THE THOL PROJECT

Metabolic Office

Ahmedabad 2021

This work is produced by Metabolic Office

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Thanks to Anahita Brahmbhatt

Note:
This is Version 1.0 of the Thol Project. The work presented in this report is a work in evolution. There will be future mutations, updates, iterations, and corrections.

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We think of the Thol Sanctuary as a contemporary ecological design laboratory that is driven by an urgent need to redefine land use, inquire into ways of ensuring food security, and focus on deeper forms of climatic adaptation and resilience to the slow violence of ecological degradation, through implementation of a new design strategy informed by regenerative principles and ethics of permaculture.

By approaching human and non human settlements through the lens of data driven ecology, integrated design and whole systems thinking, using remote sensing technologies, and utilising existing patterns observed in topographies and ecosystems, the project begins transforming the ground from invasive monocultures, to an experimental repository of biodiversity, a living archive of indigenous species, a micro climatic centre of research, and an edible and medicinal forest.

Interpreting the ecological implications of our design agency as an inherently political act, the project attempts to create complex sets of negotiations that rely on use rather than ownership by bringing in diverse vectors of knowledge and serving as a stronghold for decentralised territorial planning, the production/ dissemination of knowledge, and research.

1.0 S H I F T

Observing and interacting with various metabolic processes of the ecosystem, the project assesses, re- evaluates and draws out various meters of coherence into a series of long term strategies and trajectories that respond to the emerging and intersecting knowledge events of climate change, mass extinctions and the Anthropocene, aligning vectors and trajectories of natural development to create novel human and non human - novel Ecosystems.

By building capacity, working towards heightened ecological awareness, and through engaging with local and non local institutions, the project is designed to serve as a model, to create regenerative forms of economy, inhabitation and wilderness, and establish a renewed symbiosis between the chasms of the ‘urban’ and the ‘rural’, the ‘cultural’ and the ‘natural’.

Project Brief

The project looks into ways of re-building and capturing carbon within the soil; de-contaminating and optimizing water such that it can support the biodiversity of Thol in a sustained and regenerative manner.

The project carefully intervenes into the existing by introducing appropriate plant species of various kinds in order to conserve, contribute to and re-activate the biodiversity of the Thol wetland.

The project shares many of the ambitions of and intends to reinvigorate and plug in to the existing Thol Wildlife Sanctuary Management Plan (2014-15 to 2023-24) and help form the contours for the next integrated plan.

The project aims to bring together diverse knowledge systems and people such as the government, different departments involved in the management of Thol, locals from adjacent villages, and experts in the field of environment and ecology, policy and law; therefore, by establishing various interpretation zones, it aims to create an interface between ecology, public, management and institutions.

The project attempts to be a pilot to test new ideas about land-use, soil, water and eco-management in order to inform other approaches.

Therefore, this integrated proposal aims to promote and boost eco-tourism and generate value for the sanctuary, create economic opportunities and foster greater appreciation of natural habitats.

EXTREME EVENTS ARE INCREASING IN INTENSITY, FREQUENCY AND SEVERITY.

WE MUST DESIGN BUFFERS TO SOCIAL, POLITICAL AND CLIMATIC SHOCKS.

Permaculture
Syntropic Systems

Permaculture is an approach to habitat management that adopts arrangements observed in flourishing natural ecosystems, using whole systems thinking. It uses these principles in fields such as regenerative agriculture, integrated water resources management, rewilding, sustainable architecture, self-maintained habitats and community resilience.

The word syntropy, as contrasted to entropy, means a system that accumulates matter and energy, to become more complex over time, in order to create abundance. It is a form of process based system as opposed to conventional input based systems. This approach allows the creation of dynamic, successional, and economically viable ecosystems that restore degraded soil biodiversity, by imitating the natural regeneration of forests and provides a harmonious integration of our food production systems.

RIGHT.
Source material leading to the development of the Permaculture System.

OBSERVE AND INTERACT

CATCH AND STORE ENERGY

OBTAIN A YIELD

APPLY SELF-REGULATION

USE AND VALUE RENEWABLE RESOURCES AND SERVICES

PRODUCE NO WASTE

DESIGN FROM PATTERNS TO DETAILS

INTEGRATE RATHER THAN SEGREGATE

USE SMALL AND SLOW SOLUTIONS

USE AND VALUE DIVERSITY

USE EDGES AND VALUE THE MARGINAL

CREATIVELY USE AND RESPOND TO CHANGE

2.0 S E N S E

The project is driven by an urgent need to redefine land use through a data-driven sensibility.

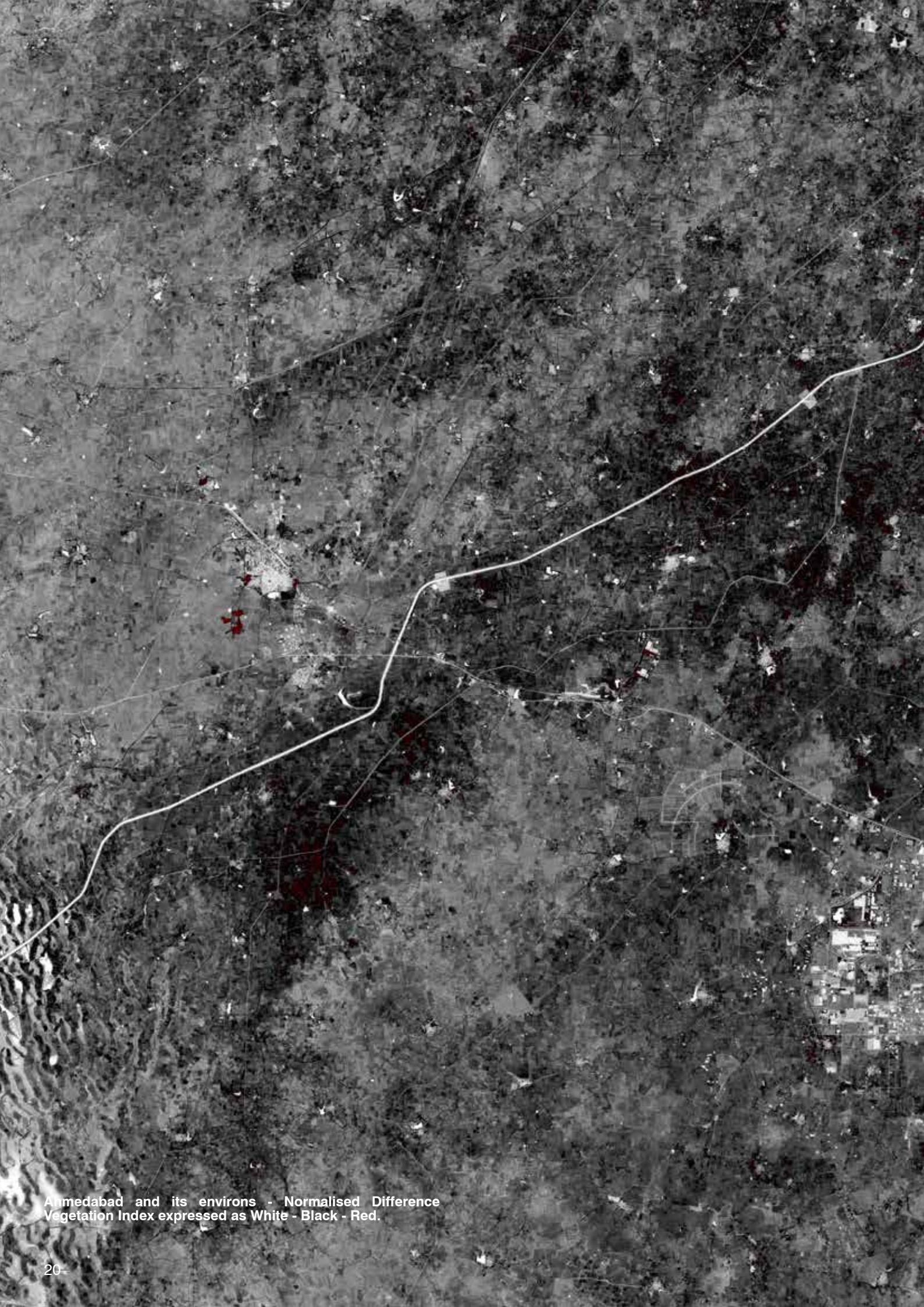
The project will consider ecosystem restoration through the use of remote sensing technologies in order to record, map, monitor and assess the changes in the landscape.

Data Driven Ecology

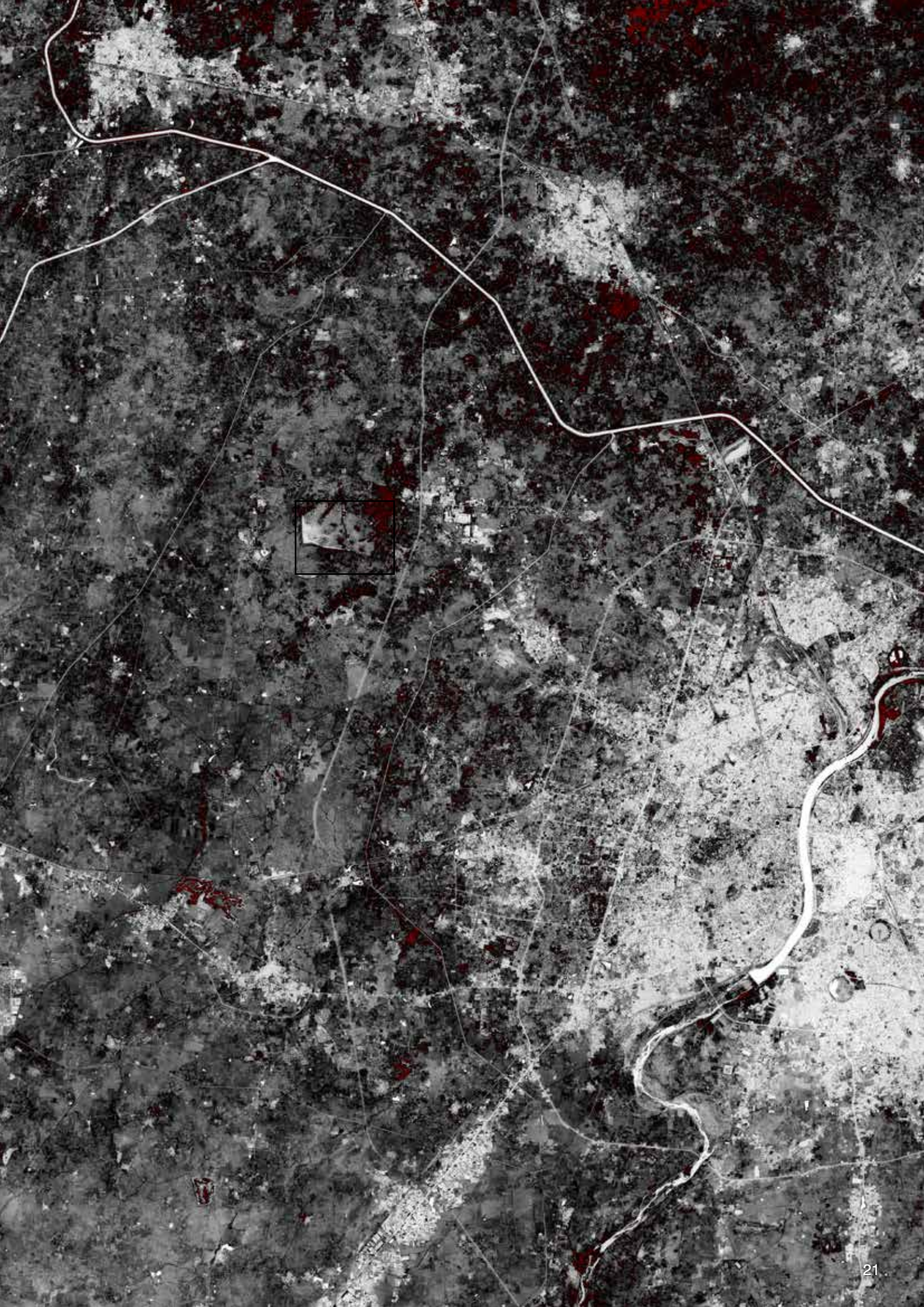
Remote sensing technologies interact with the material structures and cycles of our planet and are increasingly shaping our entanglement in the transformation of contemporary territories.

