrology and other features of different areas, providing an important basis for local planning and management.
We will establish a **landscape feature identification index system** for the research area, build a **landscape feature database** through remote sensing images and multivariate data provided by authoritative data organisations, and classify landscape feature areas through an **unsupervised hierarchical clustering model**, so as to realise the identification and mapping analysis of landscape features in the study area.

Nature Characters		Culture Characters	
Landcover	Water System Density	Language	Agriculture Ecology
Cultivated Land	Weighted Carbon Stocks	Mqsques, Churches, Schools	Bulit-up Areas
Forest Land	Height Difference	Population Density	Race Distribution

Nature Characters » **Database Creation** « Culture Characters

Unsupervised Hierarchical Clustering

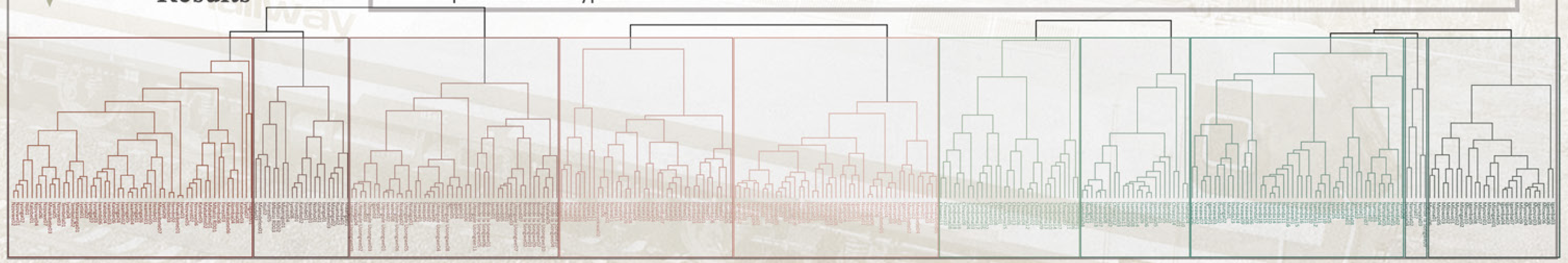
Ⅰ Data Processing » The pre-arranged database was imported into **Rstudio** software, and appropriate clustering methods were selected for data processing and analysis, taking into account the characteristics of each type of data.

Ⅱ Computational Matrix » Landscape characterisation data were collected for the study area and **Tanzania data matrix** and **Zambia data matrix** were created separately.

Ⅲ Calculate the Distance Matrix » Calculate the distance between each pair of data points using the ***dist( )*** function.For continuous variable data sets, the **manhattan (Manhattan distance) algorithm** was used to calculate the distance matrix; for binary data sets, the **euclidean (European distance) algorithm** was used to calculate the distance matrix.

Ⅳ Hierarchical Clustering » Hierarchical clustering using **ward.D2 linkage** algorithm.

Ⅴ Visualisation of Clustering Results » Use the **ggtreeExtra package** to visualise the clustering results and visually map the clustered landscape feature areas onto the **GIS**. Through the **Silhouette Coefficient** (SC), the distribution of landscape feature areas on the map and the field photos, we finally determined that there are **10** landscape character types in the study area. Of these, eight landscape character types were in Tanzania and two in Zambia.



TECHNICAL ROUTE

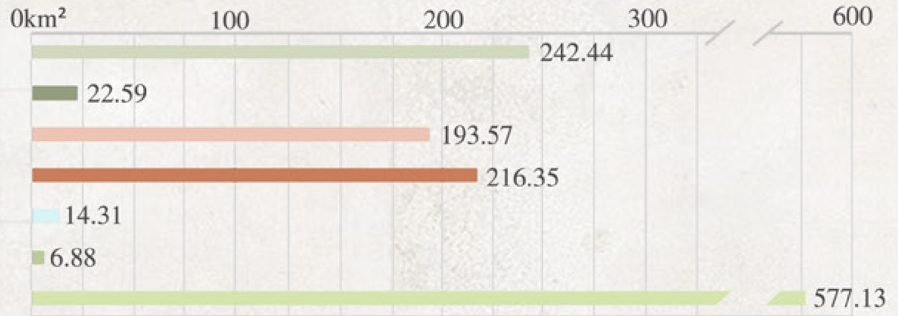
LANDSCAPE CHARACTER RECOGNITION: NATURAL CHARACTERS

RESEARCH AREA:1273.27KM²

CATEGORY
- Agriculture land
- Deciduous broadleaf forest
- Rural settlement
- Urban area
- Rivers&lakes
- Bush
- Meadow

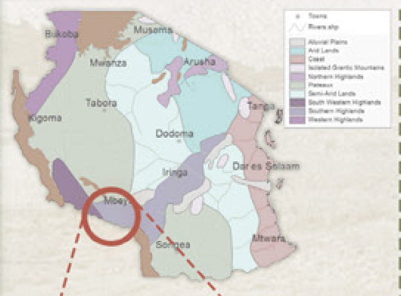
LANDCOVER

The study area is generally distributed with a large amount of farmland, among which the deciduous forests are widely distributed in Mbozi District of Songwe Region. These deciduous forest areas provide rich vegetation cover for the local ecosystem, while in the eastern Mbeya Region, Mbeya Rural District, there are large meadows. In addition, a small number of urban areas are mainly concentrated in Mbeya Urban District of Mbeya Region.



PROPORTION
- 0.0000-0.1228
- 0.1228-0.3607
- 0.3607-0.6368
- 0.6368-0.8499
- 0.8499-1.0000

CULTIVATED LAND



As Mponda Malozo, Master of Science in Agro-Environmental Management of Food and Agriculture Organisation of the United Nations, pointed out in Agriculture Climate Resilient Plan in 2014, the research area basically belongs to the southern highland agricultural ecological area.

SOUTH-WESTERN HIGNLANDS 2%

SOUTHERN HIGNLANDS 98%

PROPORTION
- 0.0000-0.0614
- 0.0614-0.2118
- 0.2118-0.4502
- 0.4502-0.7804
- 0.7804-1.0000

FOREST LAND

MAIN EXPORT TREE SPECIES

Pinus palustris Mill. 30-40m

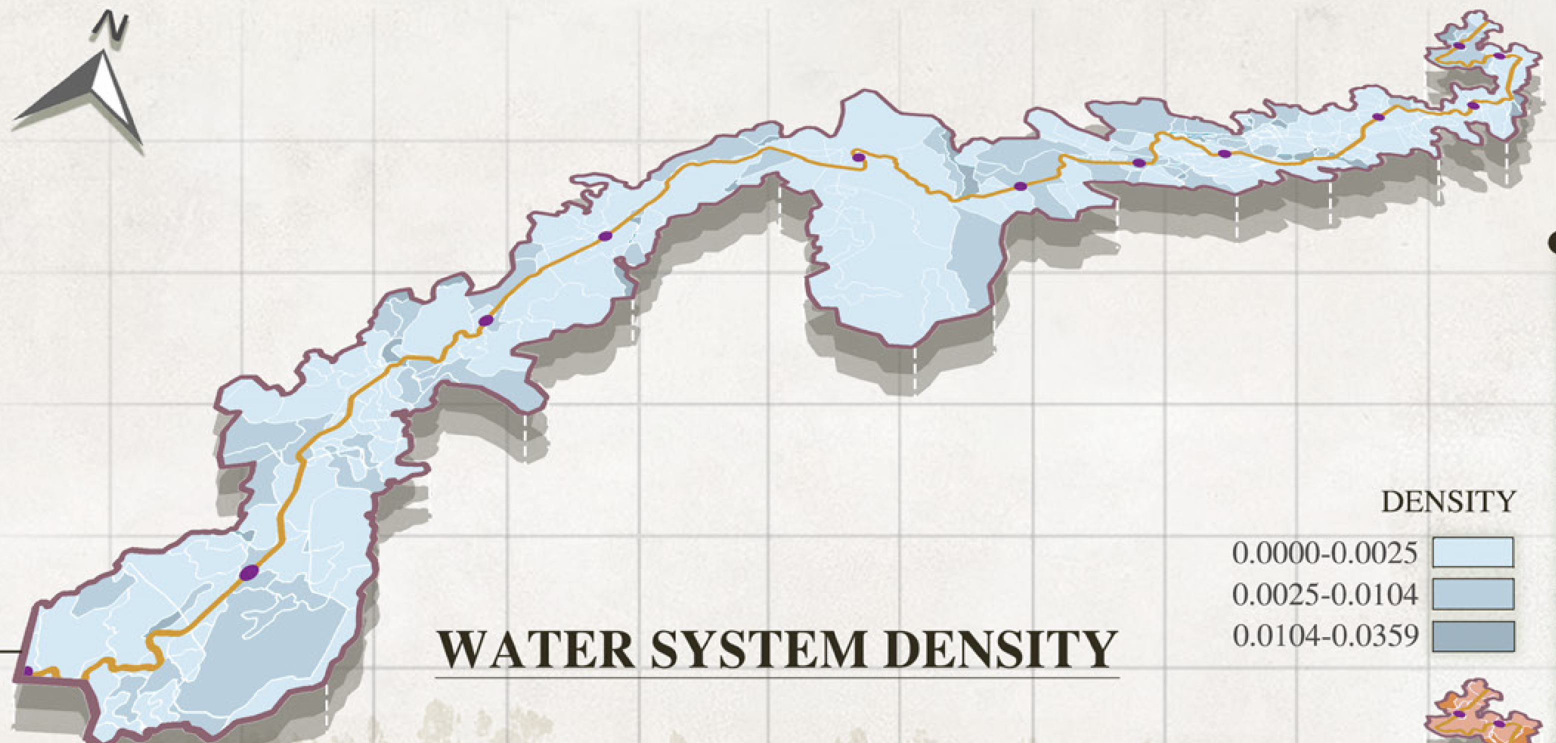
It is an important economic tree species, mainly used for timber and pulp production, with high economic value and ecological adaptability.

Eucalyptus Spp. 30-50m

It can be used in industries such as pulp and paper, wood-based panels and construction, and can also be used as biomass energy and produce by-products such as eucalyptus oil.

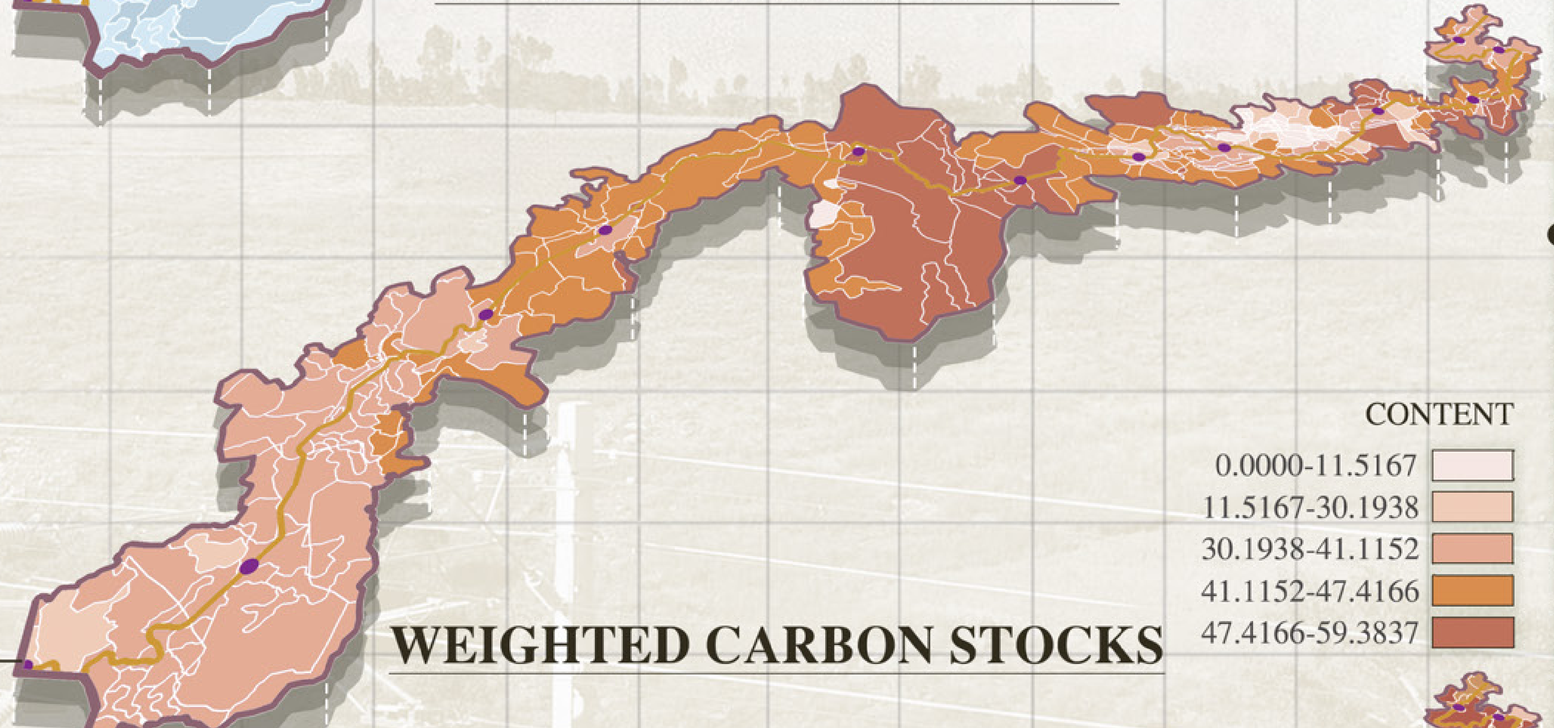
Tectona grandis L. f. 40-50m

It is often used to make high-end furniture, flooring, and interior and exterior decoration. In addition, it also has certain medicinal value.



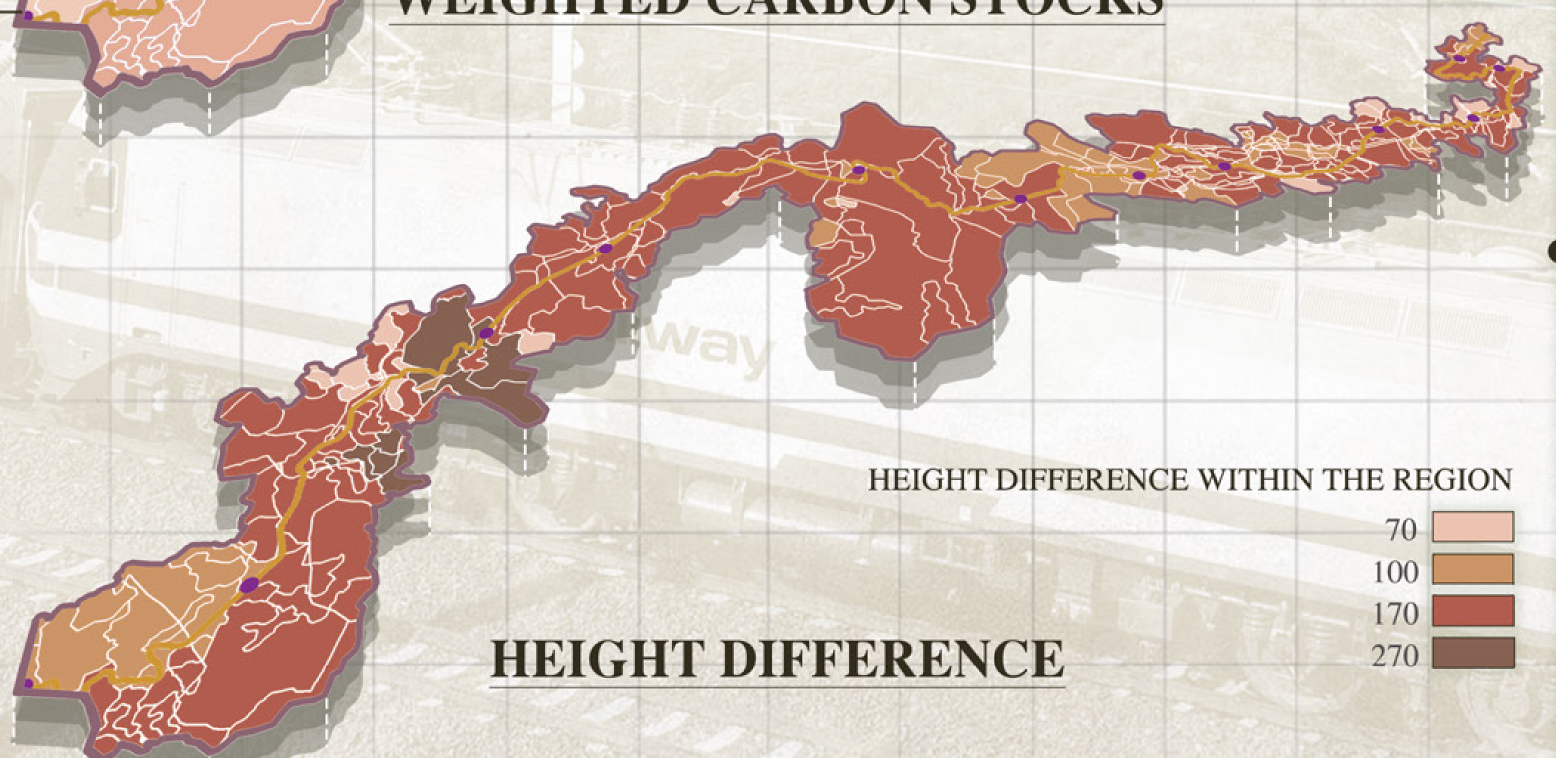
DENSITY
- 0.0000-0.0025
- 0.0025-0.0104
- 0.0104-0.0359

WATER SYSTEM DENSITY



CONTENT
- 0.0000-11.5167
- 11.5167-30.1938
- 30.1938-41.1152
- 41.1152-47.4166
- 47.4166-59.3837

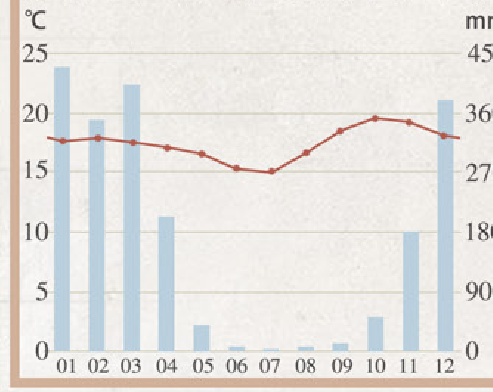
WEIGHTED CARBON STOCKS



HEIGHT DIFFERENCE WITHIN THE REGION
- 70
- 100
- 170
- 270

HEIGHT DIFFERENCE

ATTENTION PLEASE!!!