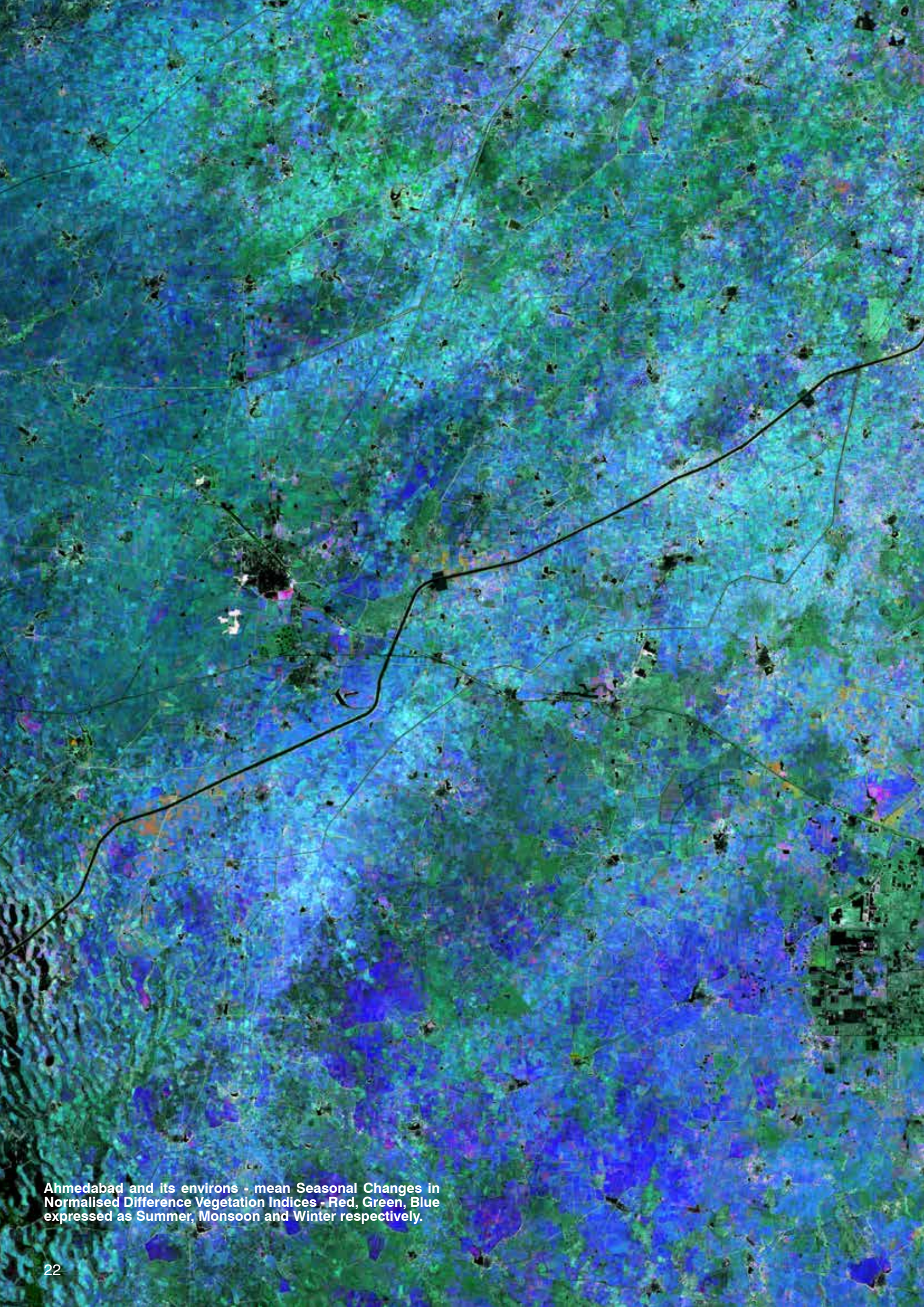
These technologies create new optical and sensorial horizons that can be harnessed to view territories in their complexity. The project uses this data as a locus to gather around and bring diverse knowledges into conversation, thereby creating new polities that have the capacity to apprehend and respond to this complexity.

Ahmedabad and its environs - Digital Elevation Model

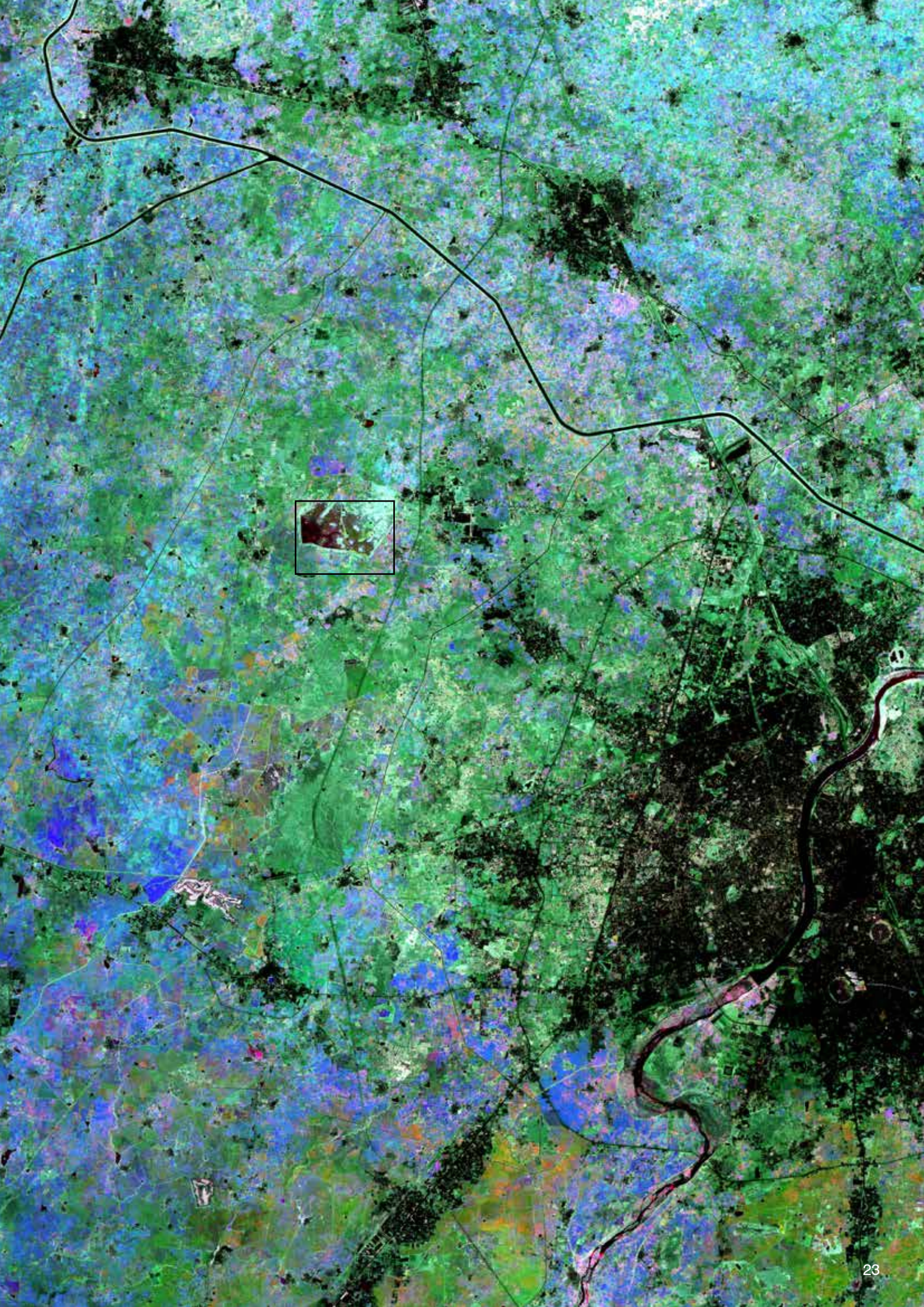


Ahmedabad and its environs - Normalised Difference Vegetation Index expressed as White - Black - Red.





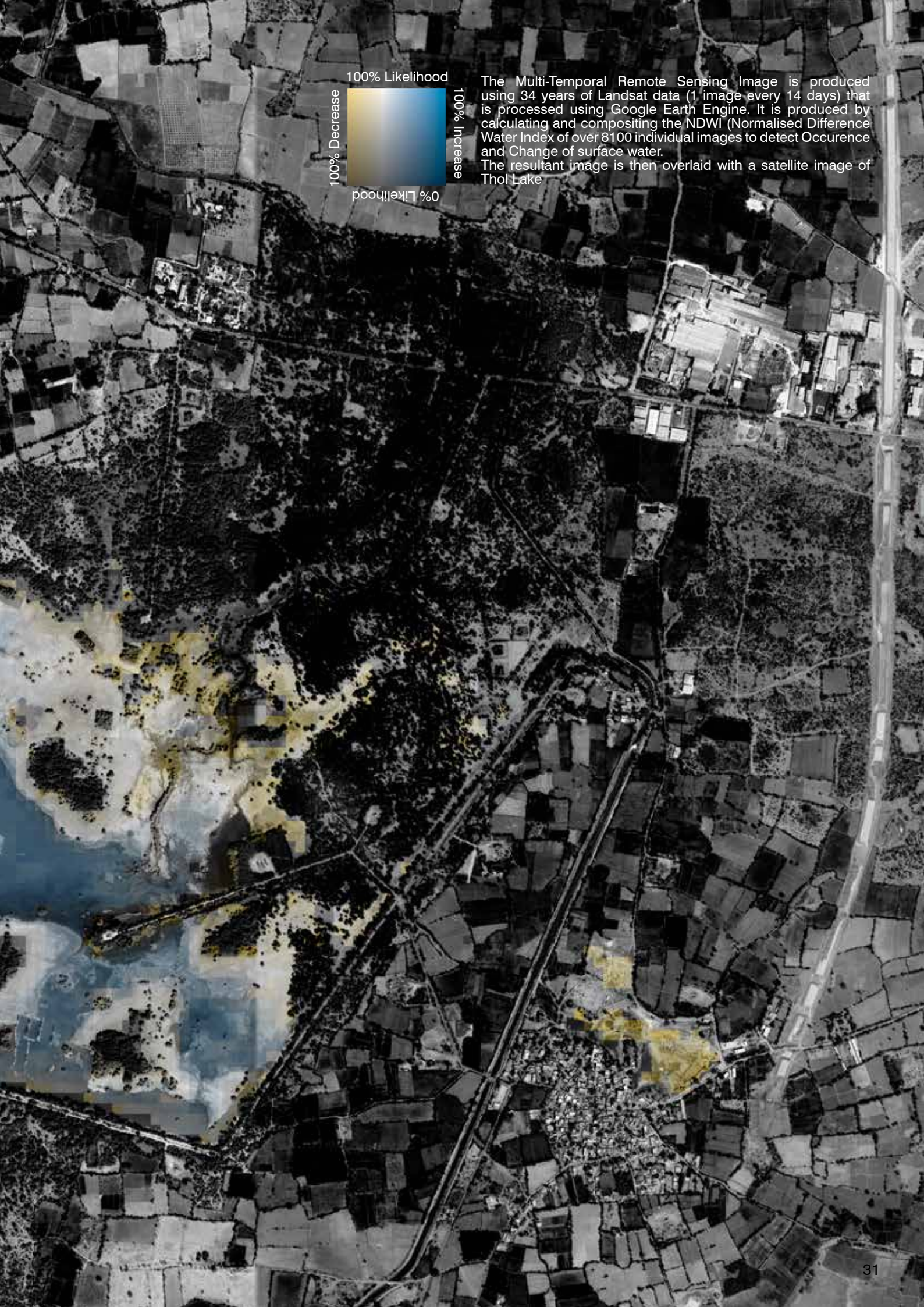
Ahmedabad and its environs - mean Seasonal Changes in Normalised Difference Vegetation Indices - Red, Green, Blue expressed as Summer, Monsoon and Winter respectively.



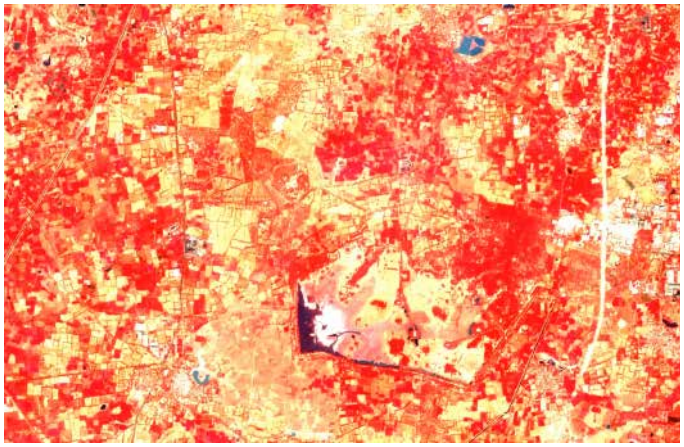
Ahmedabad and its environs - Changes in Impervious Surfaces from 1985 - 2018.

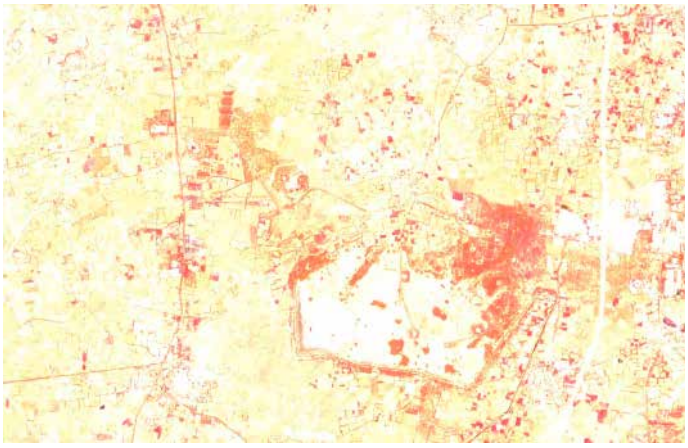
Change from pervious to impervious was determined using a combined approach of supervised classification and temporal consistency checking. Impervious pixels are defined as above 50% impervious.