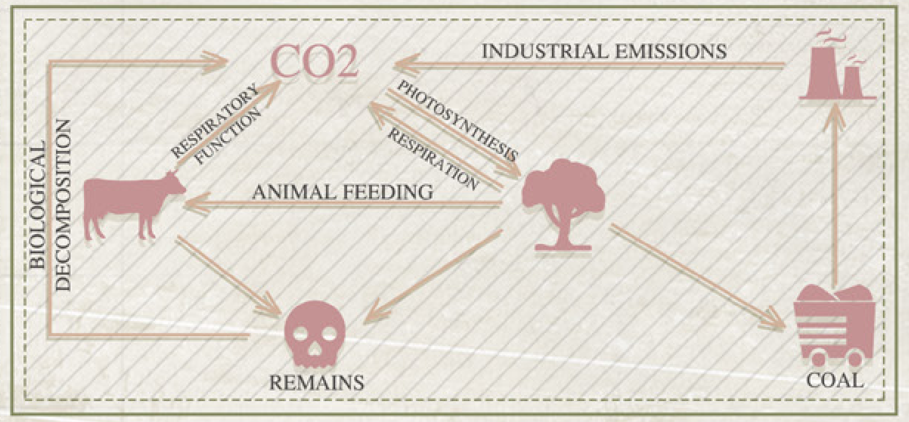
MBEYA MAY FACE DROUGHT RISK AS JUNE IS ON THE CORNER

1361m³ per person

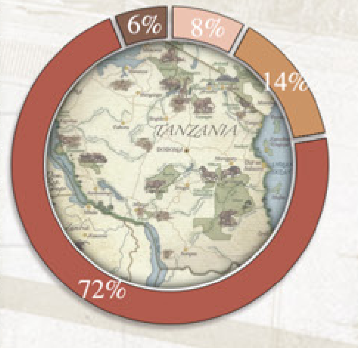
In Tanzania, renewable inland freshwater resources per capita are 1361m³.

50%-75%

The proportion of the population using an improved drinking water source in Mbeya is 50%-75%, which is below the global average.



When planning and designing solutions, the vital carbon cycle in the ecosystem need to be considered. This cycle, which includes plant growth, humus decomposition and soil carbon storage, is not only related to the health and stability of the natural environment, but also a key link in achieving sustainable development and responding to climate change.



- 70M, 8%, mainly urban area, meadow and agriculture land
- 100M, 14%, mainly bush, meadow and agriculture land
- 170M, 72%, mainly meadow, agriculture land and deciduous broadleaf forest
- 270M, 6%, mainly meadow and broadleaf forest

The height difference in the research area is distributed between 70-270 meters, mainly concentrated at 170 meters, and the terrain is relatively flat. Among them, the height difference is the largest in the Vwawa Ward area of the Mbozi District in the Songwe Region.

LANDSCAPE CHARACTER RECOGNITION: CULTURE CHARACTERS

RESEARCH AREA: 1273.27KM²

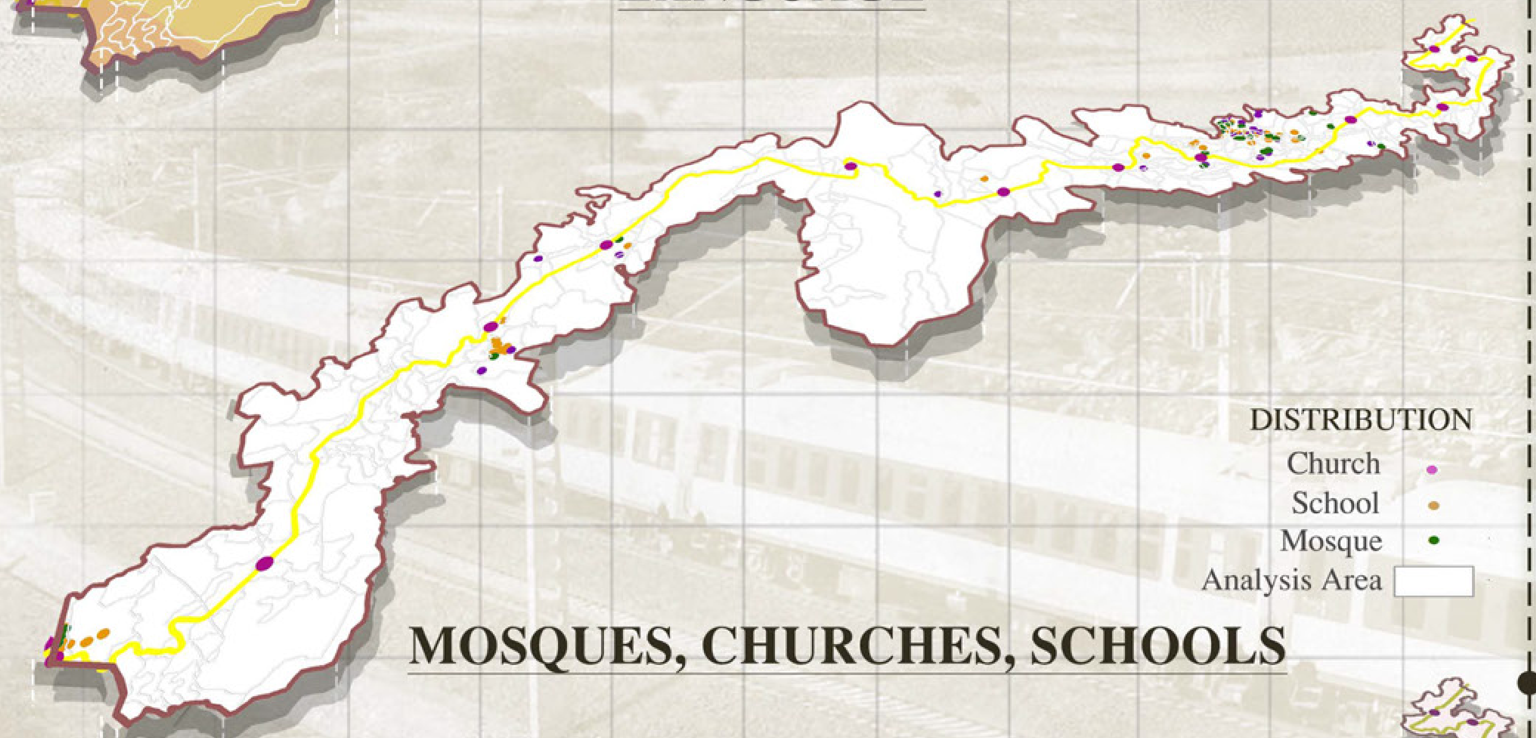
CATEGORY
Bungu
Lambya
Malila
Nyakyusa ndonga
Nyamwange
Nyiha
Safwa
Wanj
Analysis Area

LANGUAGE

The TAZARA

In the reasearch area, there are instances of multiple languages within the same ethnic group. **Kiswahili** is the official language of Tanzania and has become an important tool for national unity and communication. In addition, the widespread use of **English** has facilitated exchanges and cooperation between Tanzania and other countries, accelerating economic and cultural integration in the process of globalisation. Such language usage reflects the diversity and openness of the Tanzanian society and demonstrates the country's endeavour to actively integrate into the global community while maintaining its indigenous culture.

45% Islam
35% Christian
20% Zoroastrianism



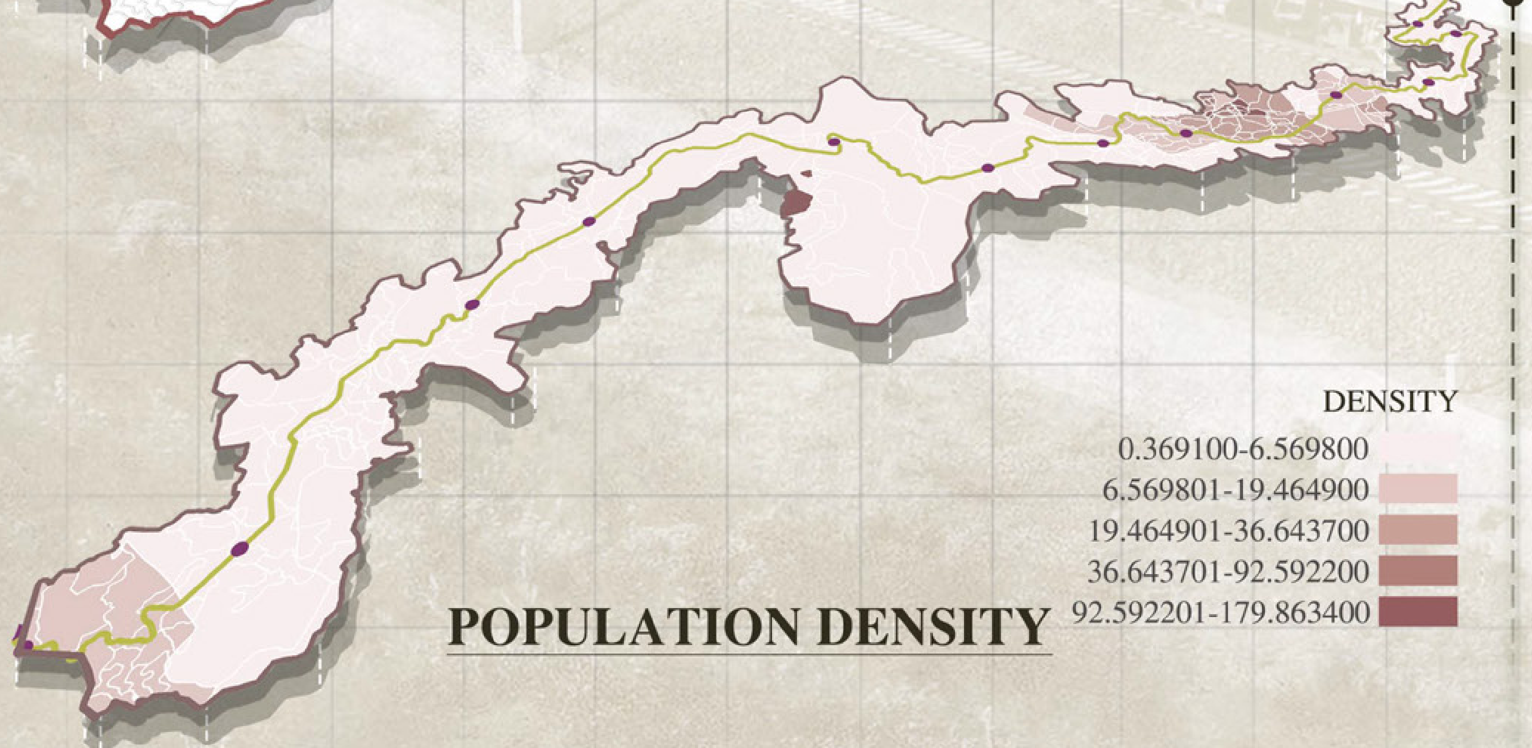
DISTRIBUTION
Church
School
Mosque
Analysis Area

MOSQUES, CHURCHES, SCHOOLS

The Government of Sanja attaches great importance to the development of education, with an adult literacy rate of **90.4%** one of the lowest in Africa, concentrated in urban areas.

At the same time, the Government is constantly improving the infrastructure and quality of education through the construction of new schools, especially in non-urbanised areas, provision of resources for education and support for children from poor families to attend school.

1/3 Muslim



DENSITY
0.369100-6.569800
6.569801-19.464900
19.464901-36.643700
36.643701-92.592200
92.592201-179.863400

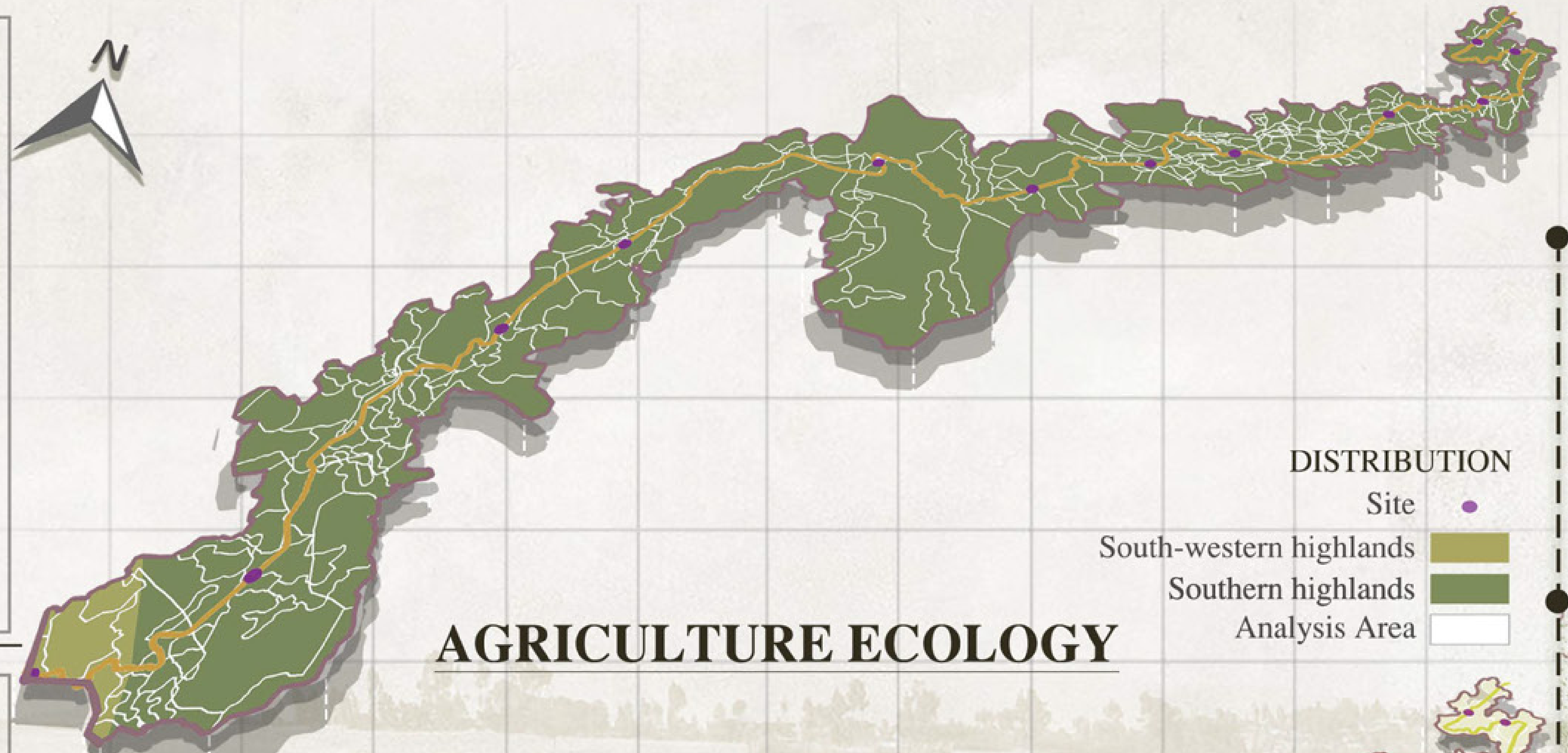
POPULATION DENSITY

Population density in the reasearch area is generally low, with most of the area being predominantly agricultural, and the areas of high population density are concentrated in the urban area of the city of Mbeya, which is highly urbanised.

The regional differences in population density in Mbeya City, the main city in the region, reflect the uneven development between urban and rural areas and also pose a challenge for future planning and development.

32.25% of the urban population in the study area is concentrated in Tomboya

645,000 urban population in Mbeya



DISTRIBUTION
Site
South-western highlands
Southern highlands
Analysis Area

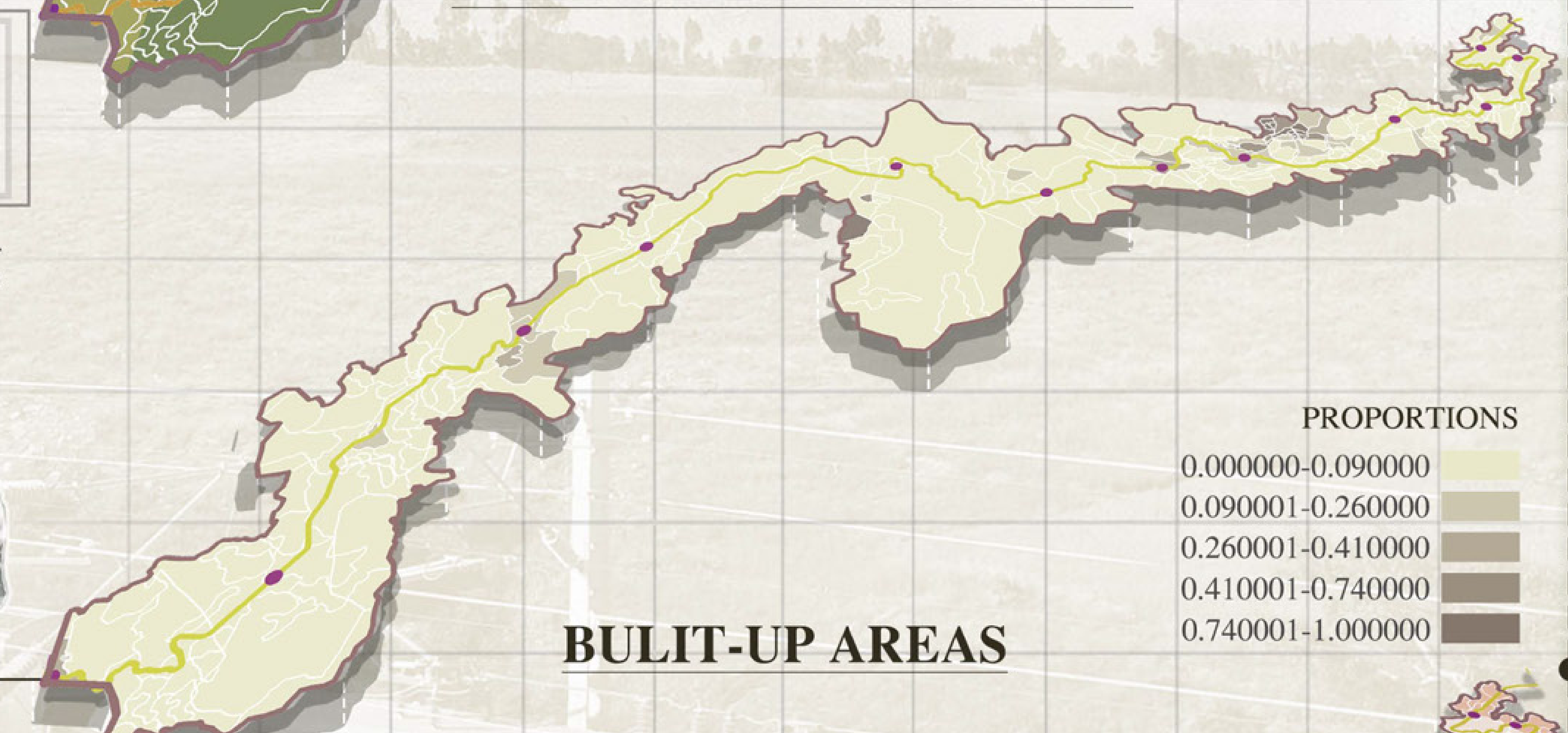
AGRICULTURE ECOLOGY

- Diversification of crop cultivation
- Livestock development in arid zones
- Rice cultivation
- farmland landscape
- ecological diversity

Mbeya--TOWNS FORMED IN THE GOLD

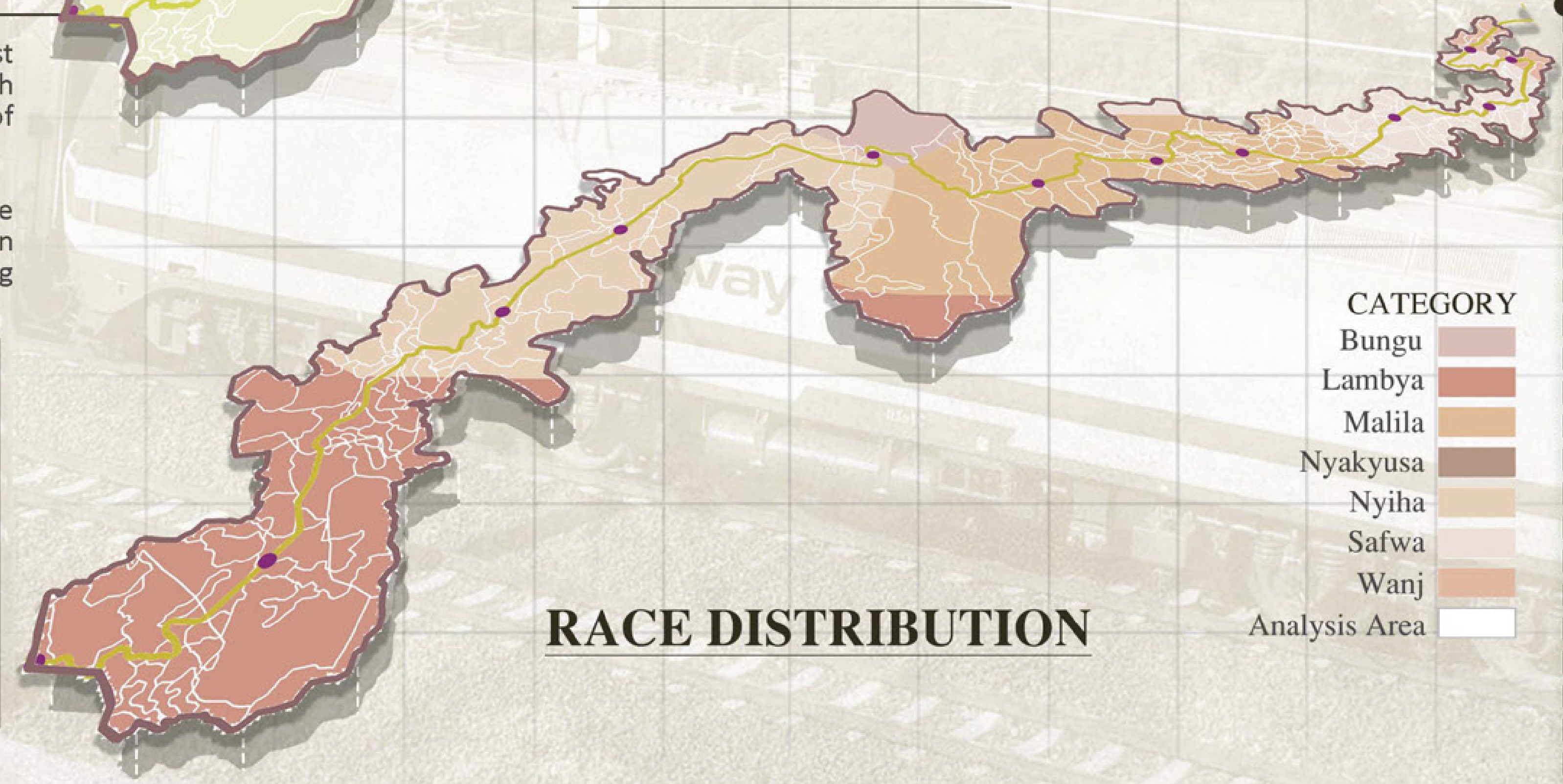
The relatively low proportion of built-up areas in the research area and the concentration of most of the urbanised and developed areas in the Mbeya area is due to the fact that In the 1830s, Mbeya was the scene of the "**gold rush**" and a large number of people settled in the area, giving rise to the present-day concentration of people in Mbeya.

The Mbeya area, being the centre of regional development, has attracted significant infrastructure investment and population concentration. It is an ideal transit point for rail and road transport, and its geographical location and accessibility make it a vital part of the regional transport network.



PROPORTIONS
0.000000-0.090000
0.090001-0.260000
0.260001-0.410000
0.410001-0.740000
0.740001-1.000000

BULIT-UP AREAS



CATEGORY
Bungu
Lambya
Malila
Nyakyusa
Nyiha
Safwa
Wanj
Analysis Area

RACE DISTRIBUTION

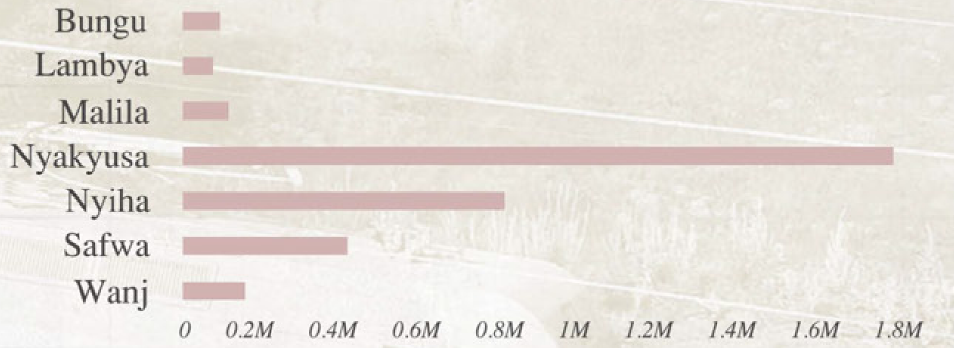


Diagram of population by ethnic group (2023)

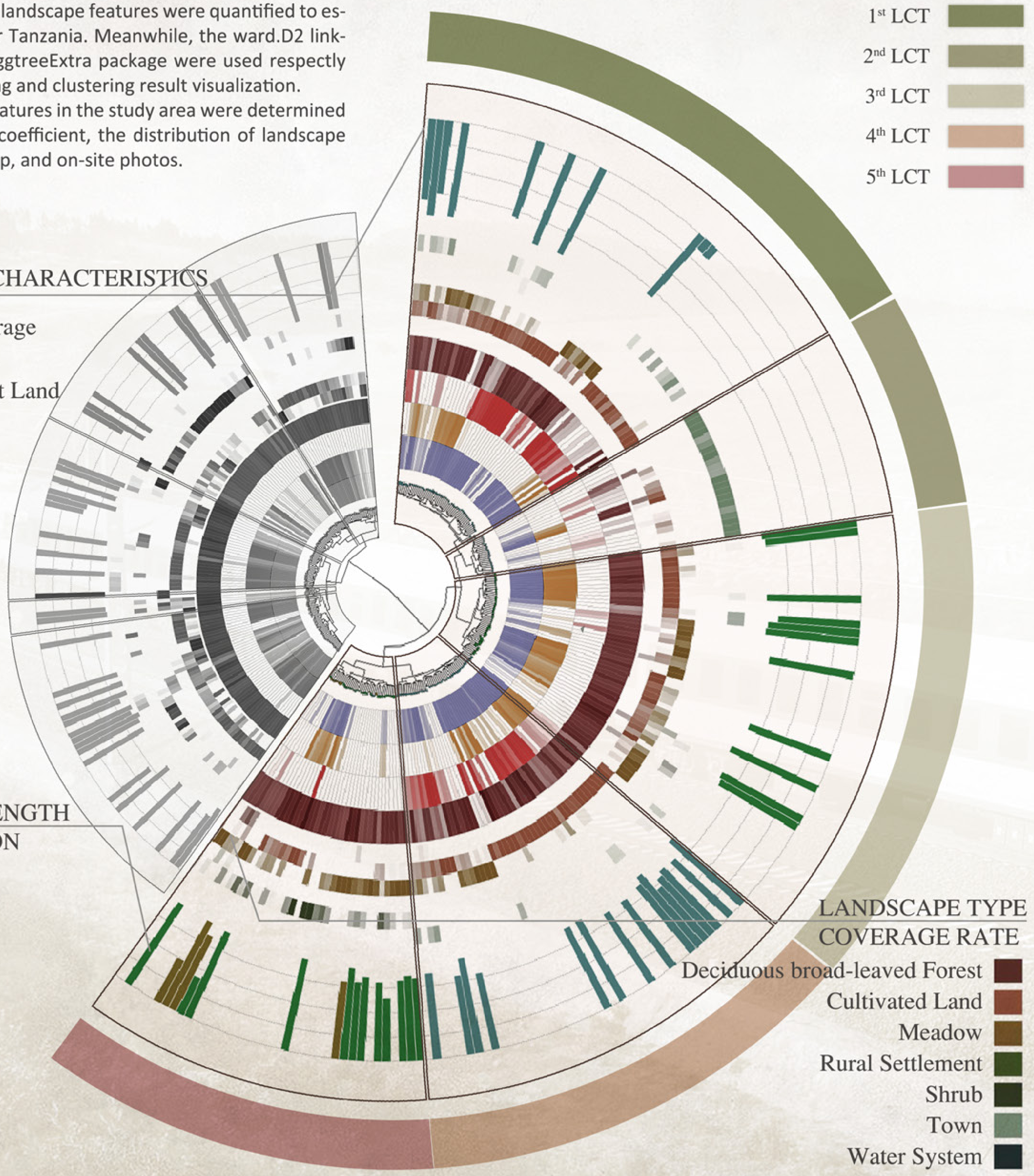
These ethnic groups have settled in towns and villages along the research area, Residents also display their traditional dances, music and cuisine in festivals and celebrations, attracting tourists and other ethnic groups to participate and promoting cross-cultural exchanges and integration. Ethnic diversity is reflected in the behaviour, lifestyle and cultural activities of the residents, enriching the cultural heritage of the region and bringing new opportunities and vitality to local tourism and cultural exchanges.

HIERARCHICAL CLUSTERING ANALYSIS: TEN LANDSCAPE CHARACTER TYPES (LCTs)

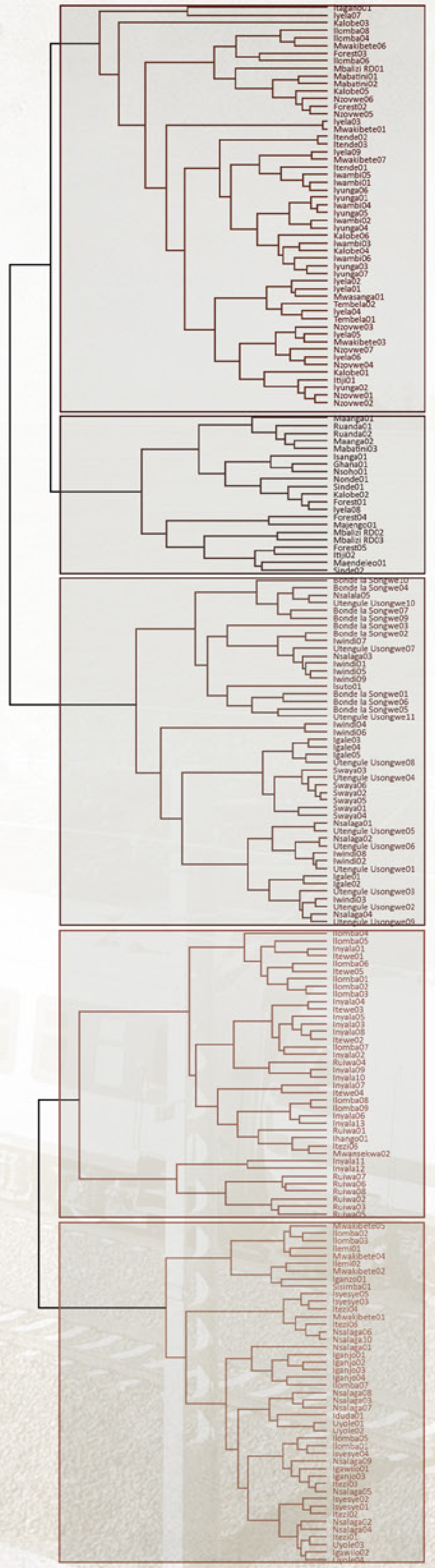
ANALYSIS OF THE 1ST TO THE 5TH LANDSCAPE CHARACTER TYPES

HIERARCHICAL CLUSTERING

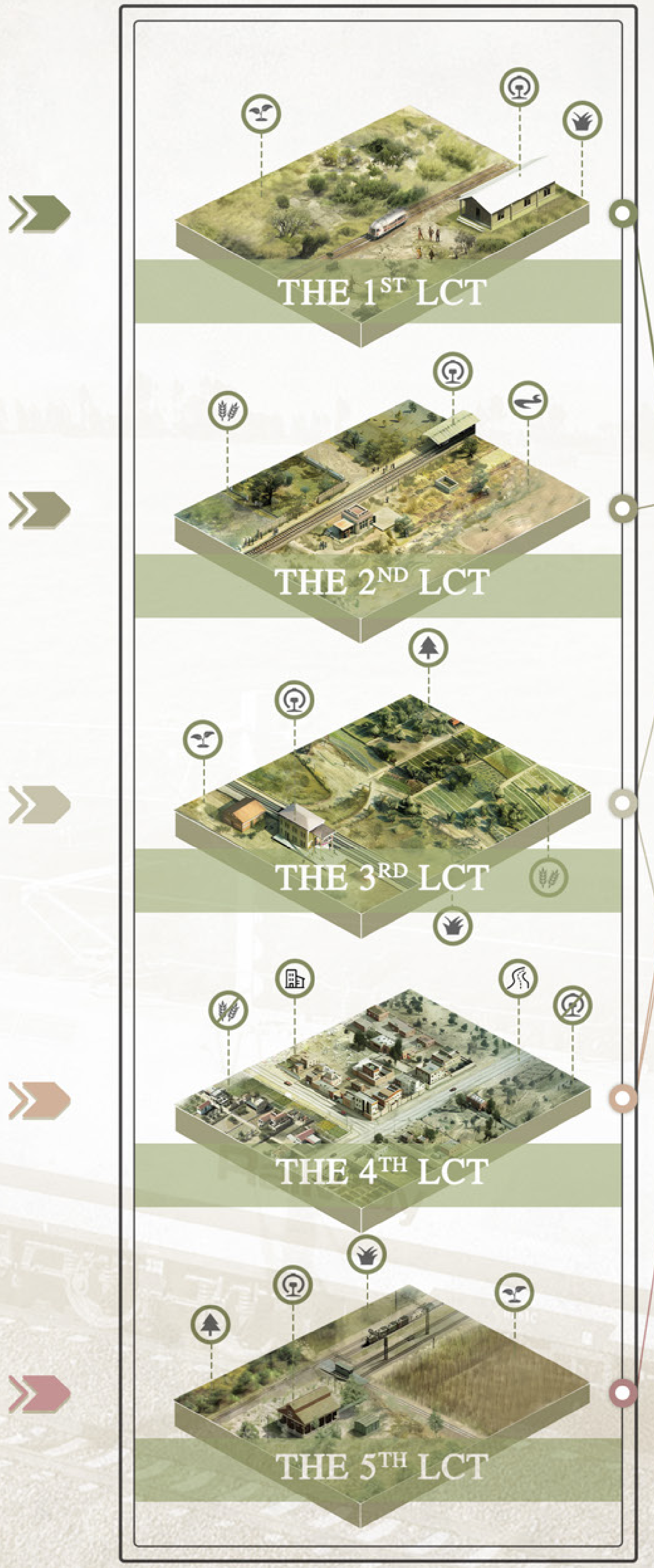
The natural and cultural landscape features were quantified to establish a data matrix for Tanzania. Meanwhile, the ward.D2 linkage algorithm and the ggtreeExtra package were used respectively for hierarchical clustering and clustering result visualization. 10 types of landscape features in the study area were determined through the silhouette coefficient, the distribution of landscape feature areas on the map, and on-site photos.



CLUSTER



LCTs



STRATEGIES

1.ECOLOGICAL RESTORATION

Plant native tree species that are adapted to the local ecological environment in deforested or degraded forest areas to rebuild forest ecosystems. Plant native grass species on degraded grasslands and conduct grassland management to restore natural grassland ecosystems.

Establish ecological protection areas or nature reserves to limit human activities from interfering with the natural environment. Set up wildlife passages along railways, such as ecological bridges and tunnels, to reduce the obstruction of railways to biological migration.

Remove trash and harmful pollutants from wetlands and restore them to their natural state. Restore the natural flow of water in wetlands by building dams or opening waterways to keep wetlands moist and promote biodiversity.

2. LANDSCAPE ENHANCEMENT ALONG THE RAILWAY

Wasteland reclamation planning: Carry out detailed land planning and assessment of wasteland along the railway to determine suitable crops and breeding projects. Build agricultural product processing plants or cooperatives along the railway to provide agricultural product processing services.

Combining AR technology with digital maps provides navigation and location information of landscape feature areas and ethnic settlements along the railway, allowing tourists to explore local landscape features and cultural heritage more conveniently.

Theme park: Build theme parks related to railway culture or local characteristics at suitable locations to enrich the landscape along the line.

Protection of cultural relics: protect and restore cultural relics and historical buildings along the line, set up exhibition areas at railway stations or along the line to display local traditional culture and handicrafts to enhance cultural appeal.

3.TRANSPORTATION REVITALIZATION

Upgrading and repairing existing roads and building new sections will allow rail stations to seamlessly connect to the main highway system.

Suitable areas are selected along the railway as planting bases for economic crops such as sisal and cashews, and modern agricultural technologies are used to improve planting efficiency and yield.

According to the needs of residents along the line and logistics needs, new railway stations will be built in convenient locations to improve the coverage of railway services. Existing railway stations will be updated and renovated to enhance the travel experience of passengers.