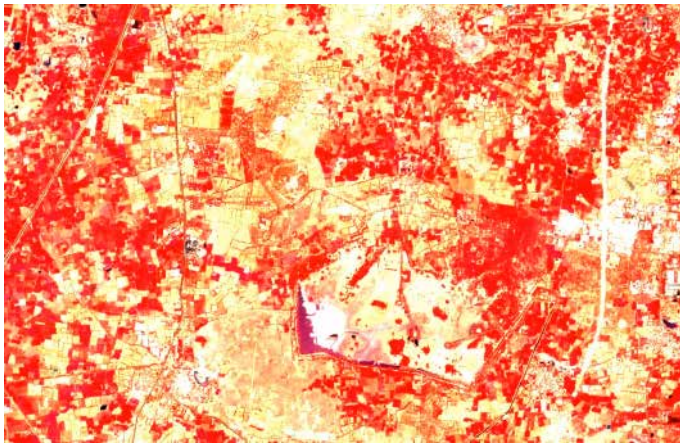
Black signifies impervious surfaces in 1985 and Red in 2018.

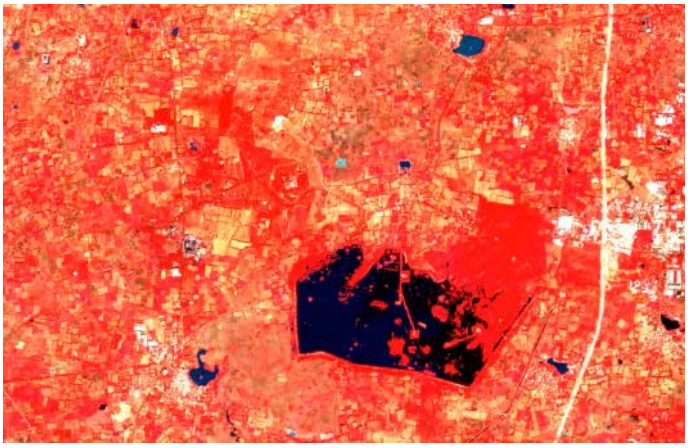


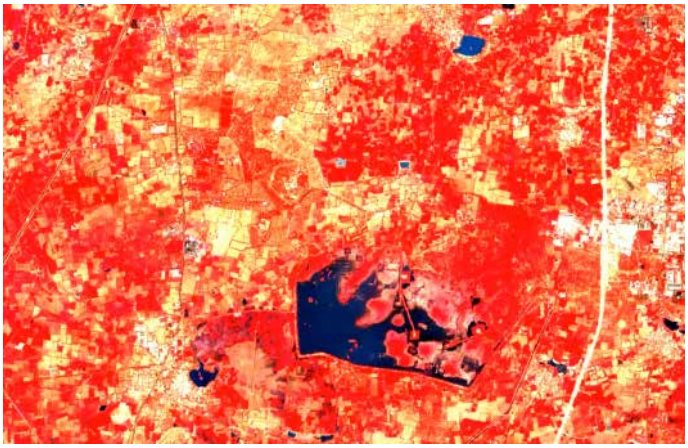
The Multi-Temporal Remote Sensing Image is produced using 34 years of Landsat data (1 image every 14 days) that is processed using Google Earth Engine. It is produced by calculating and compositing the NDWI (Normalised Difference Water Index of over 8100 individual images to detect Occurence and Change of surface water.
The resultant image is then overlaid with a satellite image of Thol Lake



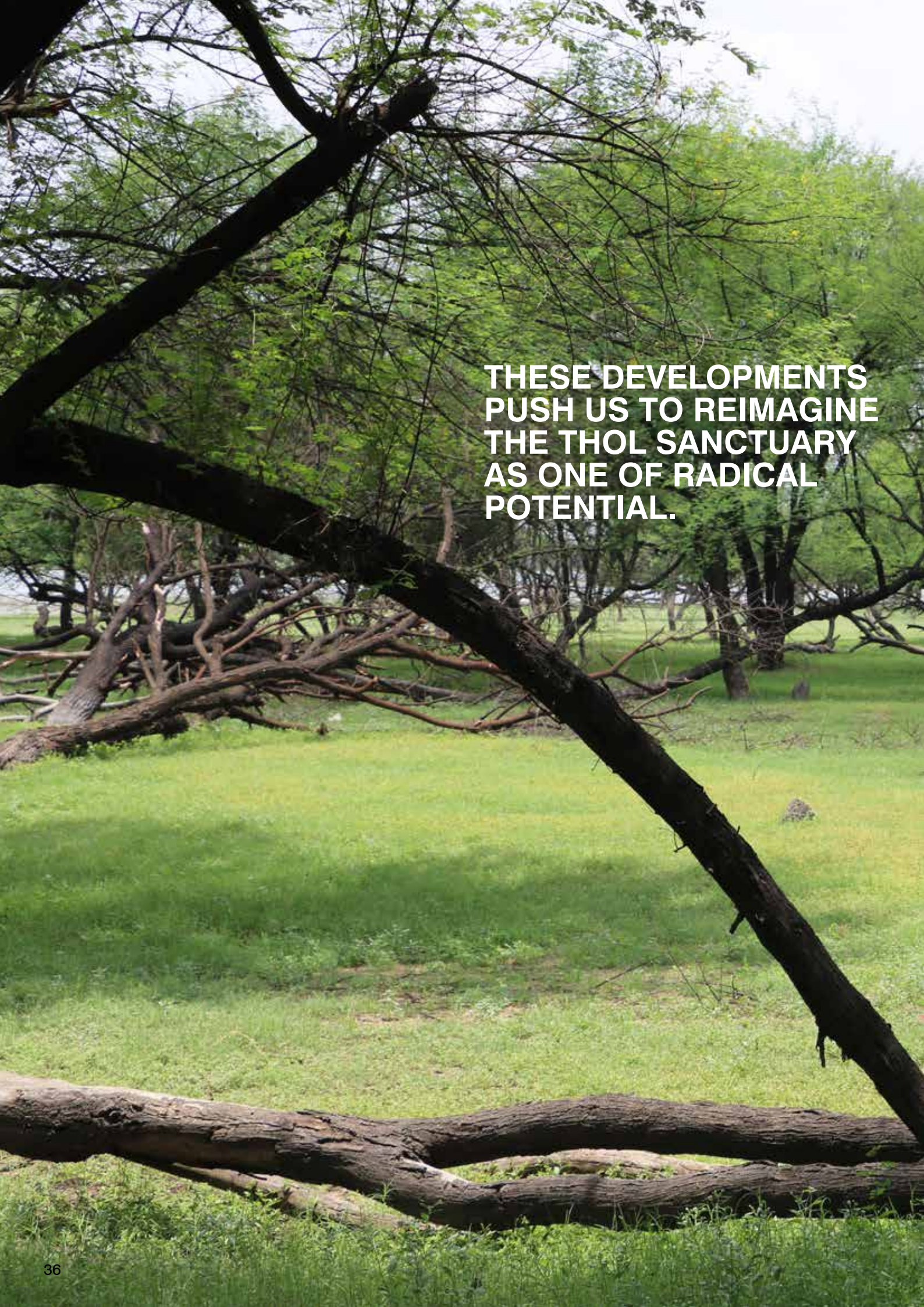




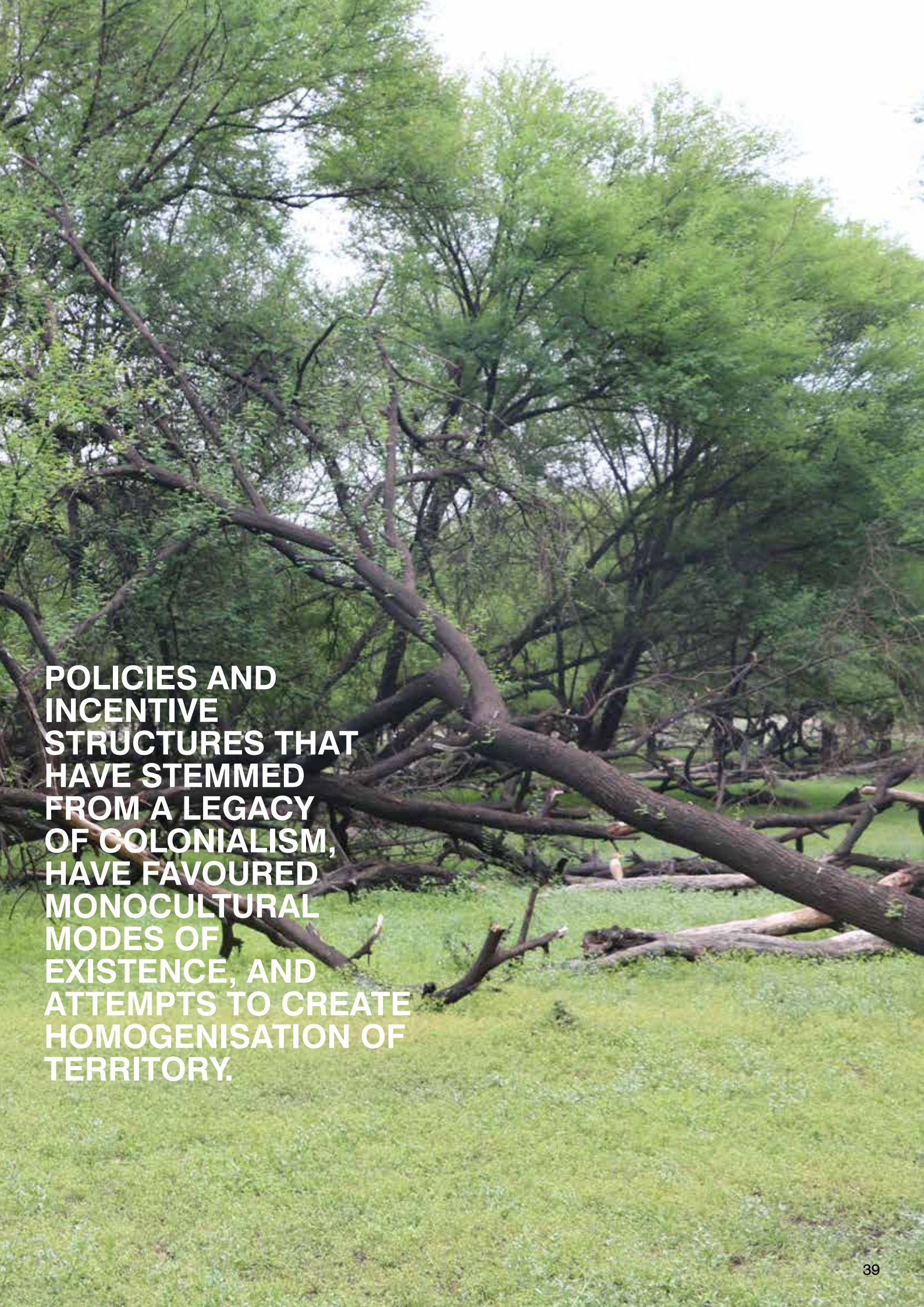




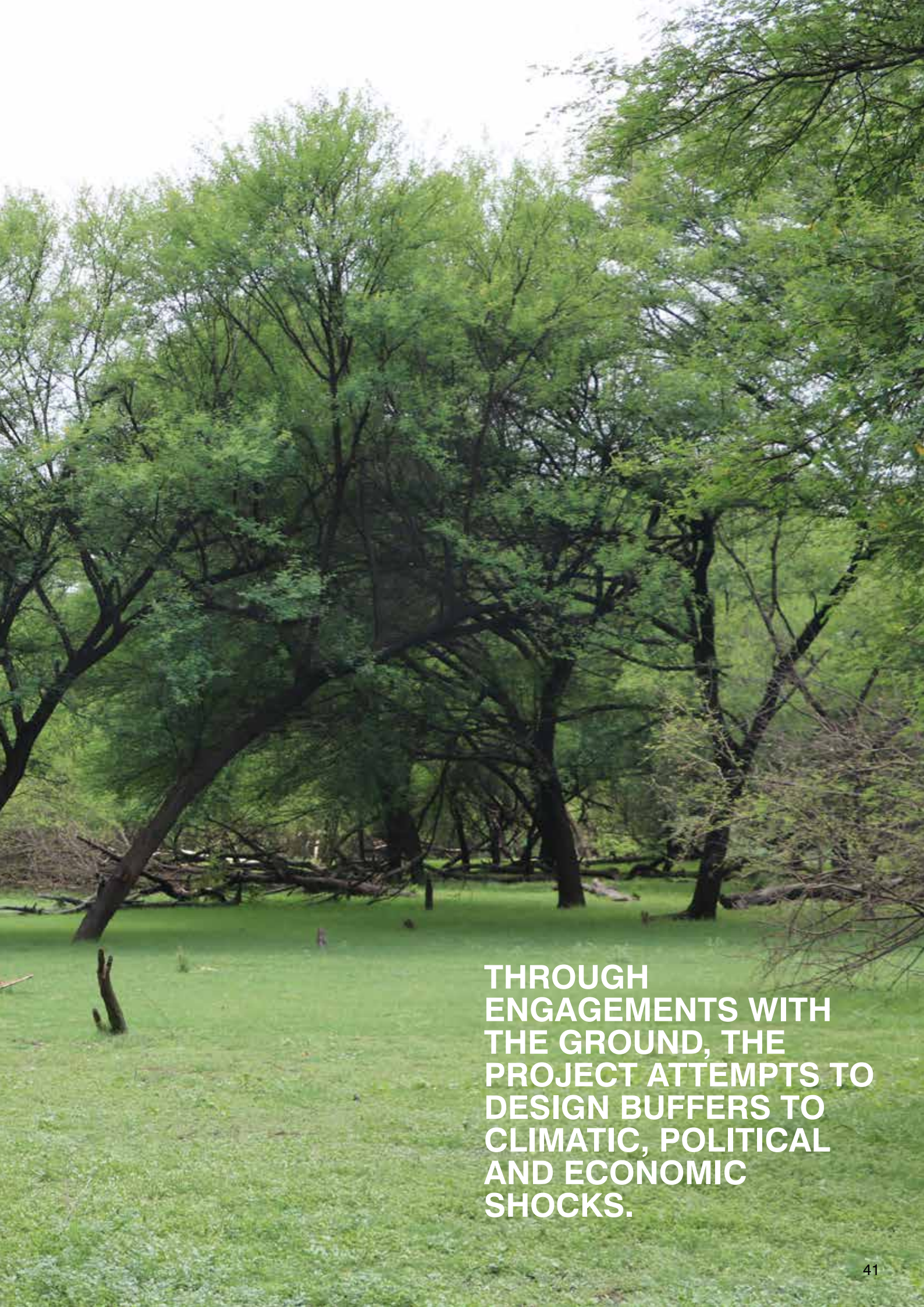
NEW DEVELOPMENTS HAVE TRANSFORMED OUR UNDERSTANDING OF VARIOUS ECOLOGICAL PROCESSES, AGENCIES, BACTERIAL AND FUNGAL SOIL LIFE AND THEIR DYNAMIC INTERACTIONS.



THESE DEVELOPMENTS PUSH US TO REIMAGINE THE THOL SANCTUARY AS ONE OF RADICAL POTENTIAL.



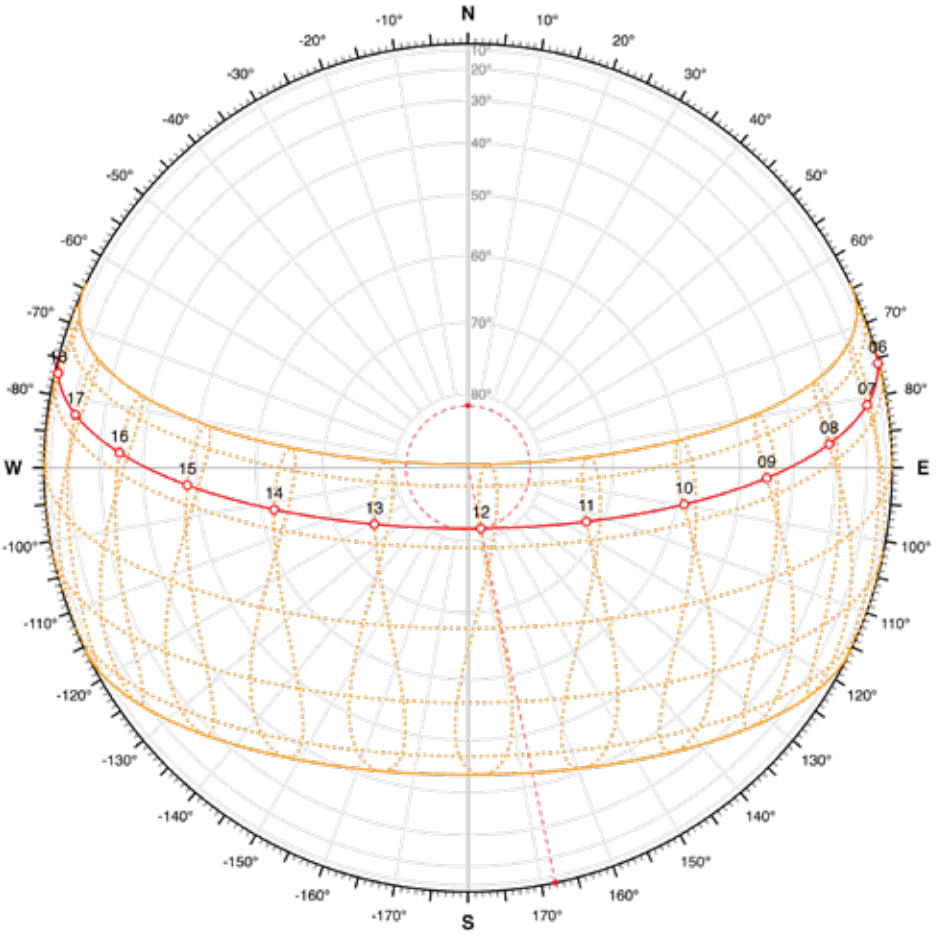
POLICIES AND INCENTIVE STRUCTURES THAT HAVE STEMMED FROM A LEGACY OF COLONIALISM, HAVE FAVOURED MONOCULTURAL MODES OF EXISTENCE, AND ATTEMPTS TO CREATE HOMOGENISATION OF TERRITORY.



THROUGH ENGAGEMENTS WITH THE GROUND, THE PROJECT ATTEMPTS TO DESIGN BUFFERS TO CLIMATIC, POLITICAL AND ECONOMIC SHOCKS.

Sun Path and Wind Rose diagrams

RIGHT.
The diagrams are for co-ordinates 72,23.
The predominant average hourly wind direction varies throughout the year, West being prevailing wind direction for 7 months of the year.


N
S
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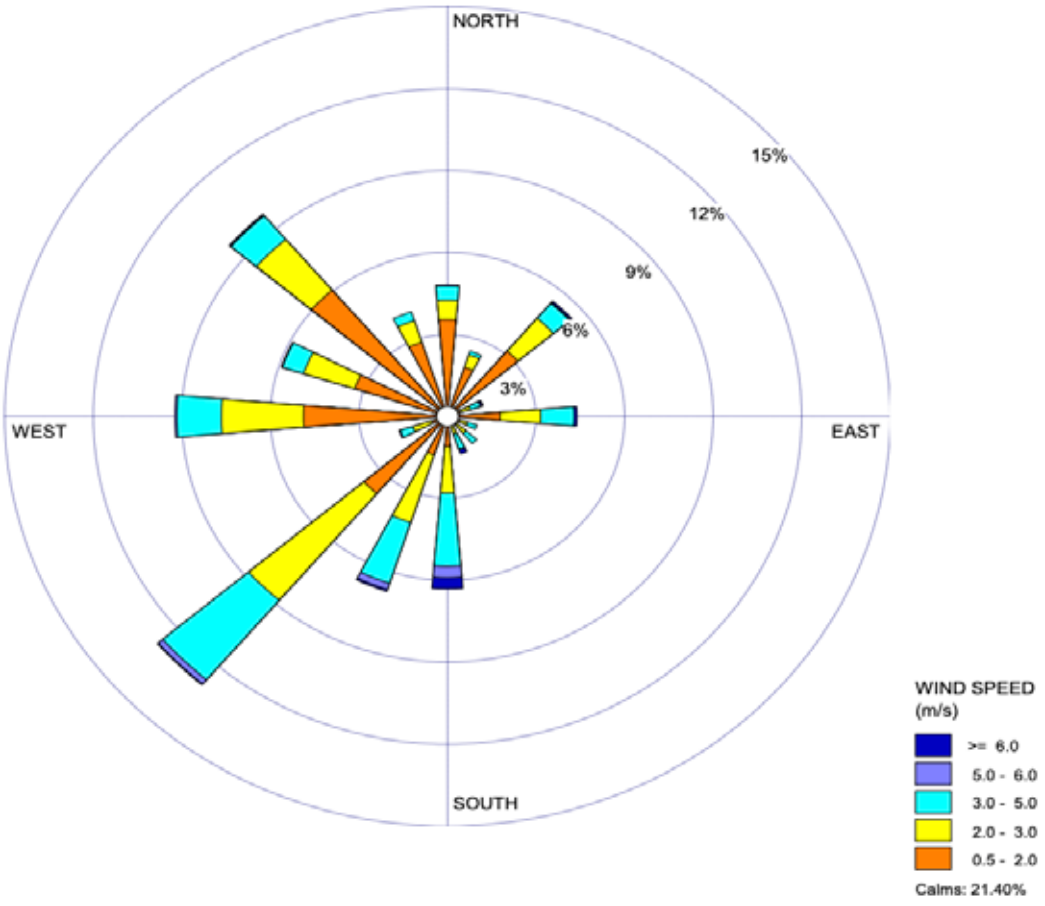
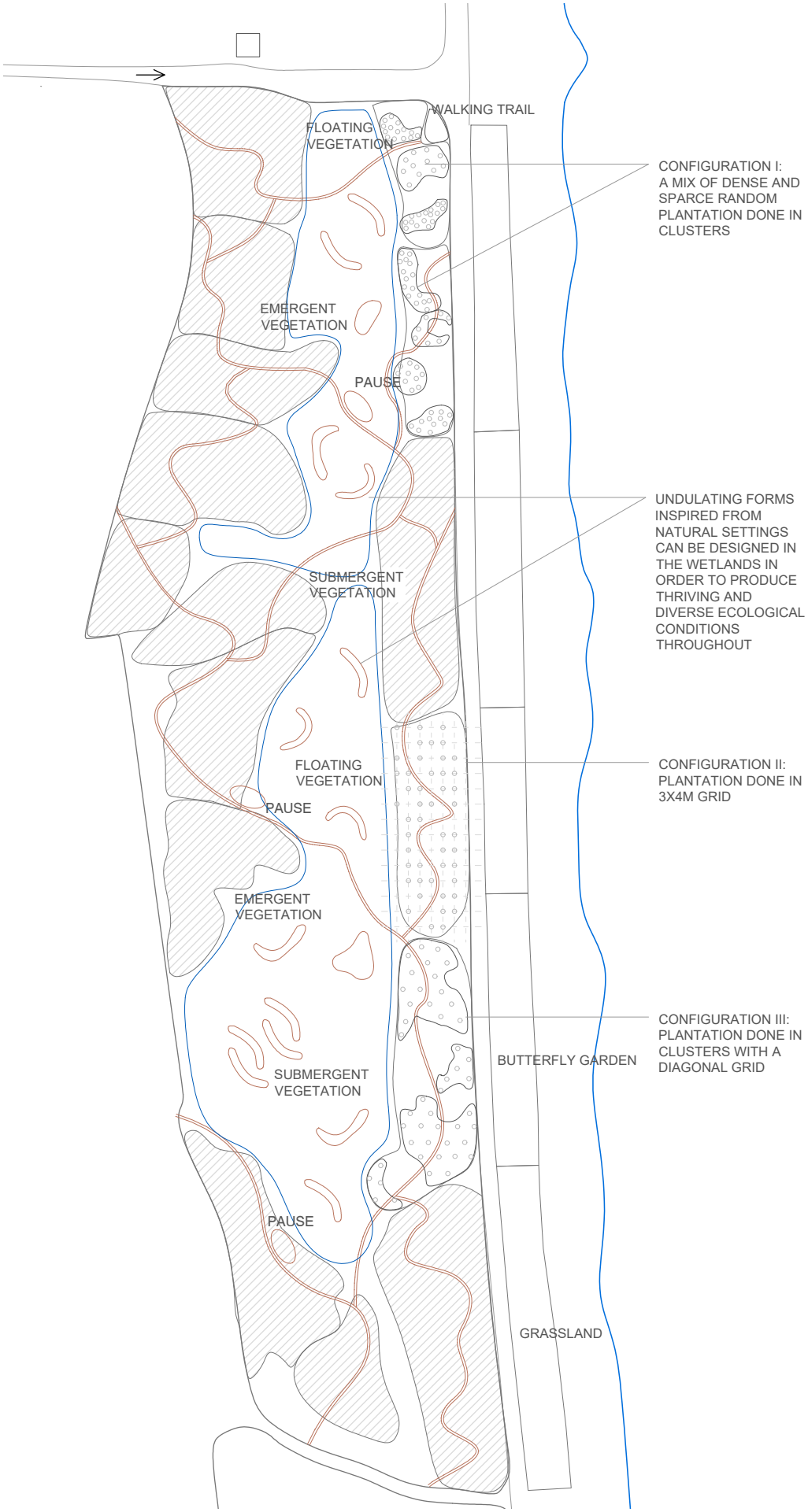

NORTH
EAST
SOUTH
WEST
15%
12%
9%
6%
3%
WIND SPEED
(m/s)
>= 6.0
5.0 - 6.0
3.0 - 5.0
2.0 - 3.0
0.5 - 2.0
Calms: 21.40%

Summary of Steps

1. Define initial area of work and Secure its perimeter.
2. Clear Rubbish and Garbage and create a series of blue drums around the site for waste collection.
3. Create a water source - pipeline and electrical connection to the plantation zones.
4. Create a water storage and distribution system for irrigation. Water for the project can be drawn from the Thol Lake itself.
5. Build a stockyard/nursery of size 250sqm. This can be made using bamboos and green netting, or can be created in a specific spot under the shade of larger trees. This would be placed near the water source along with a water connection and a flexible hose pipe. This can be near either parking lots. In the future the area can be expanded to create a native tree nursery that can raise and sell saplings of useful plants and trees to visitors.
6. Demarcate the area for clearance of land for trees and ponds, for phase 1 of food forest/intervention. Start clearing the land as described. Store large biomass inside the demarcated area and collect biomass for shredding. Arrange shredded biomass in a separate area within the demarcated zone. The maximum height of the pile should be no greater than 80 cm and is to be arranged linearly for decomposition.
7. Perimeter reinforcement to create a temporary enclosure for the defined zone.
8. Purchase dumpers of cow-dung, and adequate amount of minerals for starting nursery and initial plantation. Minerals should be stored near the nursery. Cow dung can be placed in various piles for convenience of movement wherever required. Recommendations for the minerals to be purchased will be made. An initial list of plants required for the food forest and order and store onsite in the nursery. Map the plants onto the landscape.
9. Start the removal of the Prosopis based on the specifications described through the plan.
10. Start earthworks for the initial phase based on the approved design. Purchase additional manure and minerals for the initial phase if required.
11. Create Tree Pits - approximately 1 meter cube, and fill it with the specified amended soil. Water thoroughly and infuse with Jeev Amrut. (Preparation steps will be added). Leave this for 2-3 weeks before planting.
12. Carry out the plantation of the primary species and plant N-fixing legumes around in the same pit. Mulch with neem leaves or grain straw to a layer of at least 4 inches.
13. Create an irrigation system - either with drip or a manual system depending on the size and scope of the phase and make an irrigation schedule.
14. Create a 21 day Jeev Amrut infusion cycle for the first 6 months and then change it to a 3 month cycle.
15. Maintain the plants for at least three year.