4.CULTURAL DIVERSITY ENHANCEMENT

Identification of settlement sites: Encourage local communities to participate in the identification of old settlement sites and collect oral history and folklore data to supplement official surveys.

Protection of settlement sites: Based on the importance of the old settlement sites, protection areas are demarcated and signs are set up to restrict unauthorized construction and development activities.

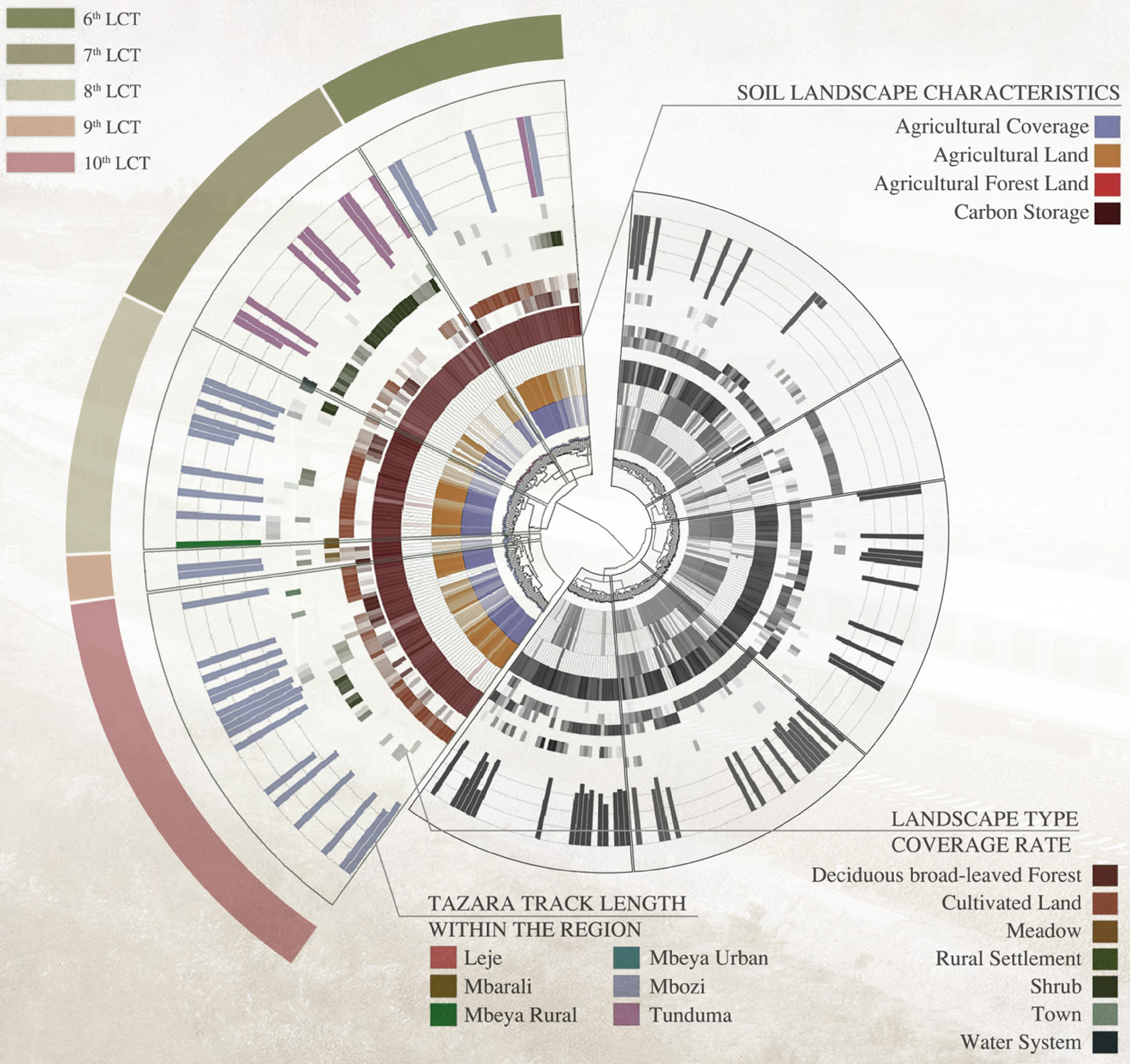
Education at settlement sites: Carry out cultural heritage education projects and integrate the protection and restoration of old settlement sites into the education system of schools and communities.

Cultural centers will be established in major communities along the railway, and cultural concerts and cultural festivals will be held regularly to promote understanding and interaction between different cultures.

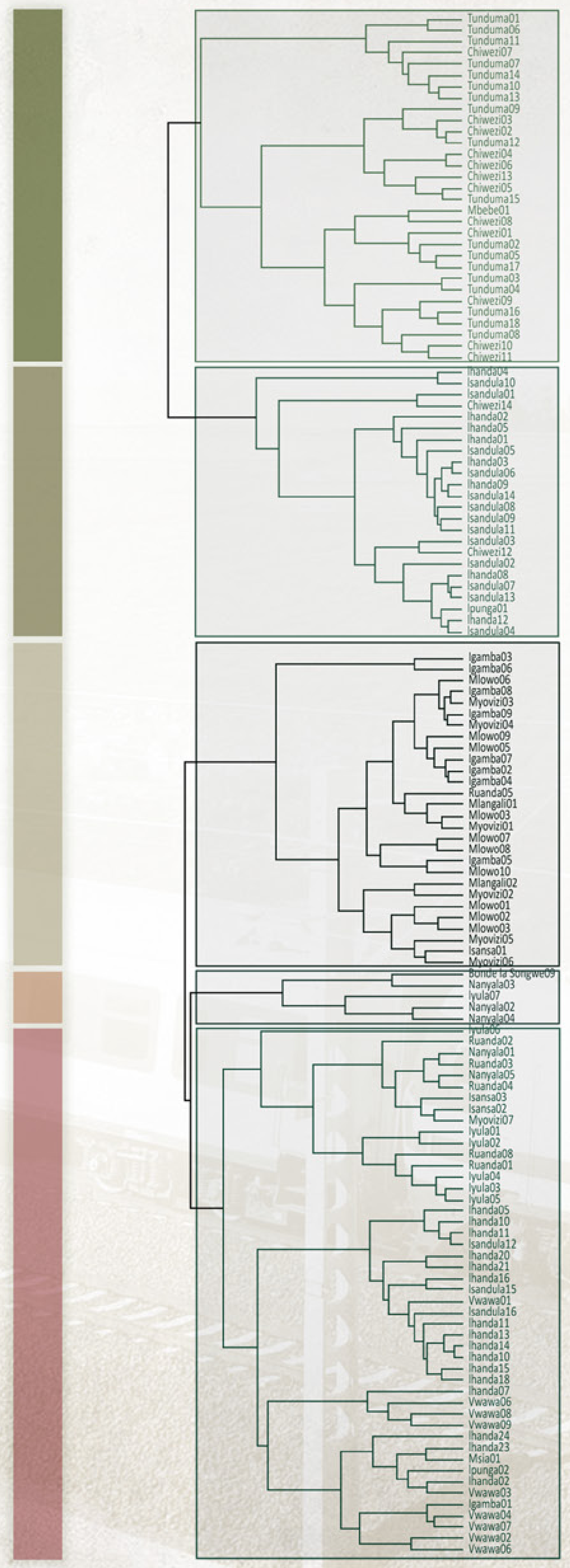
HIERARCHICAL CLUSTERING ANALYSIS: TEN LANDSCAPE CHARACTER TYPES (LCTs)

ANALYSIS OF THE 6TH TO THE 10TH LANDSCAPE CHARACTER TYPES

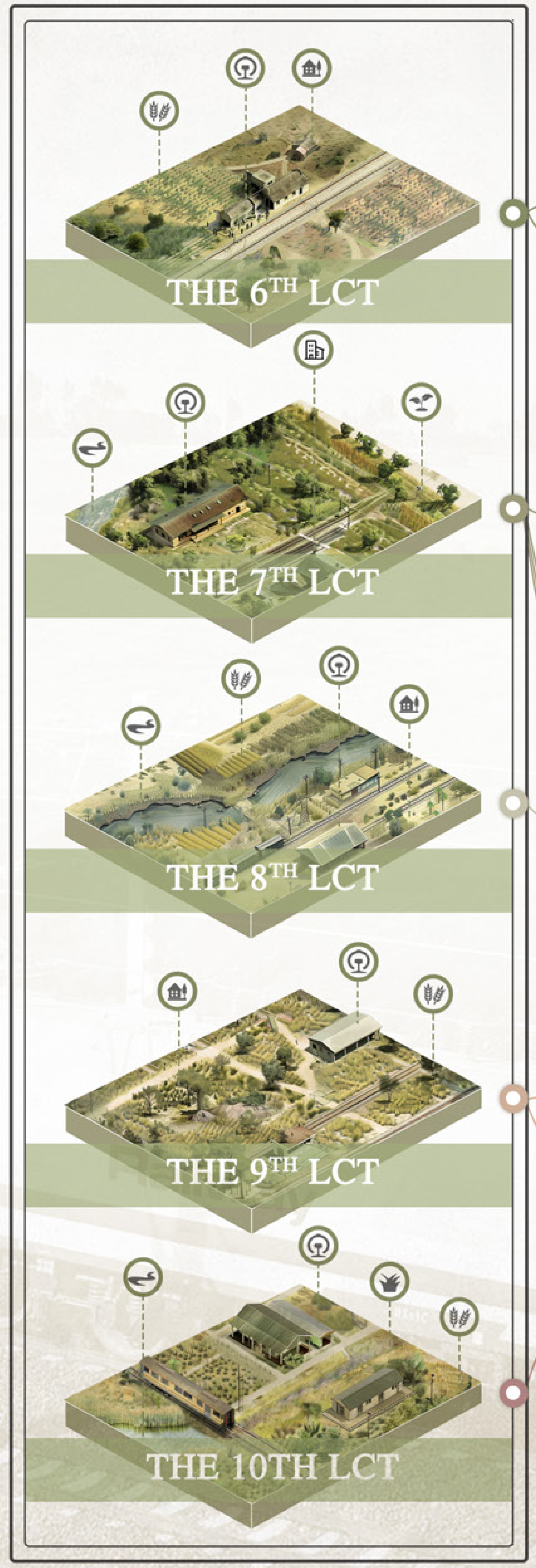
HIERARCHICAL CLUSTERING



CLUSTER



LCTs



STRATEGIES

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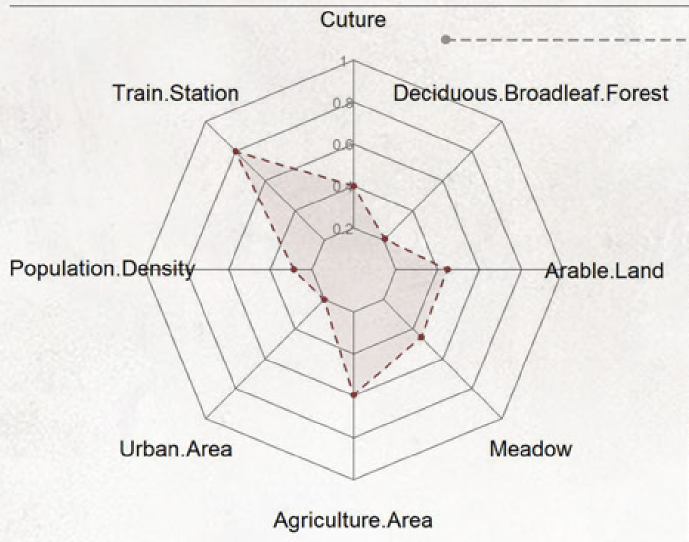
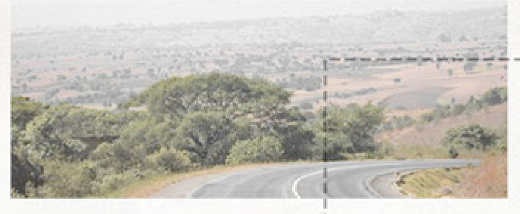
LANDSCAPE CHARACTER RECOGNITION: CLUSTER ANALYSIS

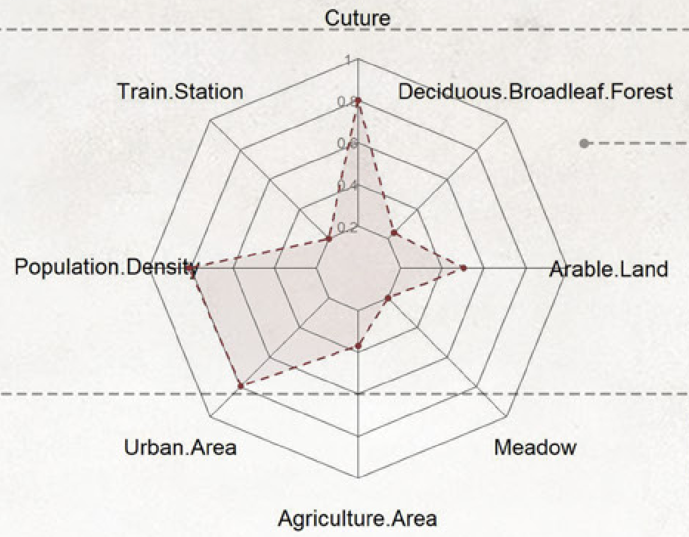
LANDSCAPE CHARACTER TYPE 1



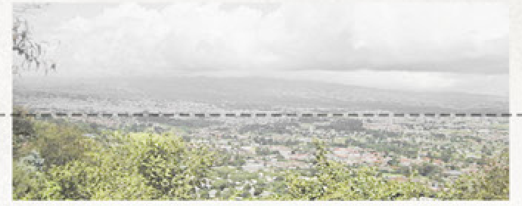
Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Mbeya	Mbeya Rural	Ijombe
Mbeya	Mbeya Rural	Inyala
Mbeya	Mbeya Rural	Ihango
Mbeya	Mbeya Rural	Itezi
Mbeya	Mbarali	Ruiwa



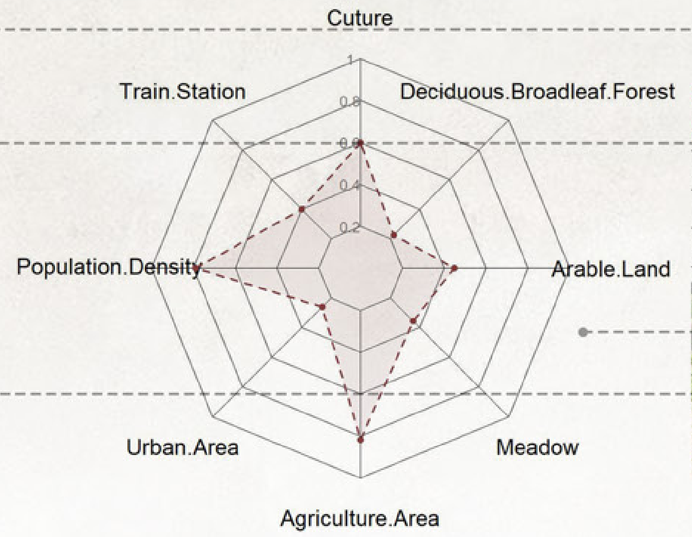
LANDSCAPE CHARACTER TYPE 4



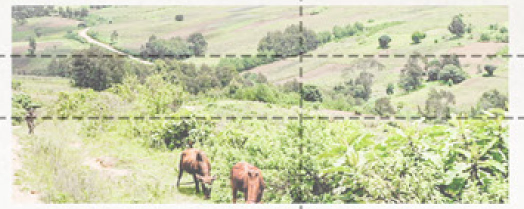
Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Mbeya	Mbeya Urban	Forest
Mbeya	Mbeya Urban	Kalobe
Mbeya	Mbozi	Ruanda



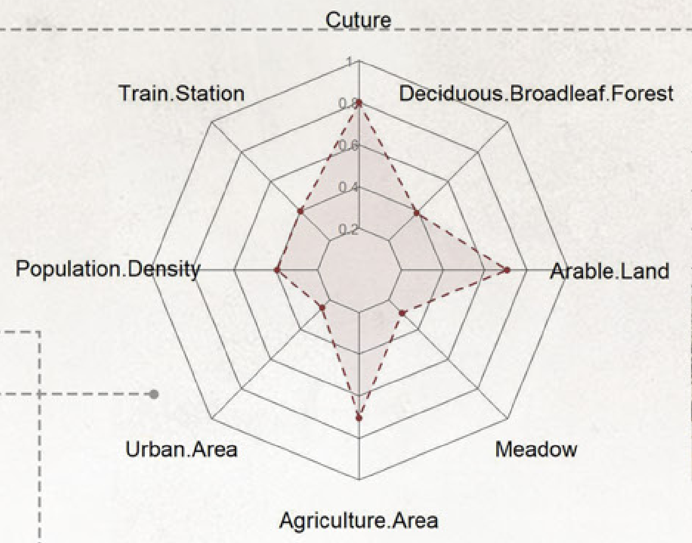
LANDSCAPE CHARACTER TYPE 6



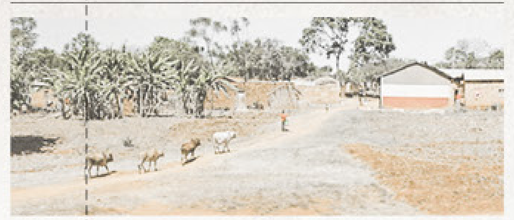
Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Mbeya	Mbeya Urban	Ilomba
Mbeya	Mbeya Urban	Uyole
Mbeya	Mbozi	Nsalaga



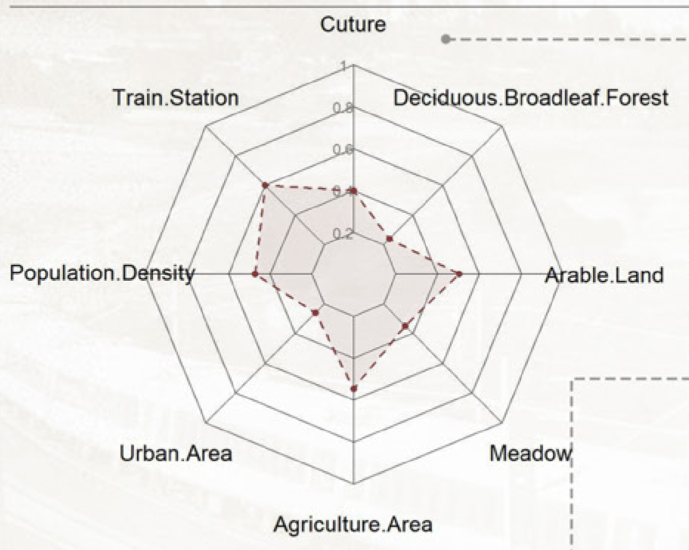
LANDSCAPE CHARACTER TYPE 8



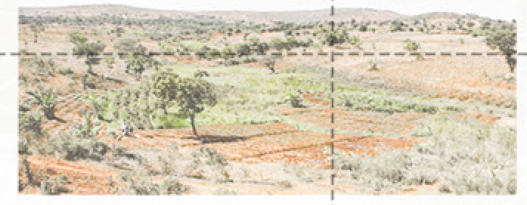
Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Songwe	Mbozi	Ihanda
Songwe	Tunduma	Isandula
Songwe	Ileje	Vwawa