Plan of Zone A - an Edible Food Forest showing different possibilities of plantation configurations.


WALKING TRAIL
FLOATING VEGETATION
CONFIGURATION I: A MIX OF DENSE AND SPARCE RANDOM PLANTATION DONE IN CLUSTERS
EMERGENT VEGETATION
PAUSE
UNDULATING FORMS INSPIRED FROM NATURAL SETTINGS CAN BE DESIGNED IN THE WETLANDS IN ORDER TO PRODUCE THRIVING AND DIVERSE ECOLOGICAL CONDITIONS THROUGHOUT
SUBMERGENT VEGETATION
FLOATING VEGETATION
CONFIGURATION II: PLANTATION DONE IN 3X4M GRID
PAUSE
EMERGENT VEGETATION
CONFIGURATION III: PLANTATION DONE IN CLUSTERS WITH A DIAGONAL GRID
BUTTERFLY GARDEN
SUBMERGENT VEGETATION
PAUSE
GRASSLAND


0
75
150 m

Orthographic image created by stiching together three hundred Aerial photographs of the site using a process called photogrammetry.

Creating New Ground

A new ground is created by increasing the living surface area by the Tessellation and Fractalization of the landscape through a system of modified contour swales that have various gradations in density, granularity height and topography, that will prevent erosion and infiltrate water into the ground, hydrating and storing water in the subsoil. Recontoured land also serves to create various niches as well as an increased surface area of the canopy structure to uptake maximum sunlight, whilst creating increased shaded areas on the ground.

These operations will boost ecological functioning, sequester carbon in productive soils, harvest energy, and conserve water.

Soil Chromatography

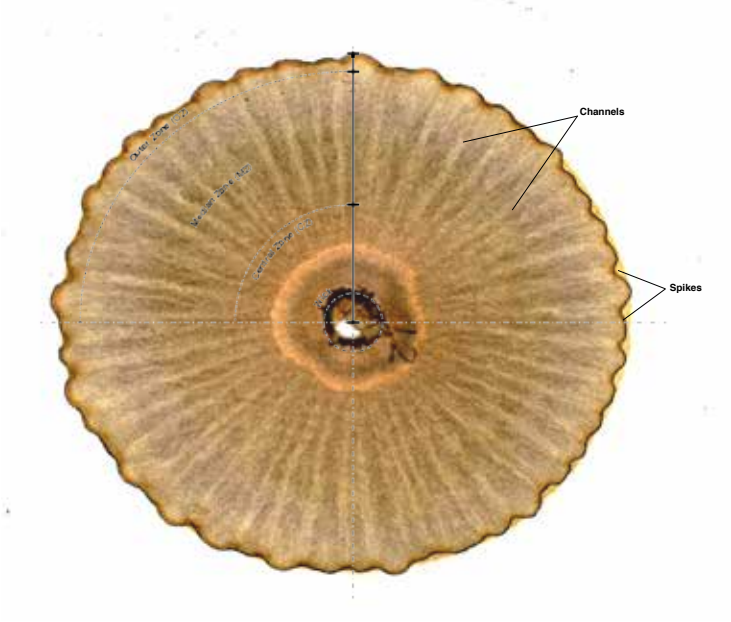
In the 1950s, Ehrenfried Pfeiffer pioneered a novel way of working with paper chromatography to assess the qualities of humus in soils or compost. This new method, known today as Pfeiffer's Round Filter Chromatography, employs filter papers treated with silver nitrate. The organic substances, such as soil or compost, are mixed together with a solution of sodium hydroxide before application to the paper. The mixture is then poured into a petri dish, and is drawn up through a wick inserted through the middle of the paper.

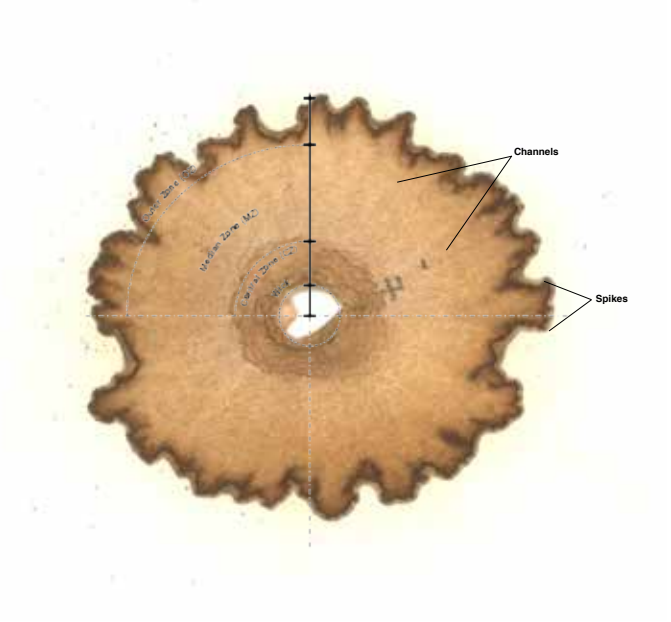
Pfeiffer's groundbreaking work was to develop a pictorial method for portraying biological processes. But these qualitative features — form, color, and pattern — are related to objective aspects of the soil or compost sample. Various studies make clear how the different nutrients, organic substances, and humus fractions are separated by the capillary action of the paper.

LEFT.
Testing Various Soil Samples at Hidimbavan, Thol.

RIGHT.
Table: Description of chromatogram features and parameters measured to quantify variability among chromatograms.

Feature	Parameters measured	What it represents	Abbreviation
Central	Central Zone radius (mm)	Patterns in the central zone inform about the presence of minerals. These are the heaviest contents of the digest to move into the filter paper and are thus move the least distance from the centre of the filter paper.	CZ
Median	Median Zone radius (mm)	Structure indicates the presence of proteins, organic carbon and organic matter (minerals and humus).	MZ
Outer	Outer Zone radius (mm)	"Clouds" at the ends of spikes indicate available nutrients. Bacterial enzyme activity displayed in this zone.	
Total	Total radius (mm)		TR
Combinations	Median + Outer Zone radius (mm)		MZ+OZ
	Central Zone radius: Median + Outer Zone radius		CZ:MZ+OZ
Channels	Channels (1=absent, 5=fully developed)	Greater number of channels suggests increased organic matter and nutrients. Channels extending across zones indicate integration of soil components.	Channels
# channels	Number of channels in quadrant		# channels
Spikes	Spikes (1=absent, 5=fully developed)	Greater number of spikes suggests increased organic matter and nutrients. Well-developed spikes are thought to represent healthy soil.	Spikes
# spikes	Number of spikes in quadrant		# spikes
Colour	Colour intensity (1=blurred, 5=intense)	Warm colours (gold, red, yellow, orange, cream) and/or high colour intensity indicate healthy soil. Colder colours (grey, dark brown, or blueish) suggest soils with less microbial activity.	Colour
Rings	Number of concentric rings	Strong rings indicate possible excess of soluble minerals	Rings

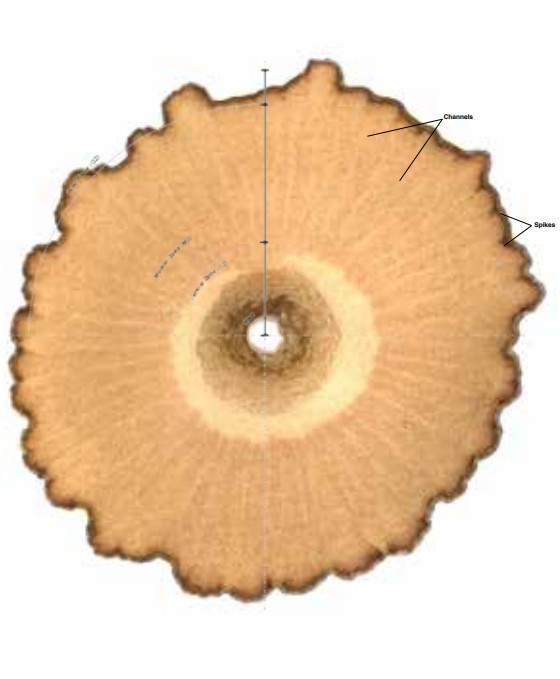


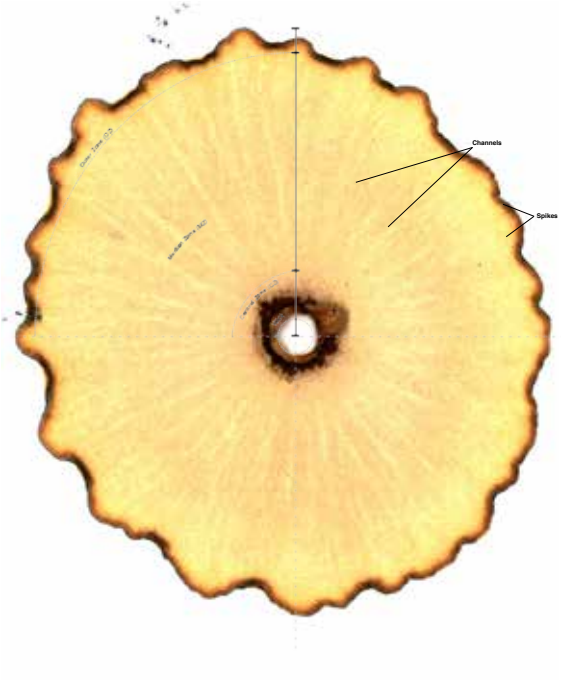


Location : Thol Sanctuary
Soil type : Clayey
Observations :
CZ- 12 mm
MZ - 12mm
OZ - 2 mm
Channels - 5
Spikes - 5
Colour - 5
Rings - 5

Location : Thol Sanctuary
Soil type : Top soil
Observations :
CZ- 7 mm
MZ - 12 mm
OZ - 2 mm
Channels - 1
Spikes - 4
Colour - 4
Rings - 3

Test results of soil chromatography of soil samples from Thol Lake. This experiment has been conducted by Anahita Brahmbhatt.





Location : Hidimbavan
Soil type : Created top soil
Observations :
CZ- 10 mm
MZ - 10 mm
OZ - 2 mm
Channels - 2
Spikes - 5
Colour - 3
Rings - 4

Location : Hidimbavan
Soil type : Clayey soil
Observations :
CZ- 5 mm
MZ - 12 mm
OZ - 2 mm
Channels - 1
Spikes - 5
Colour - 3
Rings - 2

Building Productive Soil

By accelerating components of the Nitrogen and Carbon Cycles of the ecosystem, various processes of natural development are intervened into - in order to create a deep soil system and a high carbon component that will in turn boost primary production of the ecosystem (increase rates of carbon sequestration), increase the water retention capacity of the soil, and produce cooler microclimatic conditions throughout the site.

REBUILDING

Owing to poor soil quality, it was necessary to rebuild the soil and increase its productivity. Strategies to re-use the waste generated from the removal of invasive species are employed.

The bawals removed from site are used to fill up trenches in order to let it decompose inside and create a carbon rich layer to introduce and plant new species.

BIOMASS

The Bawal gets shredded into Wood Chips, creating fertile soil conditions as it decomposes. These conditions will accommodate a higher diversity of species.

MULCHING

Dry leaves and straw are used to layer the top surface with mulch in order to conserve soil moisture, improve the fertility and health of soil.

THERMOPHILIC COMPOST

Thermophilic compost pile consisting of wood chips is spread out to thoroughly aerate it and begin the ‘cool’ decomposition phase.

SOIL MIX

The soil mix consists of minerals, compost, biomass, animal manures, biochar, etc.

BIOENZYMES

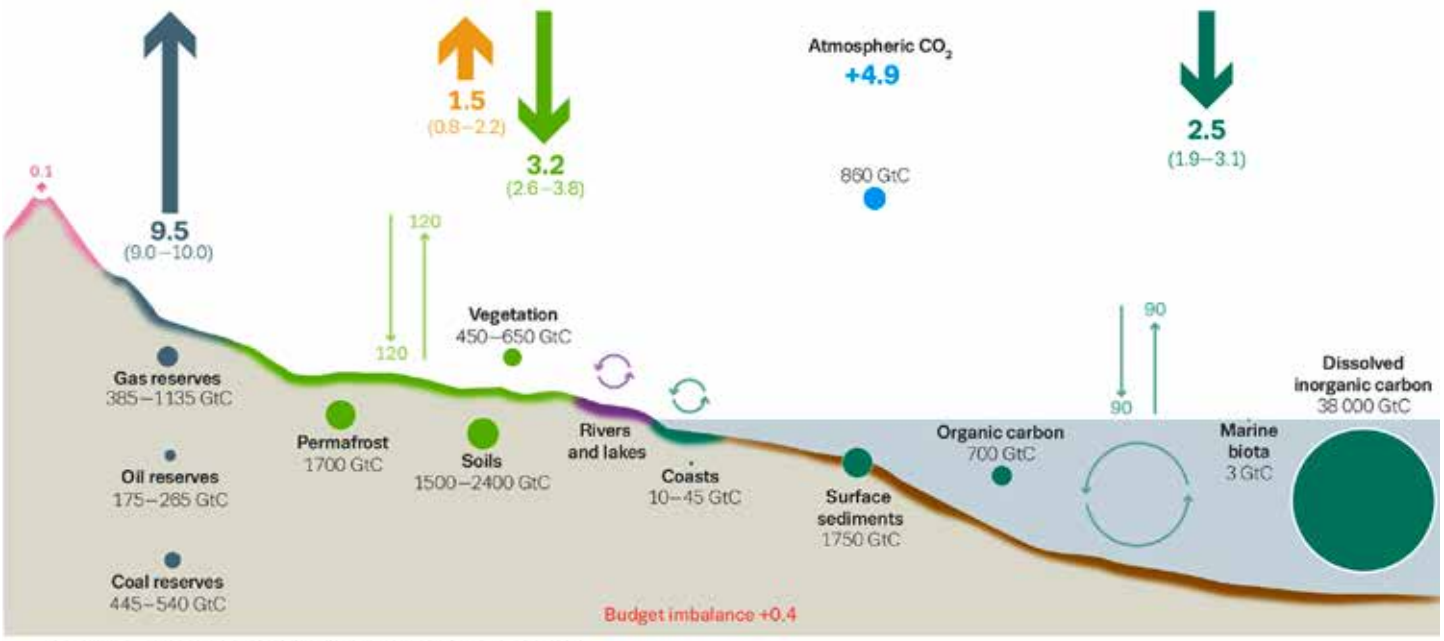
Jeevamrut - a microbial concoction that is used to fertilise the soil and also used as a microbial inoculant to repopulate the soil microbiome - is mixed with biochar so that it can retain the nurtients in soil for longer and keep releasing it according to the plant’s requirement.

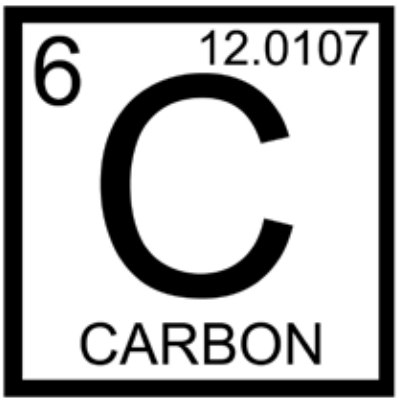
Carbon

Organic Carbon is the key building block of life and a driver of of ecosystems. Carbon's abundance, its unique diversity of organic compounds, and its unusual ability to form polymers at the temperatures commonly encountered on Earth enables this element to serve as a common element of all known life. It is the second most abundant element in the human body.

Over the long term, the carbon cycle seems to maintain a balance that prevents all of Earth's carbon from entering the atmosphere (as is the case on Venus) or from being stored entirely in rocks. This balance helps keep Earth's temperature relatively stable, like a thermostat. Increasing organic carbon and its cycling in ecosystems can yield the following results.

RIGHT.
Global Carbon Cycle
Source.
P. Friedlingstein et al.: Global Carbon Budget 2019


0.1
9.5
(9.0–10.0)
1.5
(0.8–2.2)
3.2
(2.6–3.8)
Atmospheric CO_2
+4.9
860 GtC
2.5
(1.9–3.1)
120
120
Vegetation
450–650 GtC
90
90
Dissolved inorganic carbon
38 000 GtC
Gas reserves
385–1135 GtC
Permafrost
1700 GtC
Soils
1500–2400 GtC
Rivers and lakes
Coasts
10–45 GtC
Organic carbon
700 GtC
Marine biota
3 GtC
Oil reserves
175–265 GtC
Surface sediments
1750 GtC
Coal reserves
445–540 GtC
Budget imbalance +0.4
Anthropogenic fluxes 2009–2018 average GtC per year
Fossil CO_2 E_{FF}
Land use change E_{LUC}
Atmospheric increase G_{ATM}
Carbon cycling GtC per year
Land uptake S_{LAND}
Ocean uptake S_{OCEAN}
Budget imbalance B_{IM}
Stocks GtC



RIGHT.
How Agro-biodiversity and Agro-ecology offer solutions to Climate Change by growing Living Carbon
©Navdanya

IMPROVED WATER QUALITY

INCREASED CATION EXCHANGE CAPACITY

INCREASED WATER HOLDING CAPACITY

IMPROVED WATER FILTRATION

REDUCED RUNOFF

REDUCED FERTILISER INPUTS

INCREASED SOIL BUFFER CAPACITY

INCREASED BIOLOGICAL ACTIVITY

ENHANCED NUTRIENT CYCLING AND STORAGE

ENHANCED MICROFLORAL DIVERSITY

INCREASED PESTICIDE ADSORPTION

AESTHETIC APPEAL TO SOIL

MORE ‘WILDLIFE’

REDUCED AIR POLLUTION

IMPROVED SOIL TILTH AND STRUCTURE

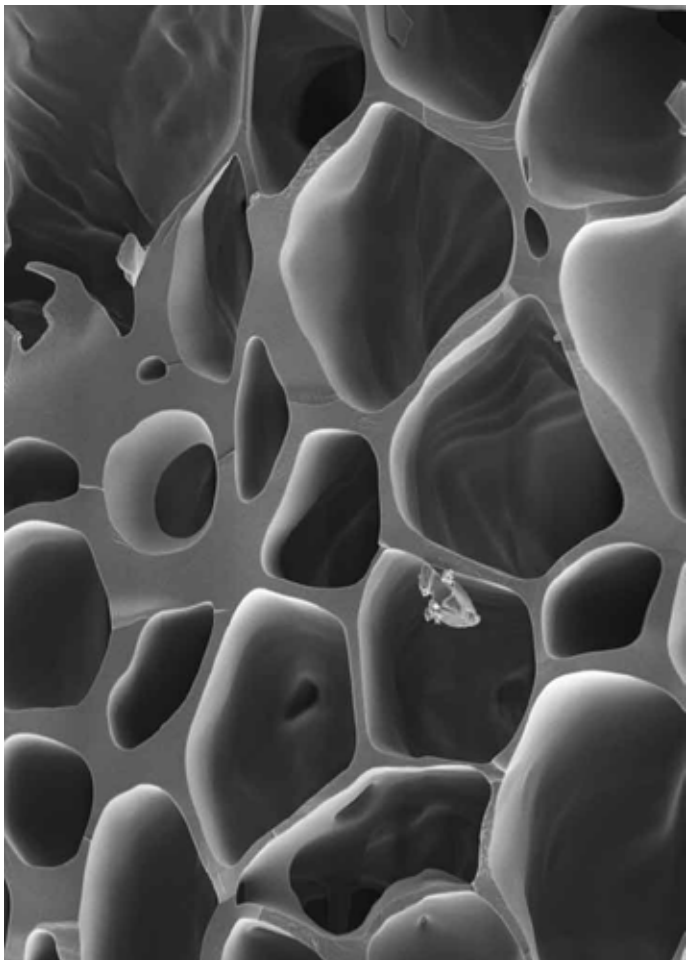
DECREASED SOIL COMPACTION

REDUCED SOIL EROSION

Biochar

Biochar can be defined simply as properly produced char (charcoal) used for agricultural purposes. It can be produced from any type of biomass, including agricultural and forestry waste streams and manure. Biochar is manufactured by heating the biomass feedstock in an oxygen deprived environment, a process which is called “pyrolysis”. Syngas, a flammable combination of hydrogen, carbon monoxide and methane, and excess heat are byproducts of the pyrolysis process. Once the reaction is started, it is largely self-sustaining, requiring no additional input of energy.

Source.
©Carbon Zero



LEFT.
Microscopic Biochar showing its highly porous nature.
©Google Images

RIGHT.
Some ways that biochar helps improve soil quality.
Source.
http://biochar.info/?p=en.biochar_overview

ENHANCING SOIL STRUCTURE

INCREASING WATER RETENTION AND AGGREGATION

DECREASING ACIDITY

REDUCING NITROUS OXIDE EMISSIONS

IMPROVING POROSITY

REGULATING NITROGEN LEACHING

IMPROVING ELECTRICAL CONDUCTIVITY

IMPROVING MICROBIAL PROPERTIES

Biochar Production
Kiln Design

In a more developed phase of the project, the sanctuary might be able to host its own BioChar Kiln for ecosystem restoration purposes, enhancing fertility and rates of Carbon cycling through the system, providing local employment and even disseminate knowledge and skills about producing, managing and operating such useful devices.

The Tipping Batch kiln design has several advantages:

- It minimizes the labor cost of operating a large batch kiln.
- It provides the option to condense wood vinegar and/or tars from the gas stream, which can increase potential revenue.
- Tipping mechanism allows for rapid, easy unloading and reloading.
- By configuring 3 units in a round-robin fashion, the excess heat from one is used to start the pyrolysis process in another.
- It minimizes electrical power requirement- a 5 kW generator is enough in remote locations.
- It minimizes water requirement as it is not necessary if the char is allowed to cool sufficiently, to about 150° C, before opening the kiln.
- The 10m3 model produce about 100 - 135 kgs of char per cubic meter of capacity, or 1.35 tonnes per batch, depending on the density of the wood and how tightly the pieces can be packed. If a condenser is used, we anticipate about 60 kgs of wood vinegar per cubic meter of capacity, or 600 kgs per 10 m3. batch, will be extracted.

RIGHT.
The workings of a Tipping Batch kiln.

Conserving Water

By employing different strategies across the site and carefully marking out contours, water is captured within the site and directed towards the drier parts to maximize the beneficial use of water resources. By maximizing the flow of water to drier ridges (using precise plow lines or mounds that fall slightly off contour), water can be infiltrated across the broadest possible area.

EARTH BERMS

Around various edges of the property, there is an EarthBerm/ Swale that has been created to create a thermal buffering, and to trap topsoil or water from leaving the boundary. Over time, this will be covered with vegetation and the increased living Carbon will create moist and cool Micro-Climatic conditions in the area.

DUGOUT PONDS

'Khet-Talavdi's' or Dugout ponds are created in topographically adequate positions as a way to control erosion, rain water conservation/ infiltration into the ground, and to act as ephemeral water bodies that can host their own ecosystems.

SWALES

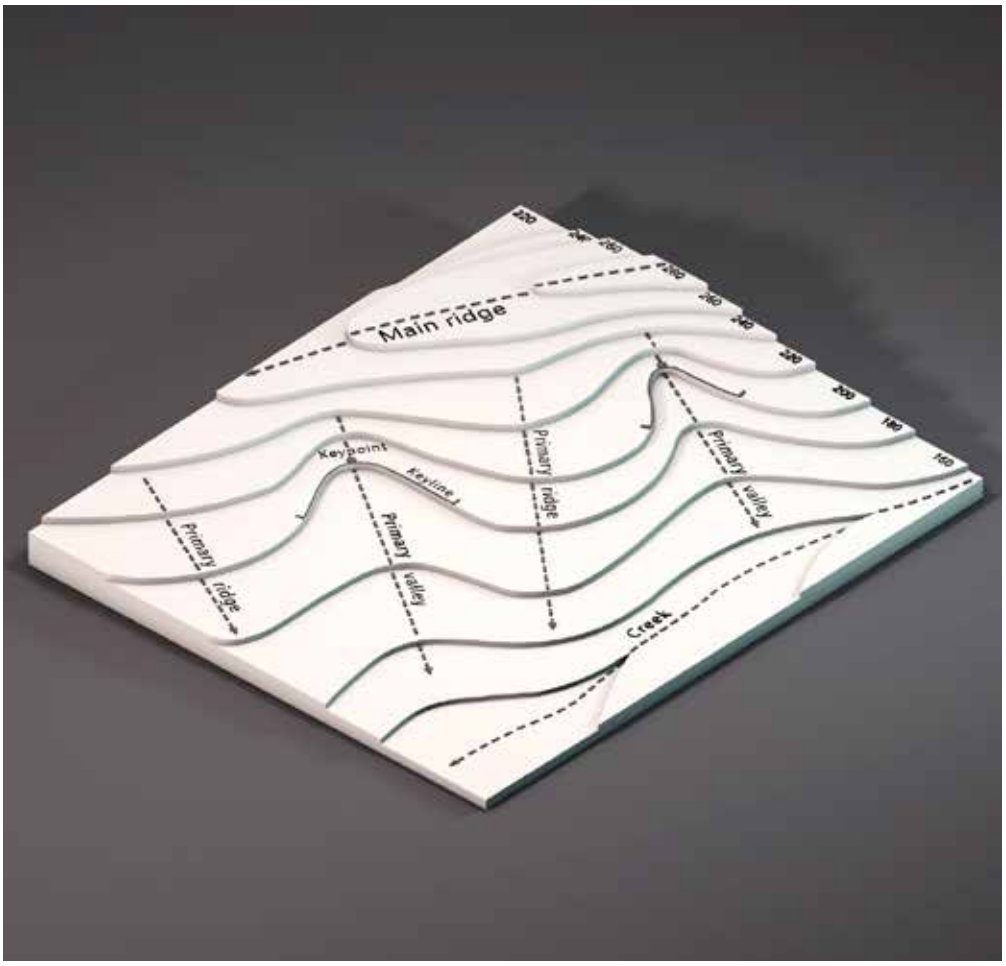
Contour Trenches or 'swales' are dug on dead level lines - these are passive irrigation strategies that infiltrate water flowing from the surface, hydrating the subsoil over time, accumulating organic matter and silt that would otherwise flow away, and create ecological niches and micro climates for a diverse biome of micro fauna, eventually contributing to the larger ecosystem.