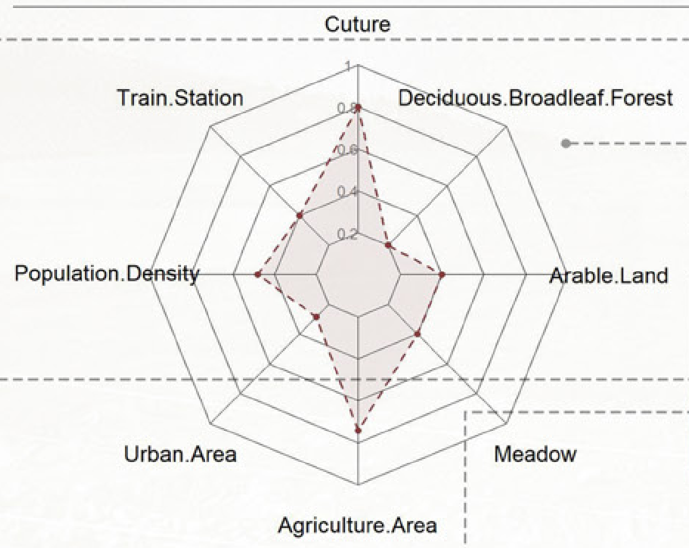
LANDSCAPE CHARACTER TYPE 2



Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Mbeya	Mbeya Rural	Utengule Usongwe
Mbeya	Mbeya Rural	Nsalala
Mbeya	Mbeya Rural	Bonde la Songwe
Mbeya	Mbeya Urban	Iwindi

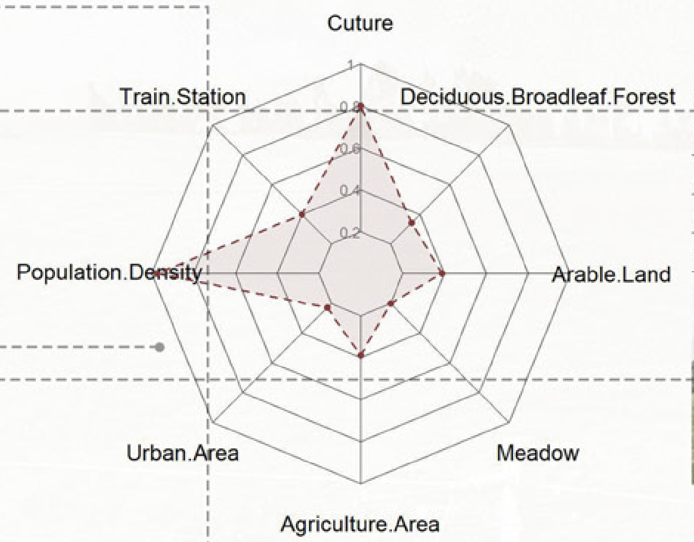


LANDSCAPE CHARACTER TYPE 5



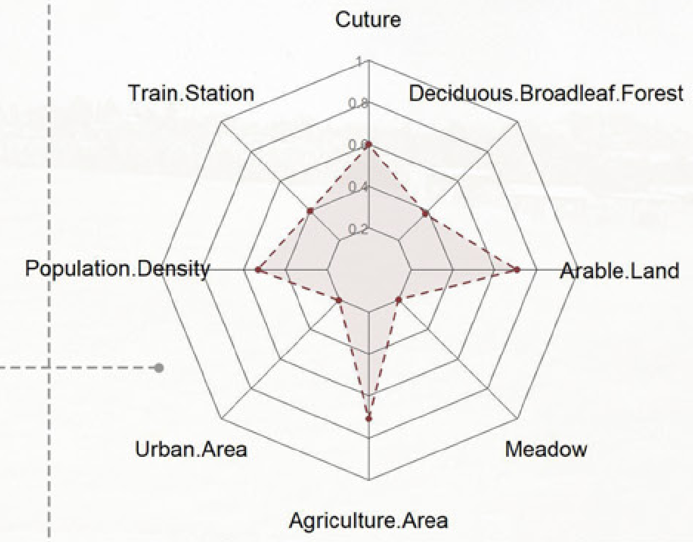
Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Mbeya	Mbeya Urban	Iyela
Mbeya	Mbeya Urban	Lyunga
Mbeya	Mbozi	Nzovwe

LANDSCAPE CHARACTER TYPE 7

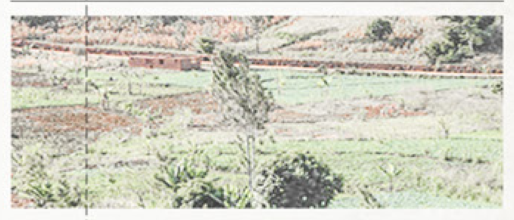


Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Songwe	Tunduma	Tunduma
Songwe	Tunduma	Chiwezi
Songwe	Ileje	Mbebe

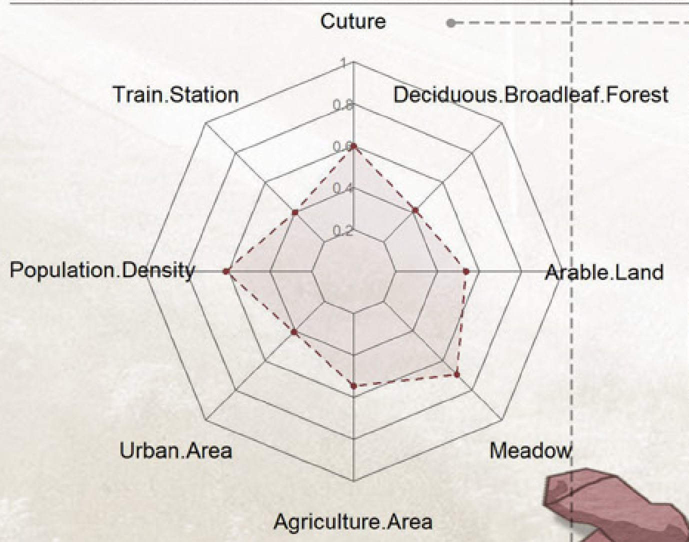
LANDSCAPE CHARACTER TYPE 9



Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Songwe	Mbozi	Mlowo
Songwe	Mbozi	Igamba
Songwe	Mbozi	Mlangali

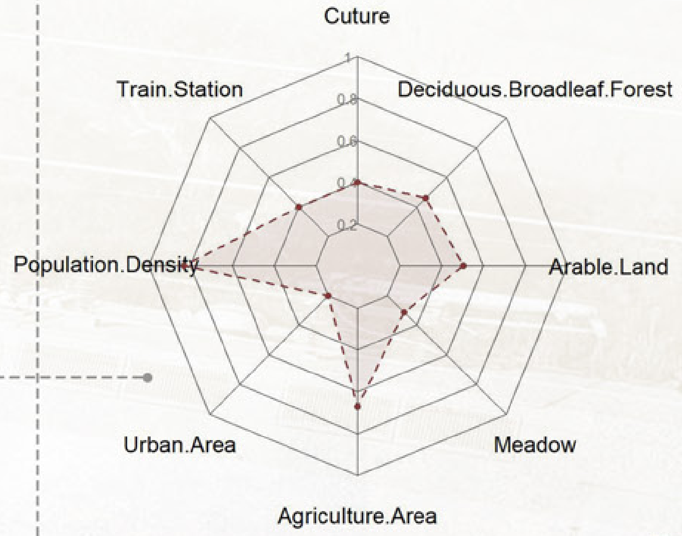


LANDSCAPE CHARACTER TYPE 3



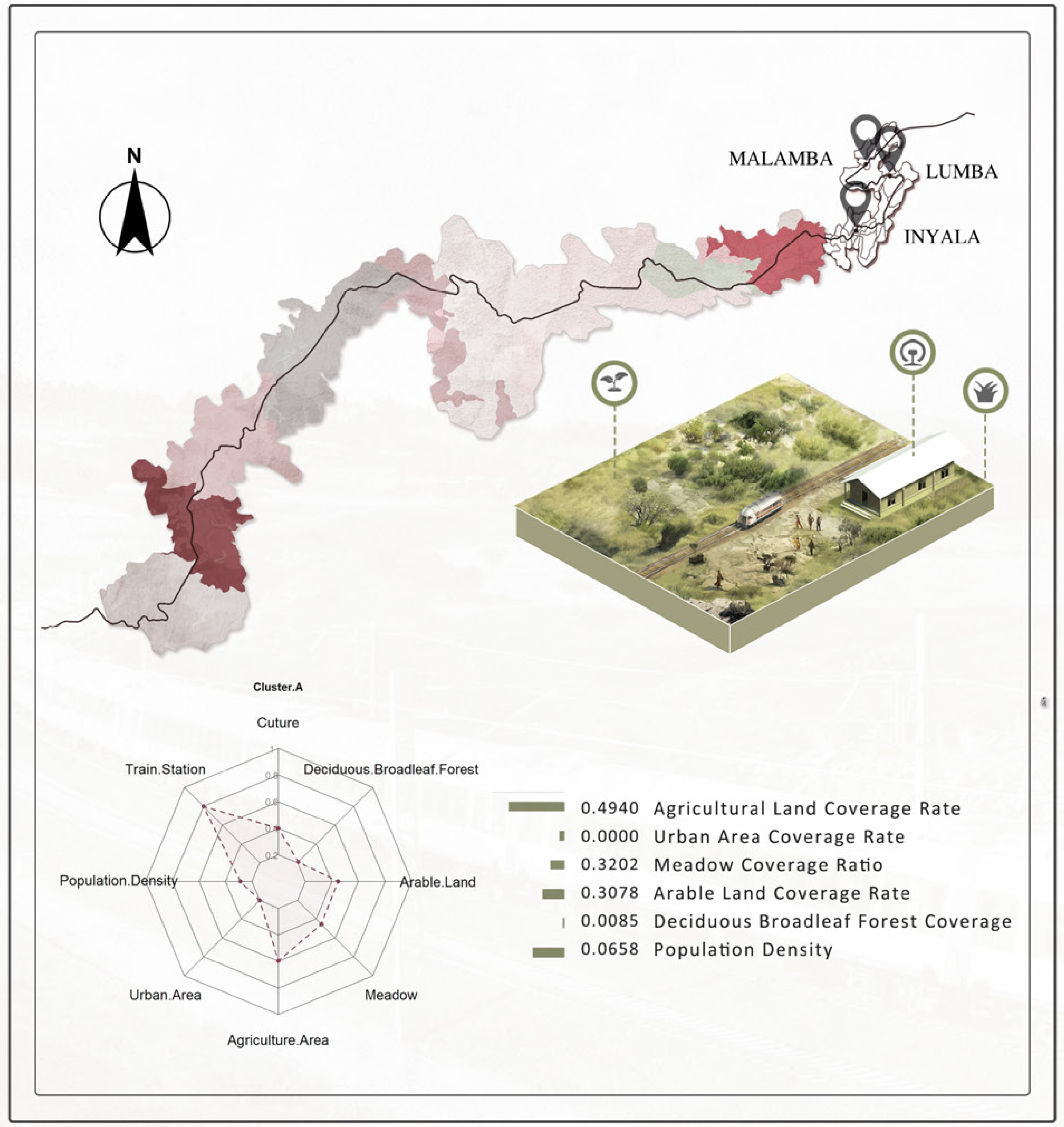
Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Mbeya	Mbeya Rural	Bonde la Songwe
Mbeya	Mbozi	Nanyala
Mbeya	Mbozi	Iyula

LANDSCAPE CHARACTER TYPE 10



Region (Mkoa)	District (Halmashauri)	Ward (Kata)
Songwe	Mbozi	Ihanda
Songwe	Mbozi	Isandula
Songwe	Tunduma	Chiwezi

THE 1ST LANDSCAPE CHARACTER TYPE:
AREA WITH SAFWA CULTURE AND EXPANSIVE FARMLAND



CLTURE PRESERVATION AND PROMOTION

The predominant ethnicity and language in this area is SAFAWA, a Bantu ethnic group residing primarily in the Mbeya region of Tanzania. The Safwa people are mainly engaged in agriculture, cultivating crops such as maize, beans, potatoes, and bananas, and raising livestock including cattle, sheep, and chickens. This agricultural lifestyle forms the backbone of their economy and sustains their community.

The Safwa people possess a rich and vibrant traditional culture that encompasses music, dance, and handicrafts. Music and dance hold significant importance in their daily lives and play a central role in various ceremonies and celebrations, including weddings, funerals, and other key events. Traditional Safwa instruments, such as drums, string instruments, and xylophones, are integral to these cultural expressions, providing a unique and distinctive sound that characterizes Safwa music.

Despite the pressures of modernization, which pose significant challenges to their traditional way of life, the Safwa people are dedicated to preserving and passing on their cultural heritage. They actively engage in efforts to maintain their customs and traditions, ensuring that the younger generations understand and appreciate their cultural roots. This commitment to cultural preservation is evident in their ongoing participation in traditional practices and their efforts to adapt these practices to the contemporary context without losing their essence.

THE 2ND LANDSCAPE CHARACTER TYPE:
AREA WITH EXTENSIVE MEADOWS AND PATCHES OF FARMLAND

AGRICULTURAL LANDSCAPE BELT & TOURISM EXPERIENCES

The land cover in this area is predominantly extensive meadow, creating a vast, open landscape that is both picturesque and ecologically significant. Interspersed within these meadows are patches of deciduous broadleaf forests, adding diversity to the region's natural environment and providing habitats for various species of flora and fauna. These forests contribute to the area's rich biodiversity and offer a contrast to the expansive grasslands.

Agricultural land is mainly distributed in the southwestern region, where the fertile soil supports the growth of various crops. This area is a vital part of the local economy, as it sustains the livelihoods of many residents through farming activities. The agricultural practices here are well-integrated with the natural landscape, ensuring sustainable use of the land.

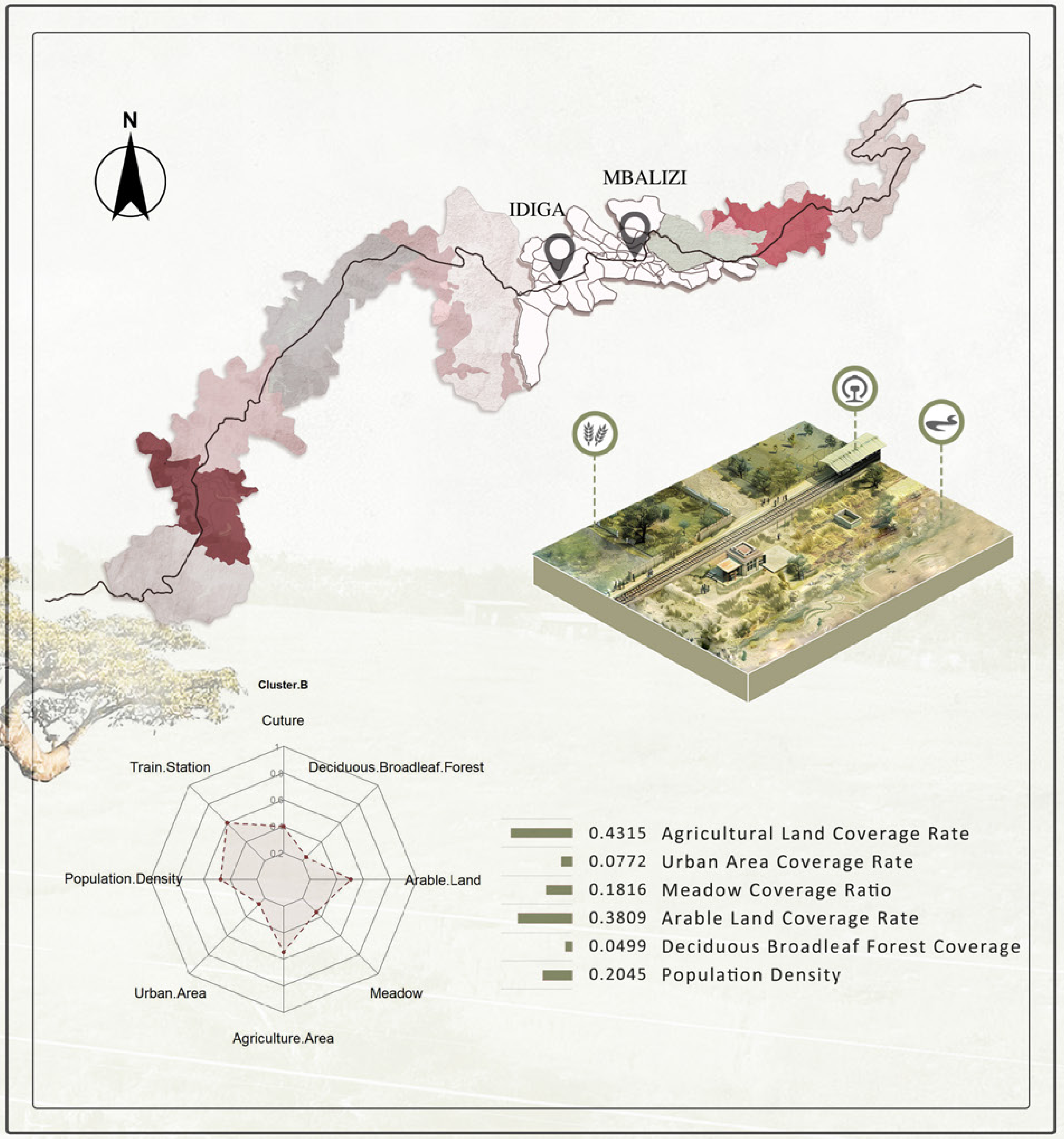
The region is served by two Tazara railway stations, which provide convenient transportation options for both people and goods. This infrastructure is crucial for connecting the area to other parts of the country and beyond, facilitating trade and movement.

The production resources in this area are primarily focused on agriculture, particularly from the Southern Highlands. The emphasis on agricultural production highlights the region's strength in this sector, although it lacks significant mineral resources. This focus on agriculture shapes the local economy and influences the way land and resources are managed and utilized.

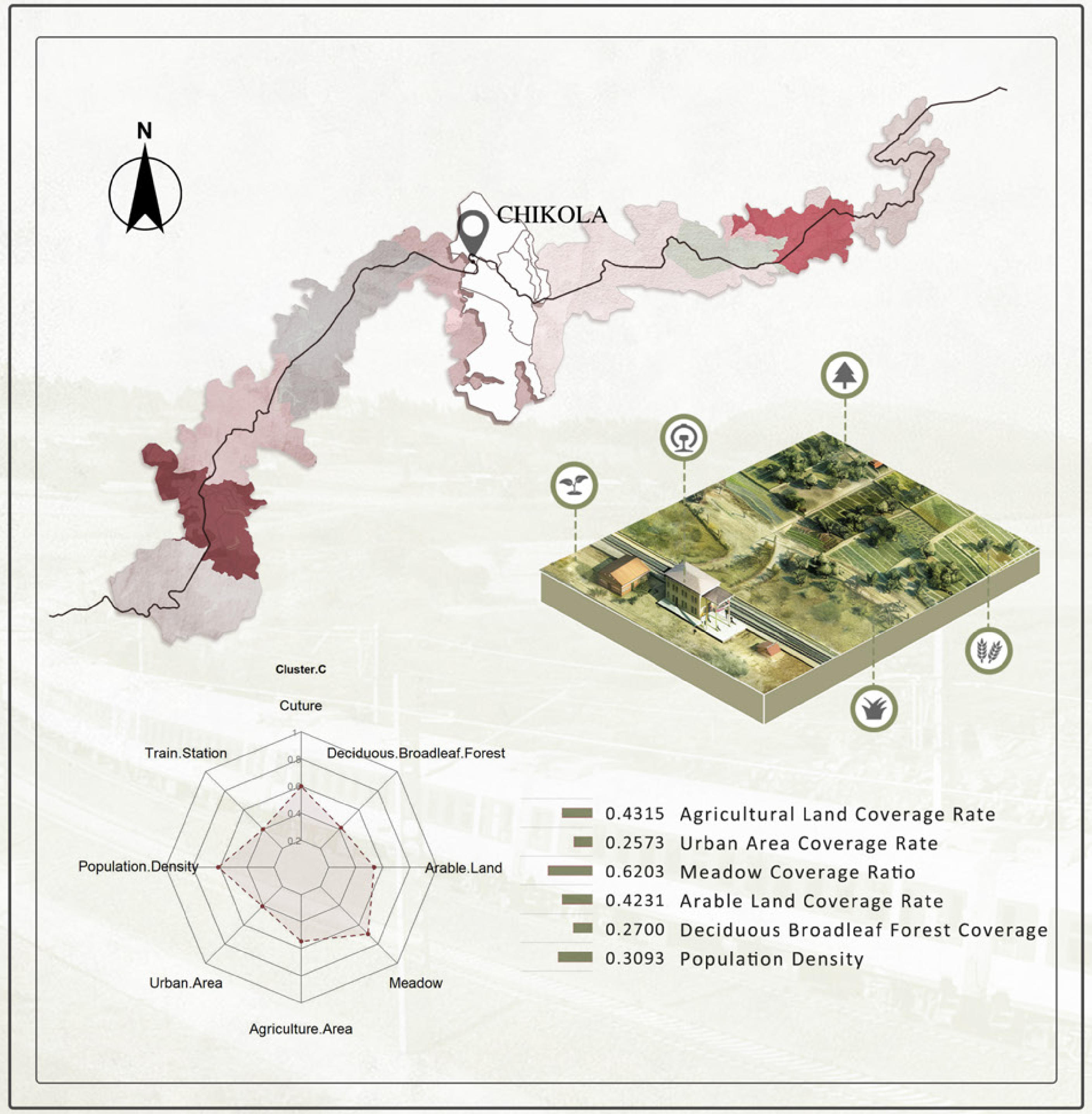
Promote the exhibition and sale of local agricultural products

Enrich cultural activities for the local residents

Enhance the convenience of station transportation



THE 3RD LANDSCAPE CHARACTER TYPE:
AREA WITH HILLY TERRAIN AND HIGH LEVELS OF URBANIZATION.



CULTURE INTERACTION & CULTURE PRESERVATION

In recent years, there has been rapid population growth within this area, with a total population ranging between 40,000 and 50,000. The majority of residents in the region are Malila, who speak the Malila language, while the northern inhabitants are Safwa, who speak the Safwa language.

Promote Cultural Exchange

Establish Cultural Markets
Set up regular cultural markets where different ethnic groups can showcase their traditional crafts, foods, music, and dances.

Digital Exhibitions:
Create online platforms that feature digital exhibitions of various East African cultures, which can include virtual tours of cultural sites, digital galleries of traditional art, and recorded performances of traditional music and dance.

Cultural Exchange Programs:
Implement exchange programs where individuals from different cultural backgrounds can visit other communities, participate in local events, and learn about different traditions and ways of life.

Preserve Cultural Characteristics

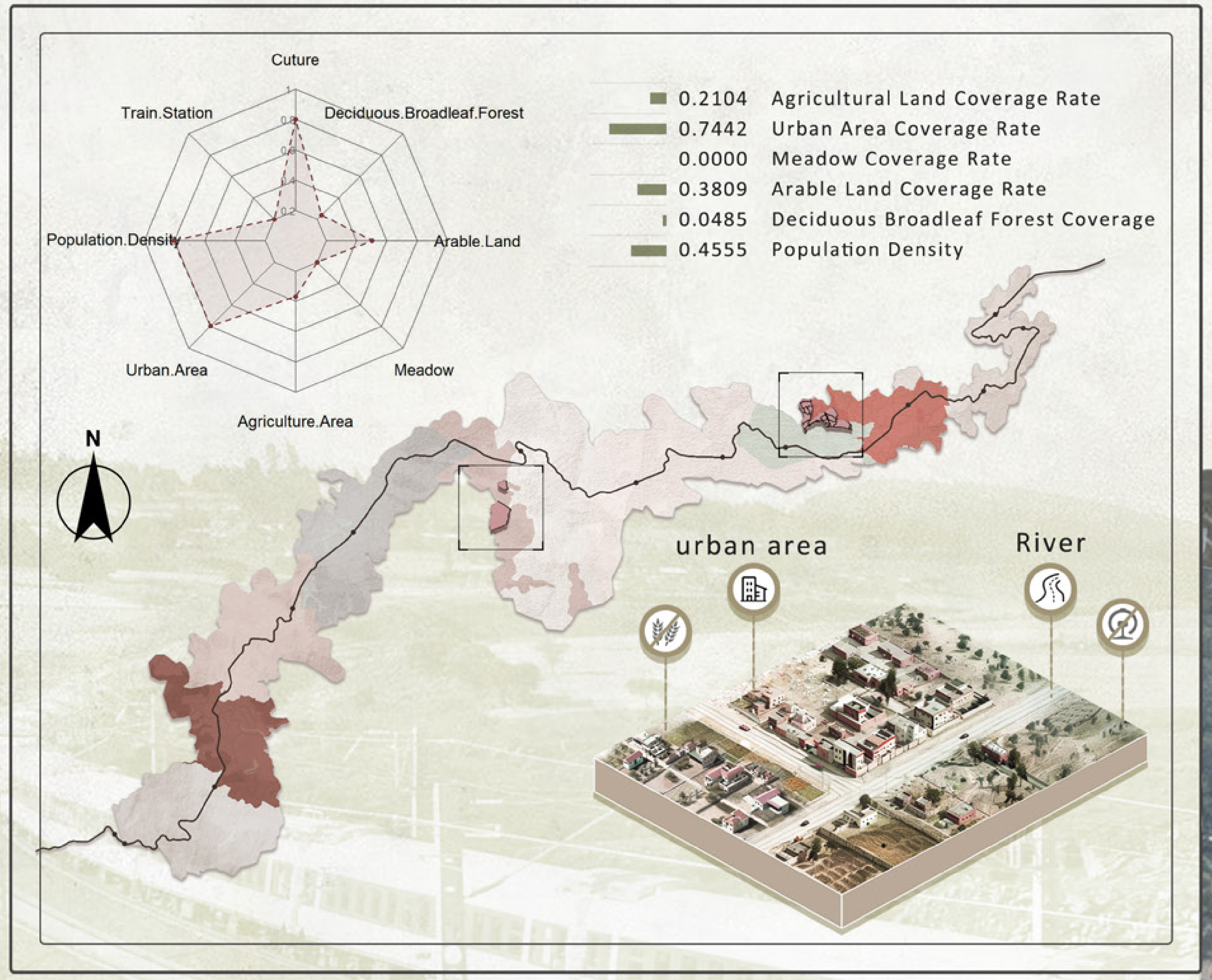
Establish Cultural Markets
Set up regular cultural markets where different ethnic groups can showcase their traditional crafts, foods, music, and dances.

Digital Exhibitions:
Create online platforms that feature digital exhibitions of various East African cultures, which can include virtual tours of cultural sites, digital galleries of traditional art, and recorded performances of traditional music and dance.

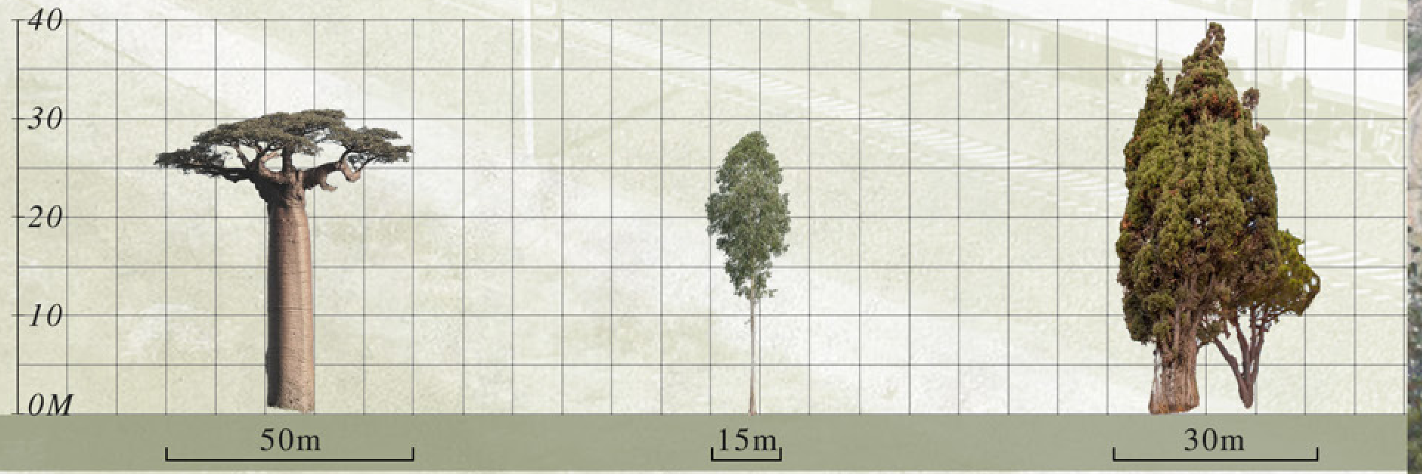
Cultural Exchange Programs:
Implement exchange programs where individuals from different cultural backgrounds can visit other communities, participate in local events, and learn about different traditions and ways of life.

THE 4TH LANDSCAPE CHARACTER TYPE:

AREA WITH COMPLEX AND DIVERSE TOPOGRAPHY & DEVELOPED AGRICULTURE



RESTORE NATURAL VEGETATION



Adansonia gregorii	*Eucalyptus Spp.*	*Pinus patula*
Baobab trees typically grow in open forests, especially in rocky areas and monsoon forests. It can be found at altitudes ranging from sea level to about 300 meters.	*Eucalyptus trees have the characteristics of wide adaptability, strong resistance, drought resistance, easy planting, and strong sprouting ability.*	*Pinus patula is a widely planted commercial tree species. It grows rapidly and plays an important role in windbreak, sand fixation, soil improvement, and other aspects.*

LARGE PROPORTION

DEVELOPED ROAD SYSTEM

BUILT-UP AREA

The built-up area in this area accounts for a large proportion, and the road system is relatively developed. The urbanization process has led to a high population density in the region and damaged the local ecosystem.

A large number of buildings, roads and infrastructure have been built, and the original natural landscape and ecosystem have been destroyed. The land has been hardened, the vegetation has been reduced, and the natural ecological space such as wetlands and rivers has been compressed.

In order to maintain ecological balance and sustainable development, the impact of urbanization on the ecological environment needs to be paid attention to, and corresponding measures should be taken to mitigate this impact.

SETTING UP ECOLOGICAL CORRIDORS

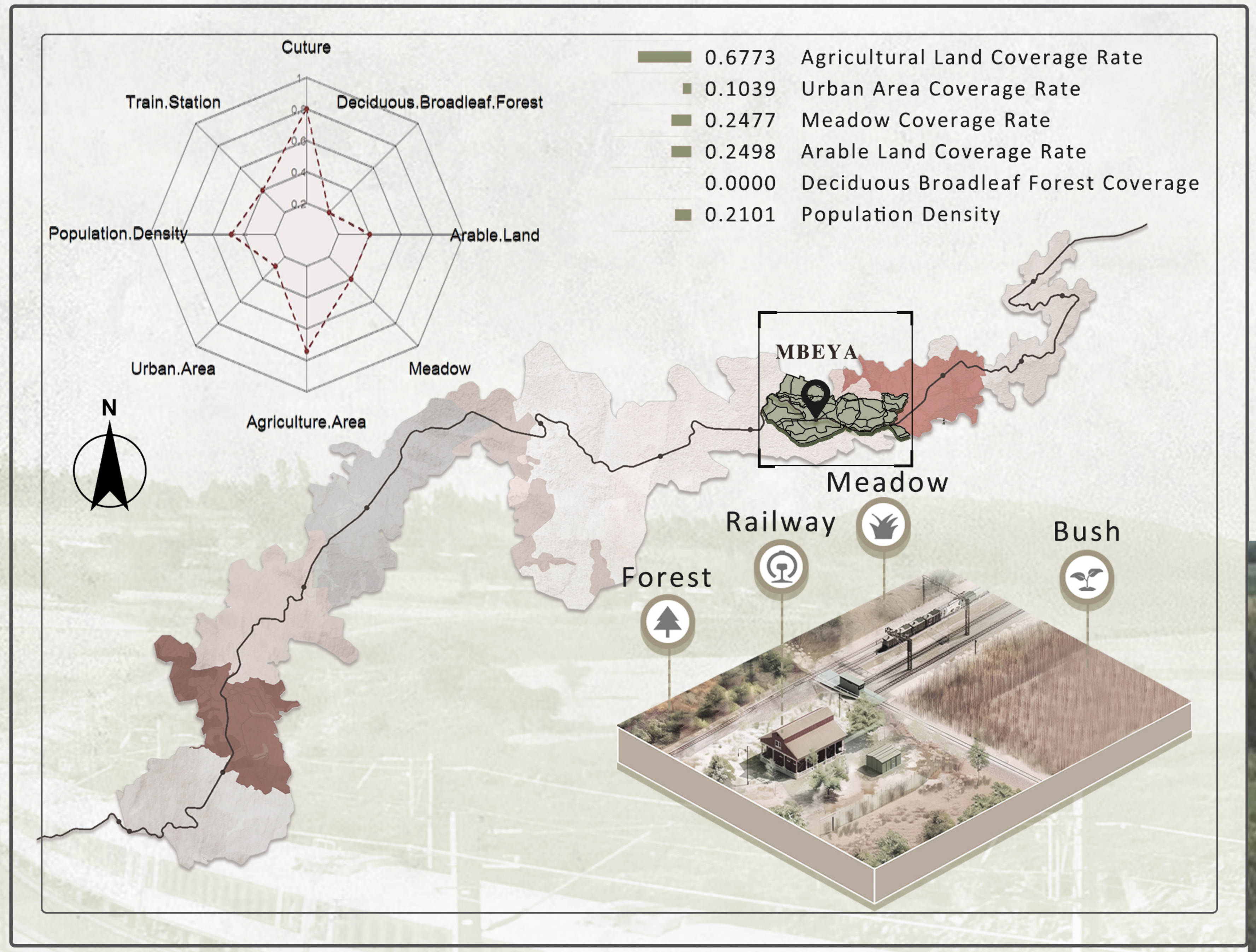
Wildlife corridors, such as ecological bridges and tunnels, are set up along the railway to reduce the obstruction of railways to biological migration and limit the interference of human activities on the natural environment.

RESTORATION OF NATURAL VEGETATION

The green landscape varieties are selected from local representative tree species, and the damaged ecosystems are restored and biodiversity is enhanced by reintroducing native vegetation and afforestation.

THE 5TH LANDSCAPE CHARACTER TYPE:

AREA WITH A DEVELOPED AGRICULTURAL INDUSTRY AND ABUNDANT WATER RESOURCES



Africa has soft soil and high organic matter content, but it is the region with the lowest food self-sufficiency rate in the world. Currently, Africa spends 35 billion US dollars a year on food imports. Despite many external factors, studies have shown that in Africa, as long as the yield of crops is increased by 10%, the poverty rate can be reduced by about 7%. The food crisis caused by climate change must be effectively resolved by taking comprehensive and practical measures.

Water-saving measures, especially those that continue to innovate from local African traditions, are the most effective basis for maintaining food production and agricultural development.