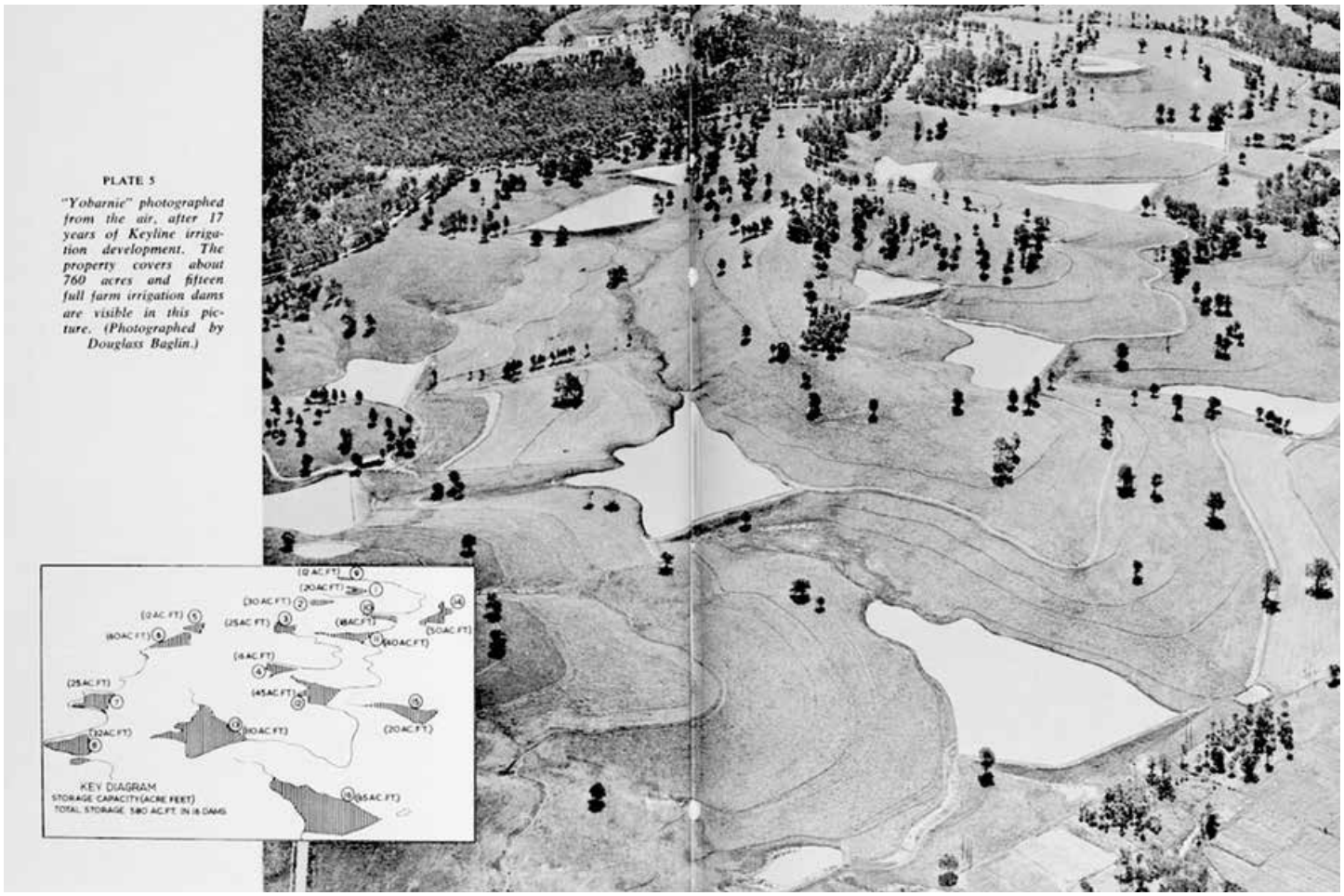
Keyline Geometry
Water Management

Keyline water management is a technique developed in Australia by farmer and engineer P. A. Yeomans. The central idea behind ‘Keyline’ design is to consciously slow, sink and spread rainwater by relieving compaction, opening up pore space in compacted soil and distributing excess water towards drier parts of the landscape. This has the effect of buffering the natural concentration of water towards valleys and reducing flooding.

Source.
http://crkeyline.ca/what-is-keyline-design/

RIGHT.
Remake of the illustration by PA Yeomans: Deploying Keyline Geometry.
Source.
http://crkeyline.ca/what-is-keyline-design/


Main ridge
Keypoint
Keyline
Primary ridge
Primary valley
Primary ridge
Primary valley
Creek



LEFT.
"Yobarnic" - a property of 760 acres and 15 full farm irrigation dams photographed after 17 years of keyline irrigation development.
©Douglas Baglin

RIGHT.
Contour Swales and Erosion Control Structures built in an ecosystem restoration and watershed management project in Maharashtra.
©Paani Foundation


SLOW
SPREAD
SINK
STORE
PLAN

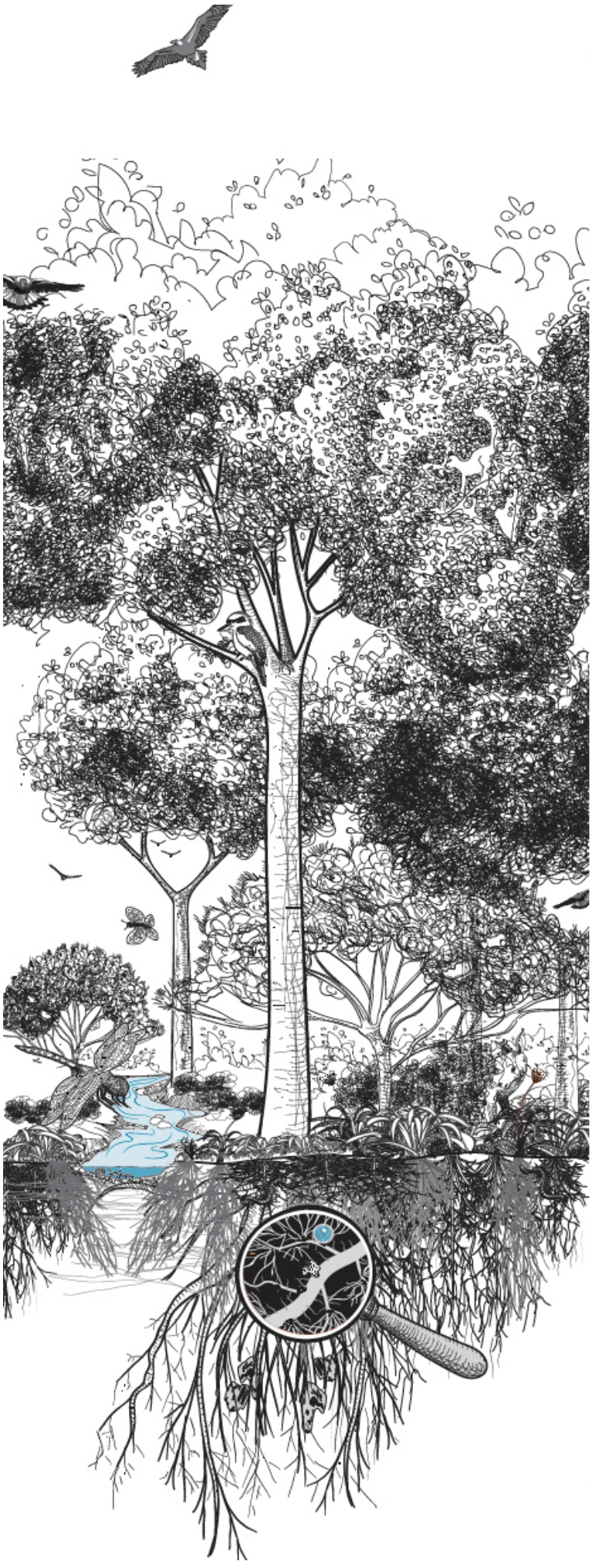
Reduce velocity of storm runoff, reduce erosion, protect flowing water from dangerous swelling

Use gravity to move water from wet areas (valleys) to dry areas (ridges)

Increase infiltration & percolation, increase 'interflow', increase groundwater recharge

Hold water in retention basins, dugouts, ponds reservoirs and in high Organic Matter soil for later use

Plan for Overflow – plan where record storm-water surges will go



50		**Emergent**	Receives most (<90%) of the sunlight. Habitat for most birds.
30			
		Upper Canopy	Receives <20% of sunlight
15			
	Vertical Climbing or hanging plants	**Lower Canopy**	Receives 5–10% of sunlight
5			
		Understory	Receives <5% of sunlight
2			
		Herbaceous	Receives <2% of sunlight. A large array of omnivores, herbivores and carnivores
1			
			Litter & decomposing organic matter, animal droppings, seeds, fungal fruiting bodies & a large array of detritivores.
0		**Ground**	
		Water	Includes streams, rivers, marshes & lakes. Can accommodate various herbaceous, understory & lower canopy plants. Typically hosts a very wide array of insects, bacteria, fungi, omnivores, herbivores & carnivores.
		Rhizosphere	Plant roots, fungi & extensive mycelium networks. Many detritivores, & a narrow array of omnivores, carnivores & herbivores.
–20			

Forest structure, height and depth in metres.

Tree Guilds

A guild is a group of species. Within a guild each species provides a unique set of diverse services that work in harmony. Guilds take many forms, including guilds of interchangeable plants, but the most common type is a mutual support guild. Mutual support guilds include compatible animals, insects, plants, etc. Plants may be grown for food production, drawing nutrients from deep in the soil through tap roots, fixing nitrogen (legumes), attracting beneficial insects, and repelling pests.

RIGHT.
Plants of various types performing following functions in an ideal guild.

NITROGEN-FIXING PLANTS TO SUPPLY NITROGEN

MINERAL-ACCUMULATOR PLANTS TO HELP SUPPLY OTHER NUTRIENTS

BENEFICIAL INSECT PLANTS TO MINIMISE PEST PROBLEMS

BEE PLANTS, BOTH FOR WILD AND HONEY BEES

PLANTS WITH DIFFERING ROOT SYSTEMS, TO EXPLOIT THE SOIL SPACE AND SOIL LAYERS EFFICIENTLY

AROMATIC PLANTS TO CONFUSE PESTS AND INCREASE SYSTEM HEALTH

GROUND-COVER PLANTS TO DENSELY COVER THE SOIL SURFACE

Azolla Pinnata fern

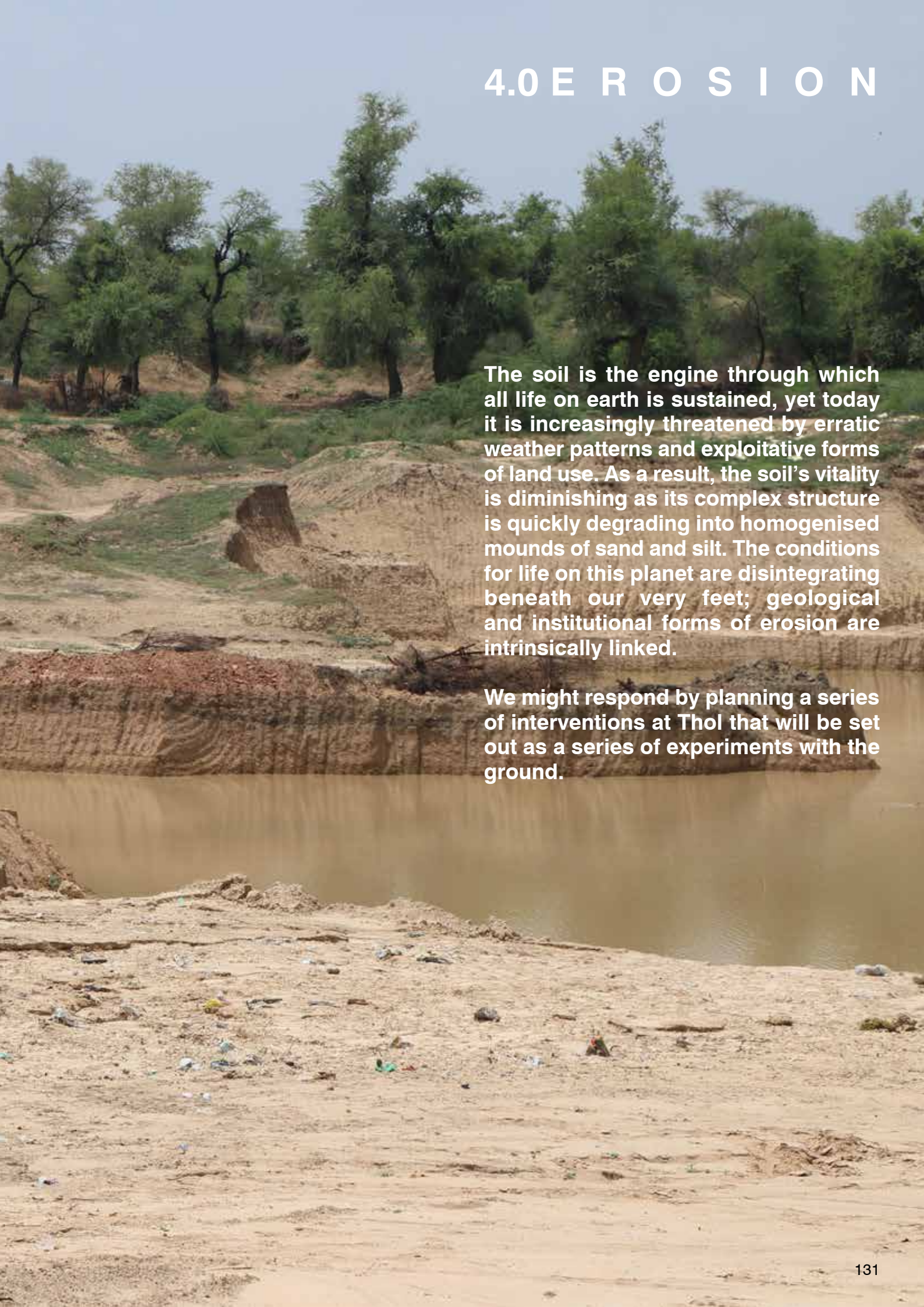
Ipomea Aquatica (An extremely agressive and invasive aquatic species)

Existing set of conditions in the wetlands of the peripheral ditch. Species of remediating grasses or beneficial aquatic plants can also be selected and brought from other such local wetlands, and experimented with here before they are introduced in the larger waterbody.