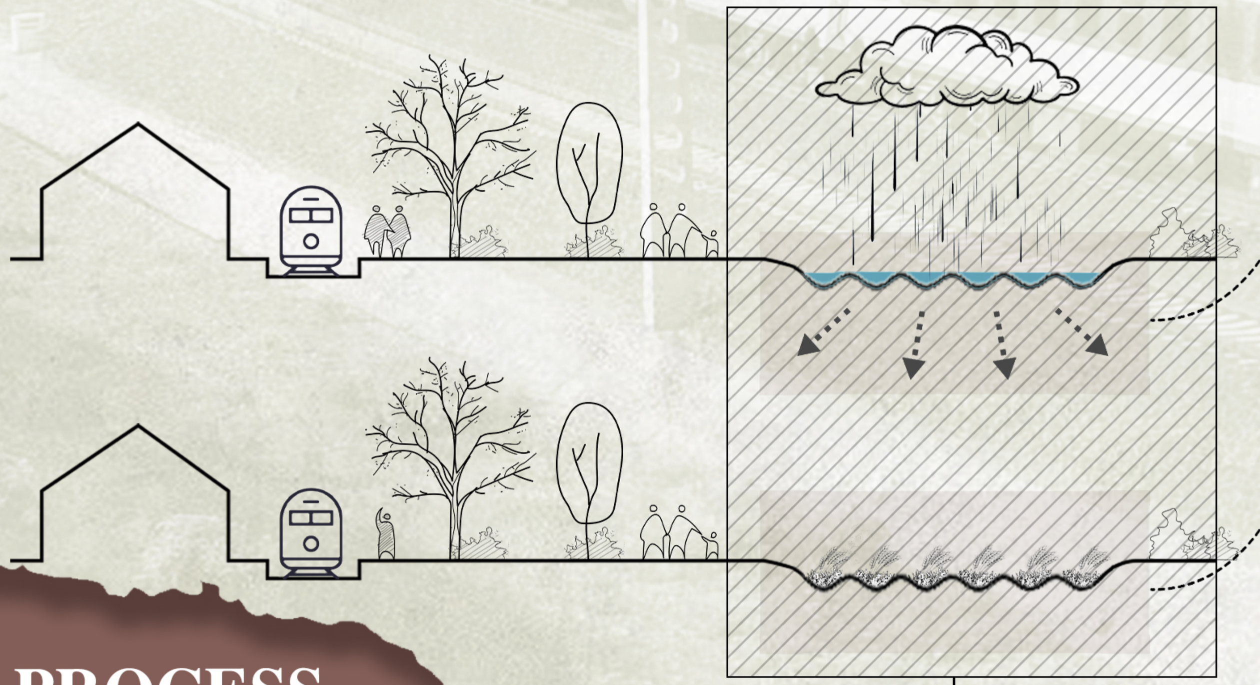
AGRICULTURE

CLIMATE

CULTURE

By introducing the traditional African water-saving irrigation method Tasa into the Mbeya region, the agricultural water production can be stabilized and increased. The introduction of this irrigation method can bring positive changes to local agriculture. The Tassa irrigation system can make more effective use of precipitation resources, thereby promoting the growth of crops.

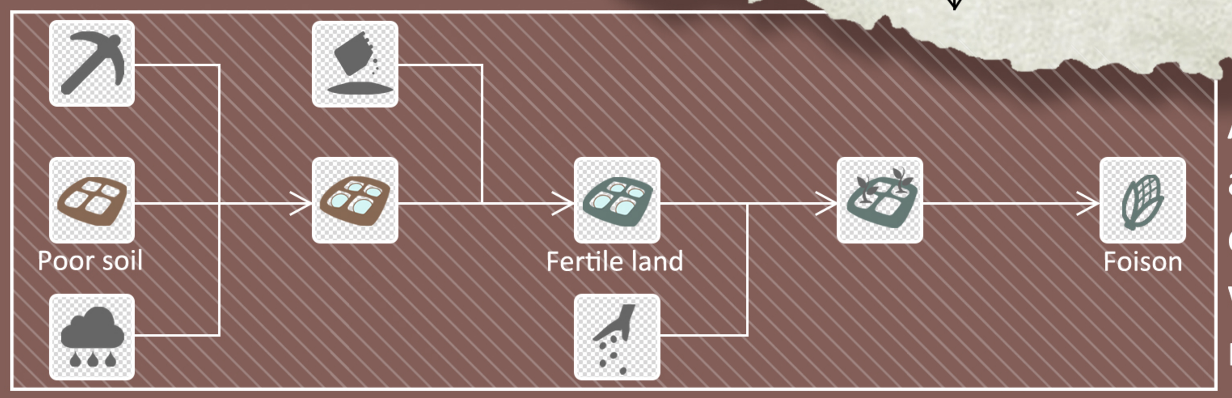
WATER-SAVING IRRIGATION: TASA



TASA:
Place vegetation or crops in small holes, and then build small dams around the fields to concentrate water and fertilizer in the holes.

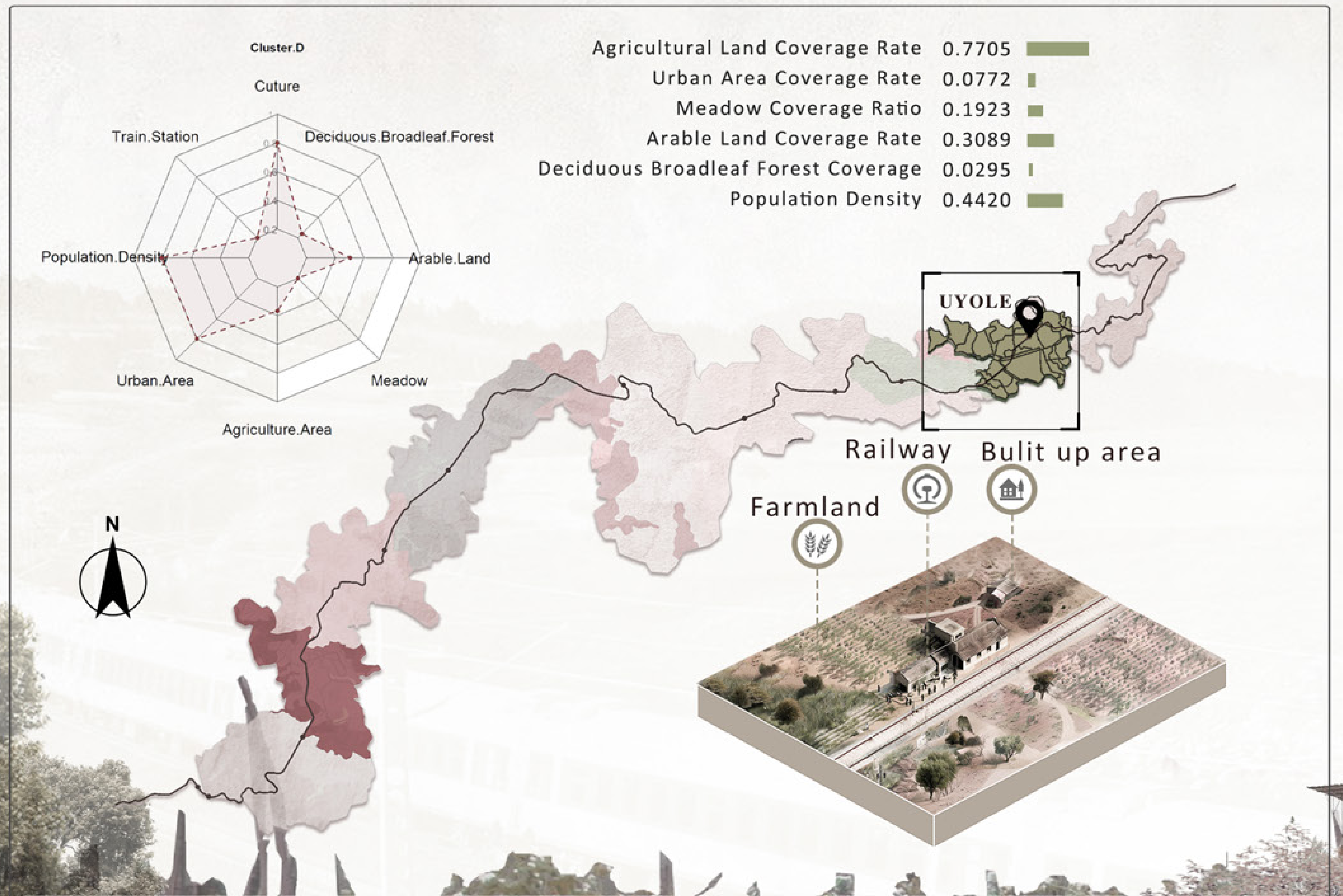
Grain production has increased , and many areas have also reclaimed severely degraded farmland.

PROCESS OF TASA



After digging small holes, crops are placed in the holes in which water and fertilizer are concentrated to restore the degraded fertility.

THE 6TH LANDSCAPE CHARACTER TYPE:
AREA WITH HIGH LANDSCAPE BENEFITS AND RICH CULTURAL RESOURCES



The land-plant cover of the area is dominated by extensive meadows with a small band of deciduous broadleaf forest. A small amount of agricultural land is located in the south-western part of the area. The area is well served by two Tazara stations. The area's productive resources are dominated by agricultural production in the southern highlands, with a lack of mineral resources.

Landscape along the railway

LANDSCAPE BENEFIT

ECOLOGY — The better biodiversity along the Tanzara allows for the development of specialised **tourism routes** and **tourism services** to attract more tourists to the experience

CULTURAL — The cultural resources along the route are rich in local characteristics, and the **settlements** of different **ethnic styles** can enhance the travelling experience of tourists and increase cultural connotations

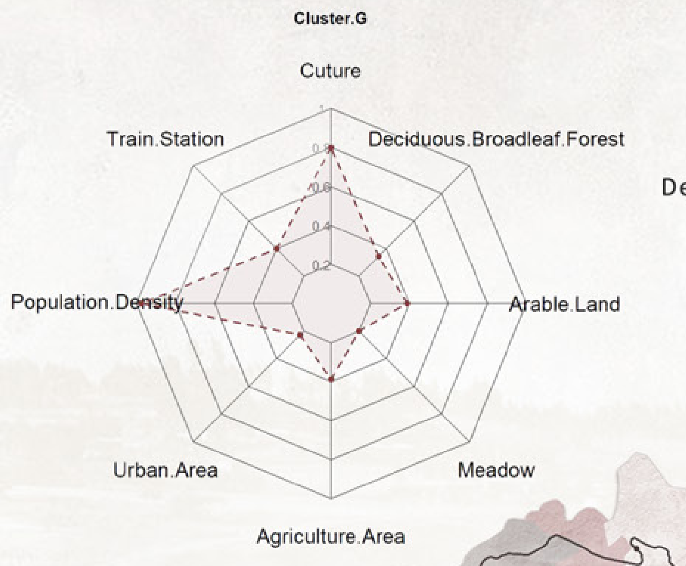
ECONOMY — Optimise station design, create **station buildings** with local characteristics and cultural connotations, strengthen the management and development of attractions, and provide more convenient excursion services and supporting facilities.

ZOOGEOGRAPHY

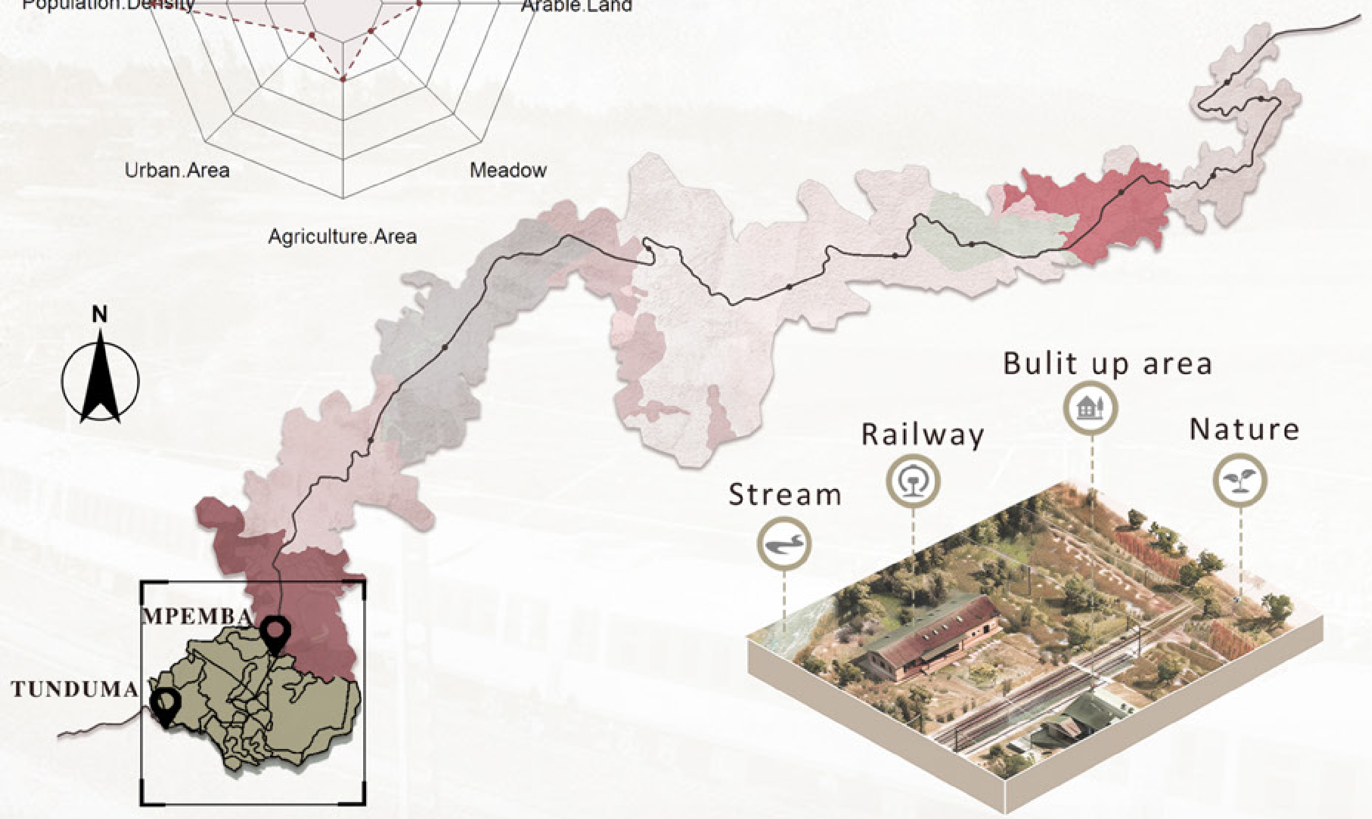
ETHNOCULTURAL SETTLEMENT

STATION TRANSPORT AREA

THE 7TH LANDSCAPE CHARACTER TYPE:
AREA WITH LOW URBANIZATION BUT RICH ETHNOCULTURE



Agricultural Land Coverage Rate	0.2359
Urban Area Coverage Rate	0.0360
Meadow Coverage Ratio	0.0000
Arable Land Coverage Rate	0.2359
Deciduous Broadleaf Forest Coverage	0.1811
Population Density	0.5807



The land-plant cover of the area is dominated by sparse scrub, with strips of deciduous broadleaf forest in the south-west. There is a small urban area at the western corner end and a mix of agricultural land interspersed in the centre. The area is well served by a railway station. The area's productive resources are dominated by agricultural production in the southern and south-western highlands, with a lack of mineral resources. The area is religiously rich and is populated by the Lambya ethnic group, most of whom speak the Lambya language, with some Nyiha speakers on the western edge.

EMBEDDED CULTURE

Promoting multi-ethnic cultural exchanges, setting up ethnic museums for existing cultures, organising cultural festivals and other means of passing on ethnic cultures and achieving harmonious development among ethnic groups.

ETHNIC AND CULTURAL EXCHANGES

Enhancing exchanges and interactions among different peoples and cultures and promoting the harmonious development of all peoples

SURVIVING CULTURE

Identifying, protecting and restoring the geographic location of settlements and former sites of surviving cultures to ensure the transmission and preservation of national cultures and the recognition of multi-ethnic cultural values

I Digital reproduction of national culture

II Digital Cultural Platform Construction

FOLK CULTURAL CENTRE

Holding ethnic cultural festivals, ethnic cultural performances, ethnic cultural exhibitions, etc.

CULTURAL FAIR

Displaying local speciality agricultural products and handicrafts, attracting foreign tourists and promoting exchanges and interactions

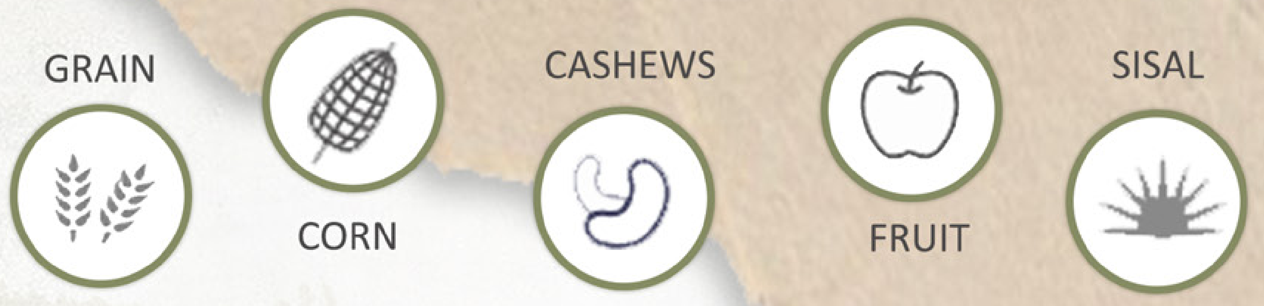
IMPORTED AND EXPORTED GOODS

Import and export transport of agricultural and sideline products and national speciality cultural products to enhance exchanges and links between regions

THE 8TH LANDSCAPE CHARACTER TYPE:

AREA WITH SPARSE POPULATION BUT WELL-FOUND AGRICULTURAL BASE

Ⅰ GROWING DIVERSIFIED CROPS



Growing a diverse range of crops on agricultural land increases biodiversity, reduces the incidence of pests and diseases and improves soil fertility. One can choose to grow different types of crops, such as cereals, vegetables and fruits.

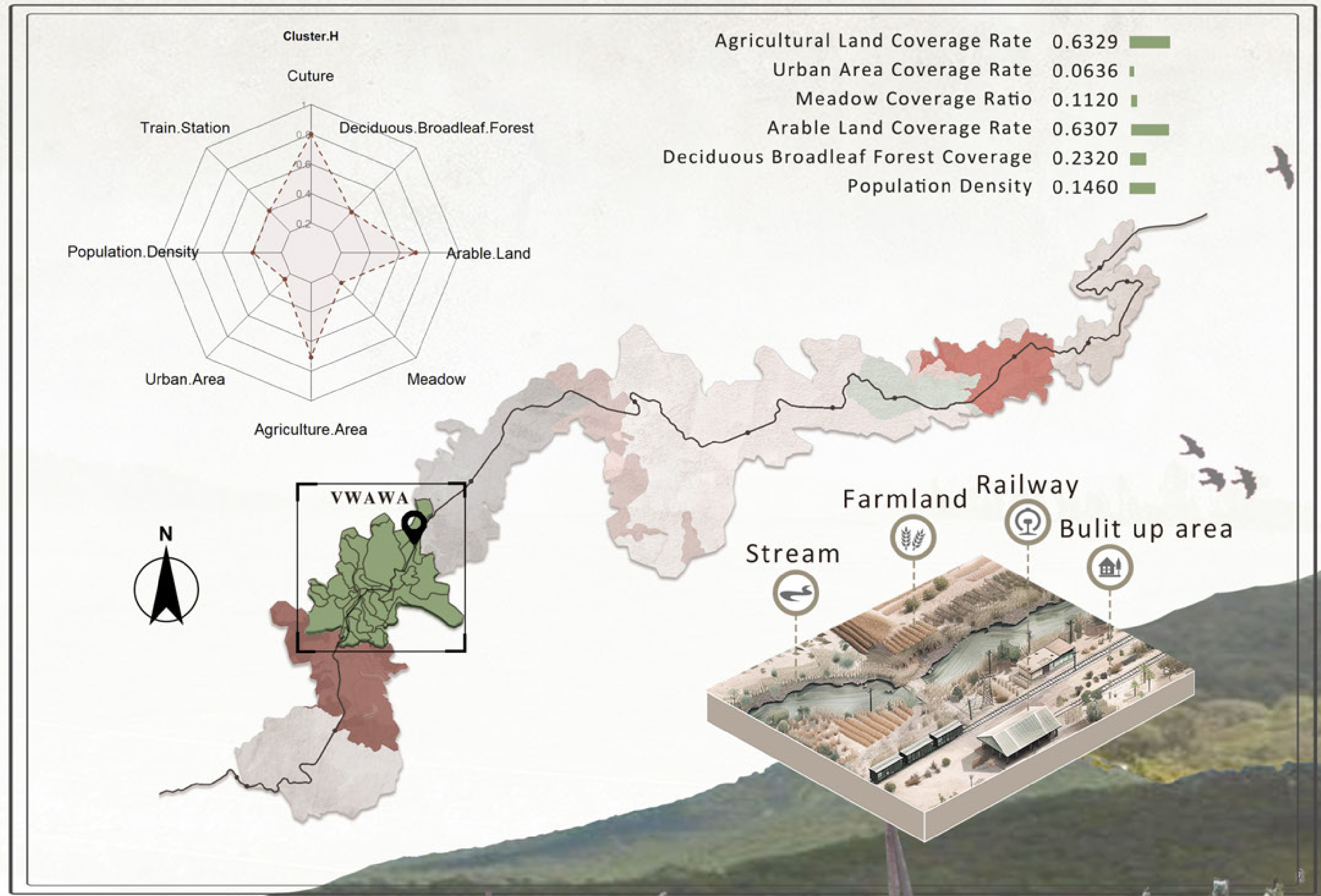
Ⅱ CIRCULATING AGRICULTURE

Through the recycling of resources and protection of the environment, to achieve sustainable development of agriculture

Ⅲ RATIONAL FERTILISER USE OF RESOURCES

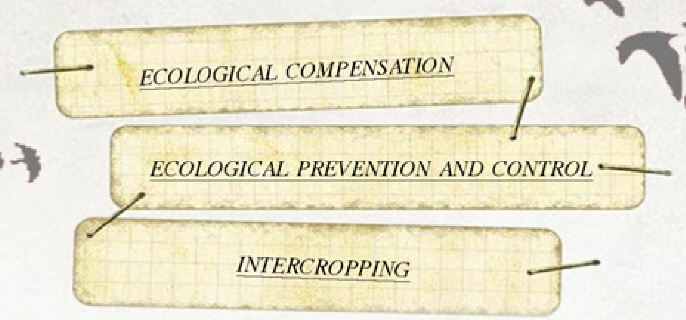
In sisal planting circular agriculture, farmers can also achieve **crop rotation** by planting other crops, and use the residues of sisal plants as organic fertilizers to provide nutrients for the soil and achieve **sustainable soil farming**.

This model of circular agriculture not only improves the yield and quality of crops, but also protects the environment and reduces the consumption and destruction of natural resources by agriculture.

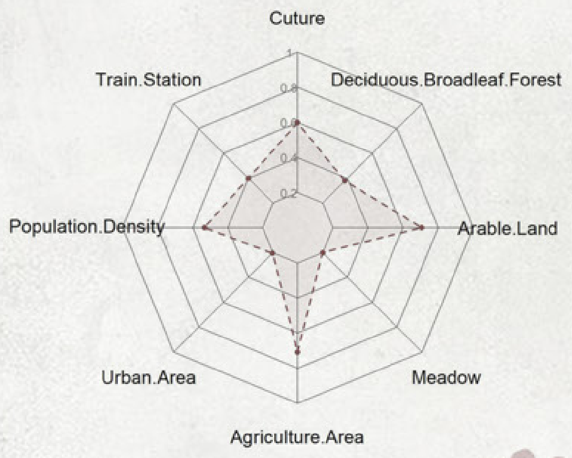


The land cover in the area is predominantly agricultural, with some rural settlements and scrubland extending from the centre to the north, east, west, south and north corners, and rivers and lakes along the eastern centre edge. There is a Tazara station in the western part of the area, and no station in the eastern part of the area, so the overall accessibility is average. The area's productive resources are dominated by agricultural production in the southern highlands, with a lack of mineral resources.

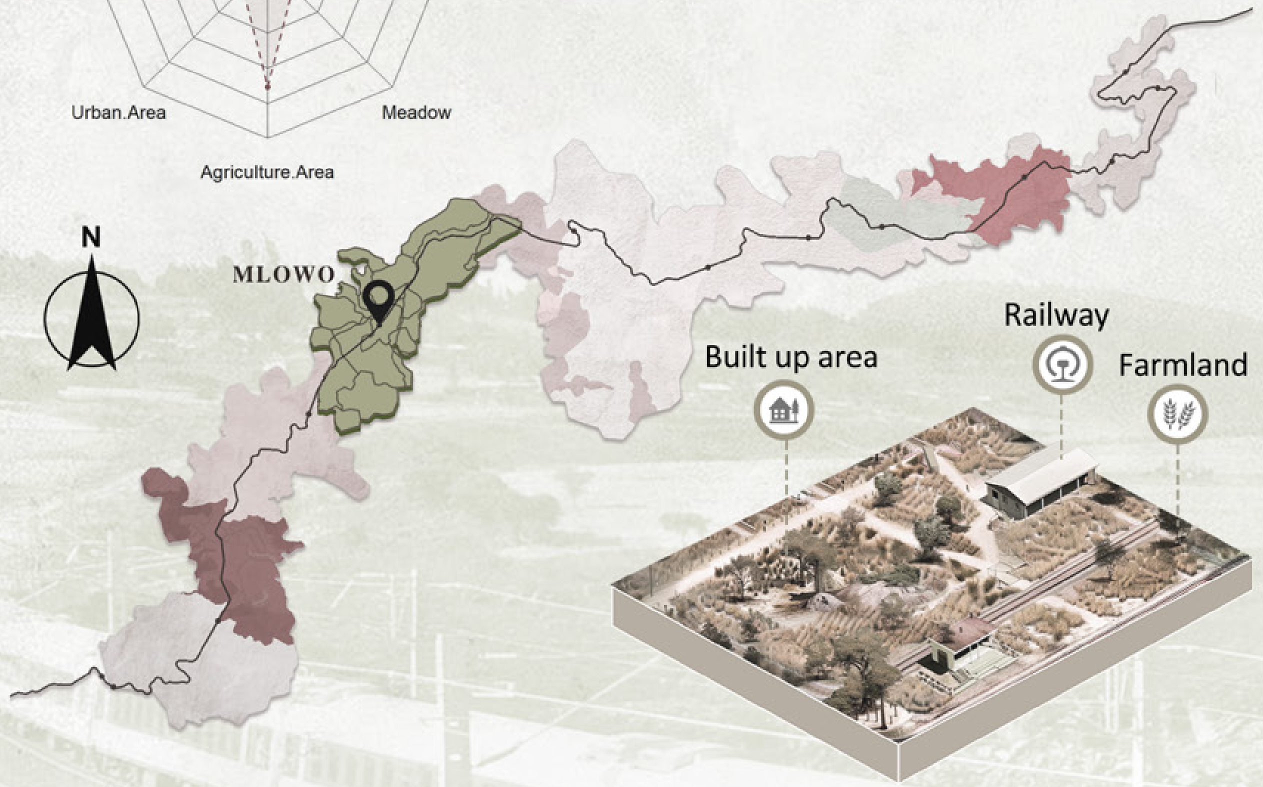
Agroforestry ecosystem include various elements such as biological communities, soils, water resources, climate, etc. in agricultural and forest lands, as well as their interactions and cyclical processes.
In agroforestry ecosystems, farmland and woodland are not only places where humans produce food, timber and other agroforestry products, but are also habitats for biodiversity and part of natural ecosystems.



THE 9TH LANDSCAPE CHARACTER TYPE:
AREA WITH RICH CULTURE BUT SPARSE POPULATION

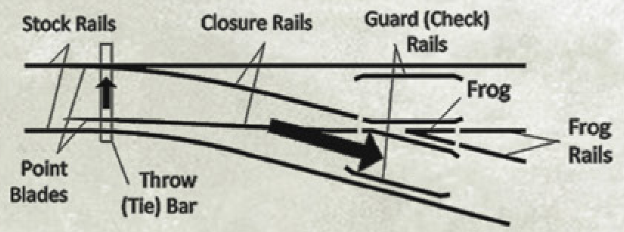


Agricultural Land Coverage Rate	0.6358
Urban Area Coverage Rate	0.0026
Meadow Coverage Ratio	0.0000
Arable Land Coverage Rate	0.6328
Deciduous Broadleaf Forest Coverage	0.2247
Population Density	0.2477

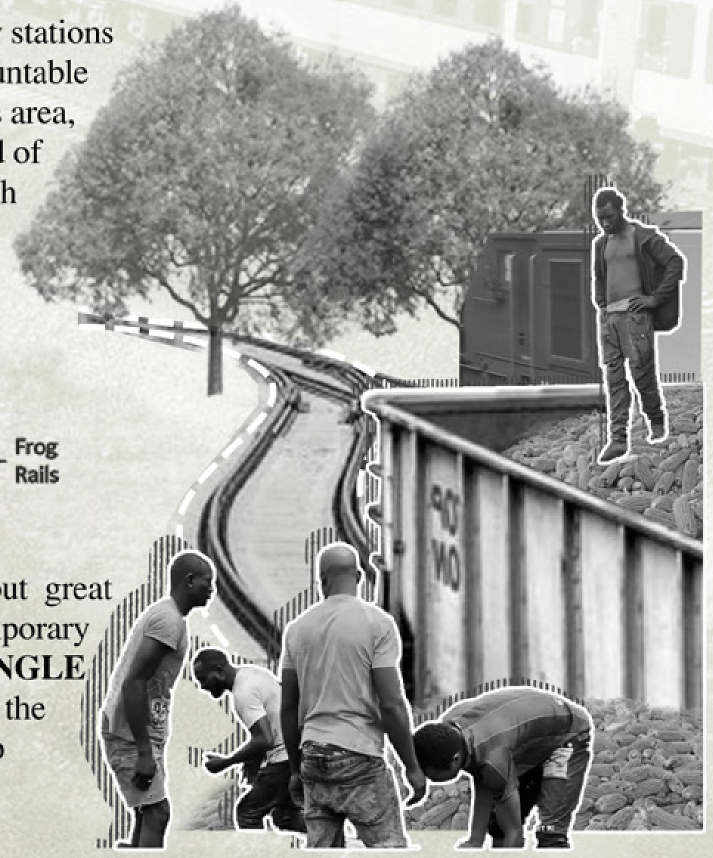


ADD RAILWAY STATION POINTS

It is planned to add a series of temporary stations with special features and flexible dismountable carriages near the railway stations in this area, aiming at supplementing the use demand of existing stations and relying on the rich cultural resources in this area to develop unique tourism.



In the area with low station density but great potential of landscape resources, the temporary station trains were built in the form of **SINGLE TURNOUT** in the early stage, and after the coupler was untied, the trucks could stop and unload.



CULTURAL EXCHANGE AND THE MANIFESTATION OF REGIONAL CHARACTERISTICS

OPEN CULTURAL MARKETS
<Promote intercultural communication>

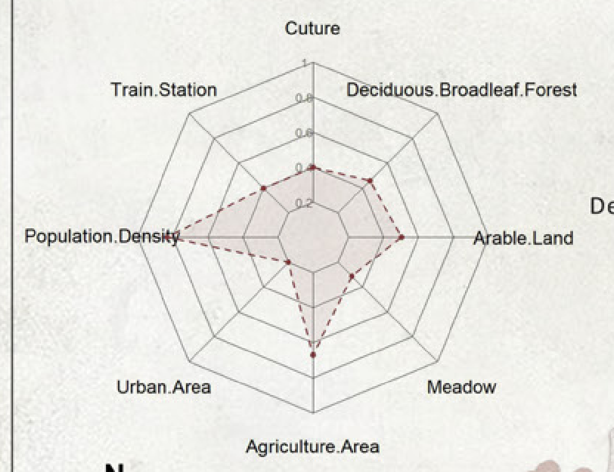
HOLD CULTURAL FESTIVALS
<Promote intercultural communication>

SET UP CULTURAL FESTIVALS AND MUSEUMS
<Inherit the original cultural characteristics>

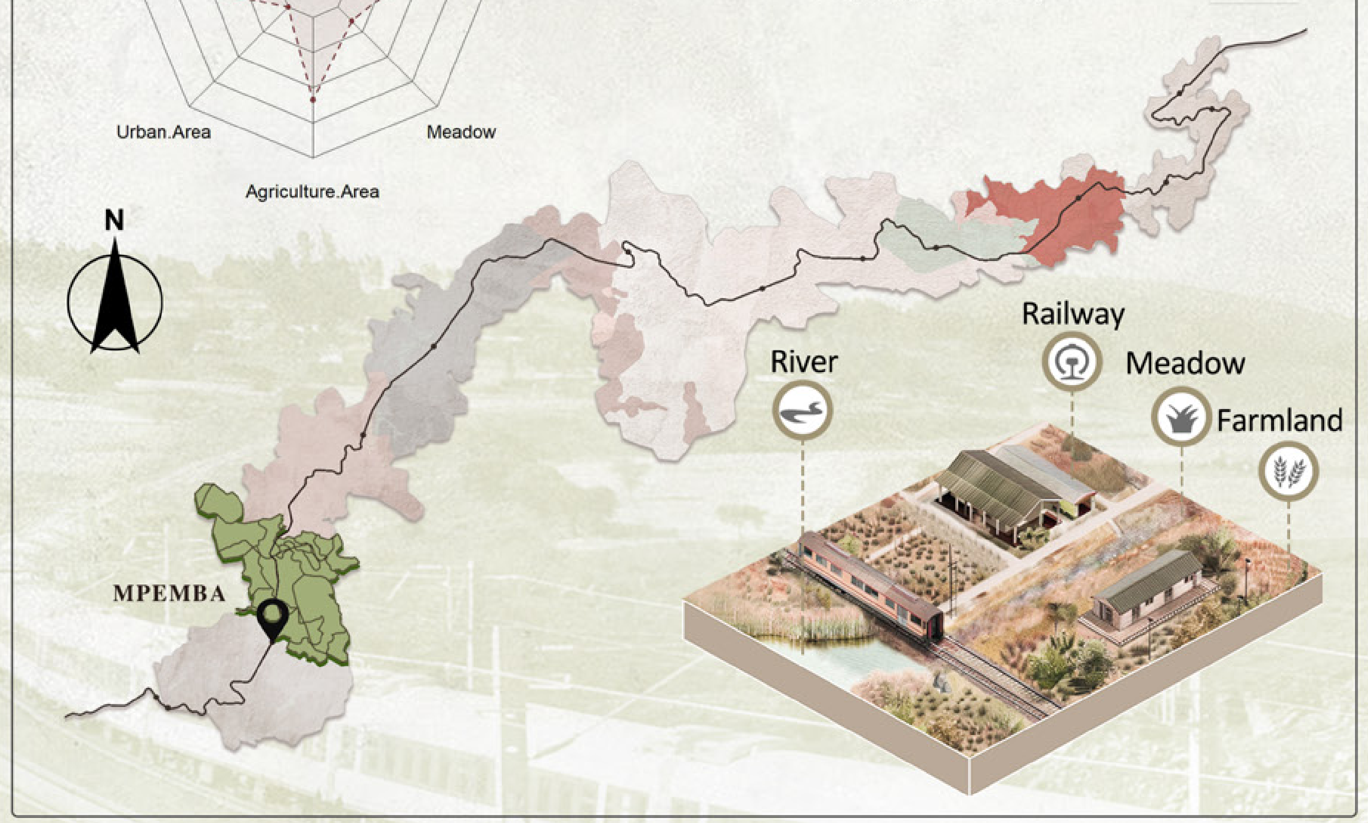
- Pottery, textiles, wood carving and metal crafts
- Believe in Islam
- Mankaba and Buji
- All kinds of spices and condiments
- Mali Empire
- Ghana Empire

THE 10TH LANDSCAPE CHARACTER TYPE:

AREA WITH RICH WATER RESOURCES AND AGRICULTURAL RESOURCES



Agricultural Land Coverage Rate	0.5906
Urban Area Coverage Rate	0.0000
Meadow Coverage Ratio	0.1408
Arable Land Coverage Rate	0.3809
Deciduous Broadleaf Forest Coverage	0.3219
Population Density	0.4727



Railway brings experts and technology

Cashew plantation derived Tourism

Transport cashew produced in plantations

Railway brings agricultural equipment

Based on the original traditional industries in Tanzania, the local processing capacity of sisal and cashew nuts can be improved, new technology and management experience can be introduced, and the output and quality can be improved, so as to further improve the added value and market competitiveness of products.

CHARACTERISTIC AGRICULTURAL PRODUCTION

Picking, Processing & Transportation- CASHEW

Cashew industry in Tanzania is one of the important cash crops in the country, and its output ranks among the top in the world. Cashew nuts are planted in a vast area, mainly in southern areas, such as Mtwara and Lindi.

SISAL HEMP -Planting, Harvesting, Transportation & Deep processing

Tanzania's sisal industry has a long history. It once became the largest sisal producer and exporter in the world because of its suitable climate and soil conditions, and was known as the "Sisal Kingdom". However, after the 1970s, the industry faced a serious contraction, and the number and output of farms dropped sharply.

FUTURE VISION: THE REVIVAL OF THE ROAD TO FREEDOM BRINGS MAN-LAND SYMBIOSIS

THE PAST

SURVIVAL RESOURCES

As the cradle of ancient human evolution, East Africa bears the oldest story of man and nature. In primitive society, human beings lived by picking, hunting and slash-and-burn cultivation, and landscape resources were contested as survival resources.

THE PRESENT

PRODUCTIVE RESOURCES

The completion of the TAZARA Railway has promoted the economic development of the two countries and accelerated the circulation of resources, but it has also increased the intensity of human intervention in landscape resources. Landscape resources are mainly used in the form of production resources, but it has caused a series of harm to the relationship between environment, resources and people and land.

THE FUTURE

MAN-LAND SYMBIOSIS

In the future, TAZARA Railway should be transformed into a medium for human beings to control landscape resources and realize landscape fairness, and it will inject vitality into the region. Regionally control the surrounding areas of the railway to realize a new prospect of sustainable development and symbiosis between man and land.