Typha latifolia - Bulrush

Thriving aquatic vegetation in one of the wetland patches

4.0 E R O S I O N



The soil is the engine through which all life on earth is sustained, yet today it is increasingly threatened by erratic weather patterns and exploitative forms of land use. As a result, the soil's vitality is diminishing as its complex structure is quickly degrading into homogenised mounds of sand and silt. The conditions for life on this planet are disintegrating beneath our very feet; geological and institutional forms of erosion are intrinsically linked.

We might respond by planning a series of interventions at Thol that will be set out as a series of experiments with the ground.

Land Mismanagement Degradation Indicators

The declaration and definition of the space, within the codified set of property rights and absolute forms of ownership - as a ‘Bird Sanctuary’, ‘Irrigation Tank’ or ‘Ecologically Sensitive Zone’, are tools used by the state to delegitimize the commons and reinstate binaries of public and private.

We intend for Thol to be a place where participatory management of ecology and changes to policy regarding such areas can set a new precedents for such practices across India.

TOP RIGHT.
Acacia Nilotica and Prosopis Juliflora

INVASIVE SPECIES

Monocultures of Desi, Gando and Israeli Bawal have been planted by the Forest department in the 1980s as part of the afforestation program in order to increase green cover but have now become predominant and have caused an adverse biodiversity situation today.

DESTABLISATION OF SLOPE

People are deployed to remove grass along the slopes for the purpose of maintenance, leading to destabilisation of the slope and soil erosion.

FELLING OF TREES

On the side of the lake, trees along the slope are being felled carelessly for better viewing of birds in the lake. However, that is might intensify the problem of erosion along the slope.

Water Pollution and Water Management

The Thol lake is a man made irrigation tank, and the pressures from the irrigation department as well as the influx of Narmada water have dramatically changed its seasonal patterns. The irrigation department currently maintains and regulates the water level of the lake between 3 to 6 feet.

Additionally, there are Oil and Natural Gas Commission (ONGC) wells installed in one part of the lake. It also receives toxic affluents that get discharged into the canals by industrial zones and adjacent agricultural lands. Over a period of time, this influx and outflux has led to waterlogging in the peripheral wetland areas and overfertilization of the catchment area that are causing cyano bacterial blooms in the lake, severely threatening the ecological balance of the sanctuary.

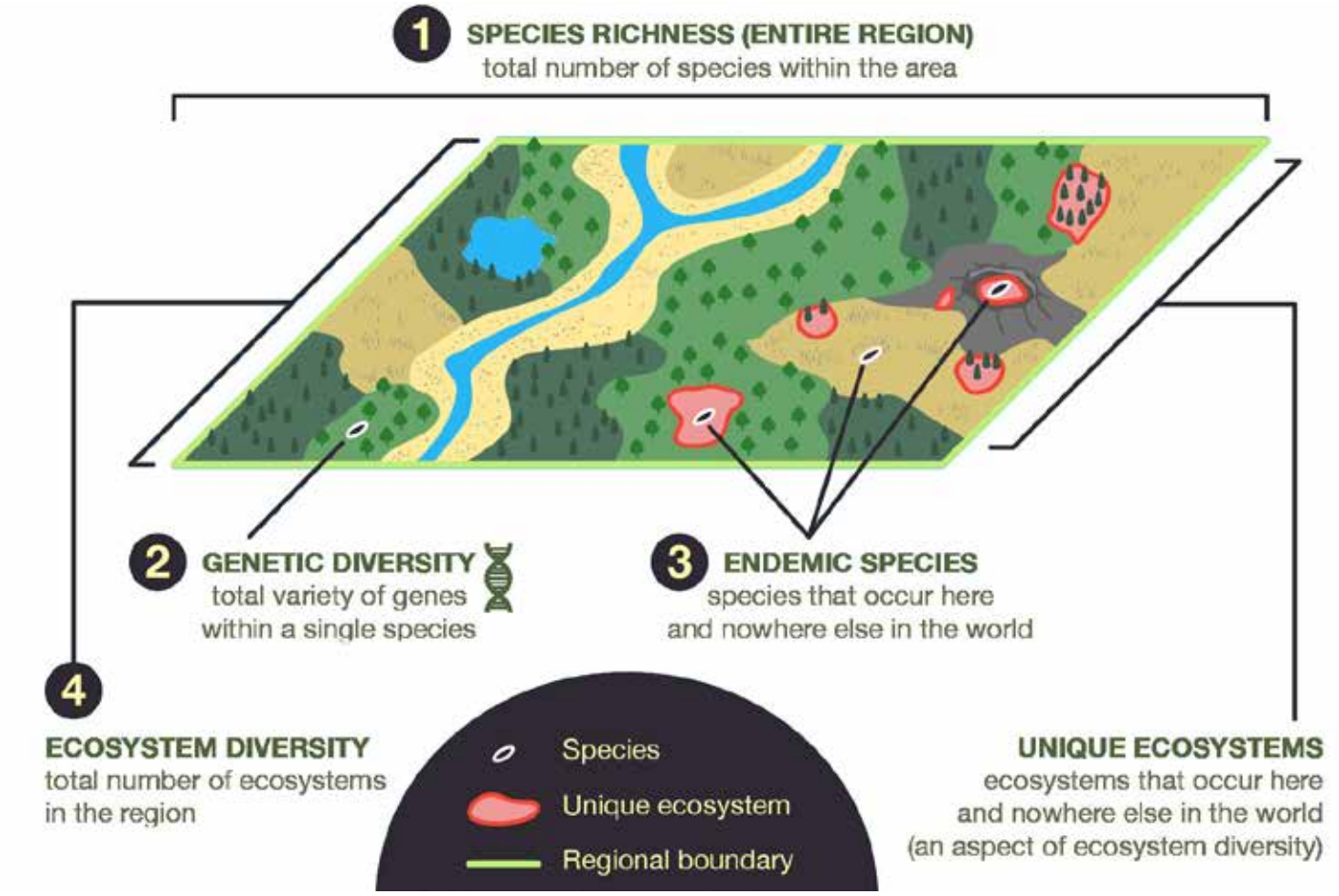
Biodiversity

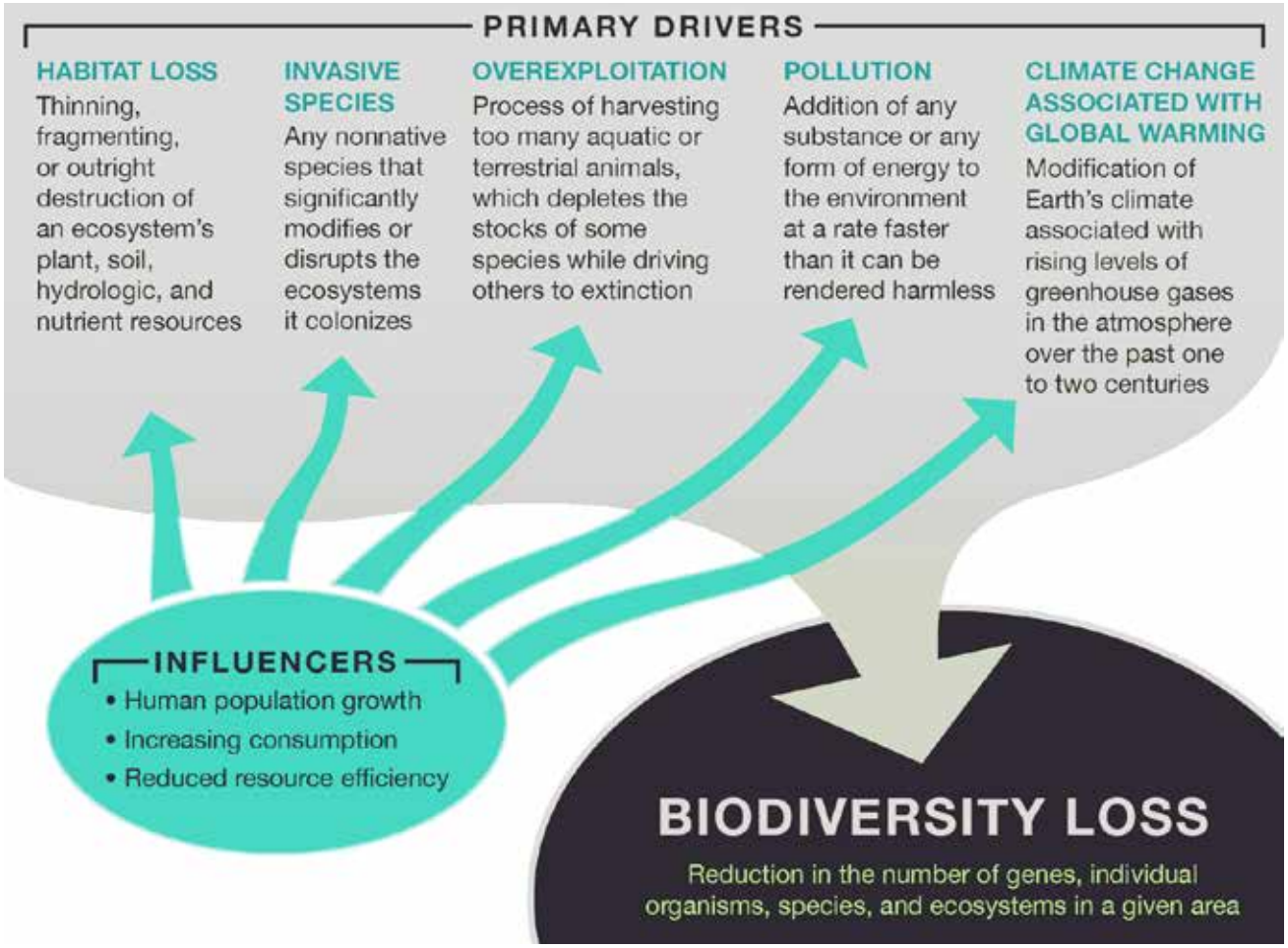
“Biological diversity” refers to the variety of life on Earth at all its levels, from genes to ecosystems, and can encompass the evolutionary, ecological, and cultural processes that sustain life. Biodiversity includes not only species we consider rare, threatened, or endangered but also every living thing—from humans to organisms we know little about, such as microbes, fungi, and invertebrates.

Humans and human cultural diversity are part of biodiversity. The term “biocultural” means the dynamic, continually evolving and interconnected nature of people and place, and the notion that social and biological dimensions are interrelated. This concept recognizes that human use, knowledge, and beliefs influence, and in turn are influenced, by the ecological systems of which human communities are a part.

TOP RIGHT.
Four different ways to measure Biodiversity

BOTTOM RIGHT.
The primary drivers of biodiversity loss are influenced by the exponential growth of the human population, increased consumption as people strive for more affluent lifestyles, and reduced resource efficiency


1 SPECIES RICHNESS (ENTIRE REGION)
total number of species within the area
2 GENETIC DIVERSITY
total variety of genes within a single species
3 ENDEMIC SPECIES
species that occur here and nowhere else in the world
4 ECOSYSTEM DIVERSITY
total number of ecosystems in the region
Species
Unique ecosystem
Regional boundary
UNIQUE ECOSYSTEMS
ecosystems that occur here and nowhere else in the world (an aspect of ecosystem diversity)


PRIMARY DRIVERS
HABITAT LOSS
Thinning, fragmenting, or outright destruction of an ecosystem's plant, soil, hydrologic, and nutrient resources
INVASIVE SPECIES
Any nonnative species that significantly modifies or disrupts the ecosystems it colonizes
OVEREXPLOITATION
Process of harvesting too many aquatic or terrestrial animals, which depletes the stocks of some species while driving others to extinction
POLLUTION
Addition of any substance or any form of energy to the environment at a rate faster than it can be rendered harmless
CLIMATE CHANGE ASSOCIATED WITH GLOBAL WARMING
Modification of Earth's climate associated with rising levels of greenhouse gases in the atmosphere over the past one to two centuries
INFLUENCERS
• Human population growth
• Increasing consumption
• Reduced resource efficiency
BIODIVERSITY LOSS
Reduction in the number of genes, individual organisms, species, and ecosystems in a given area

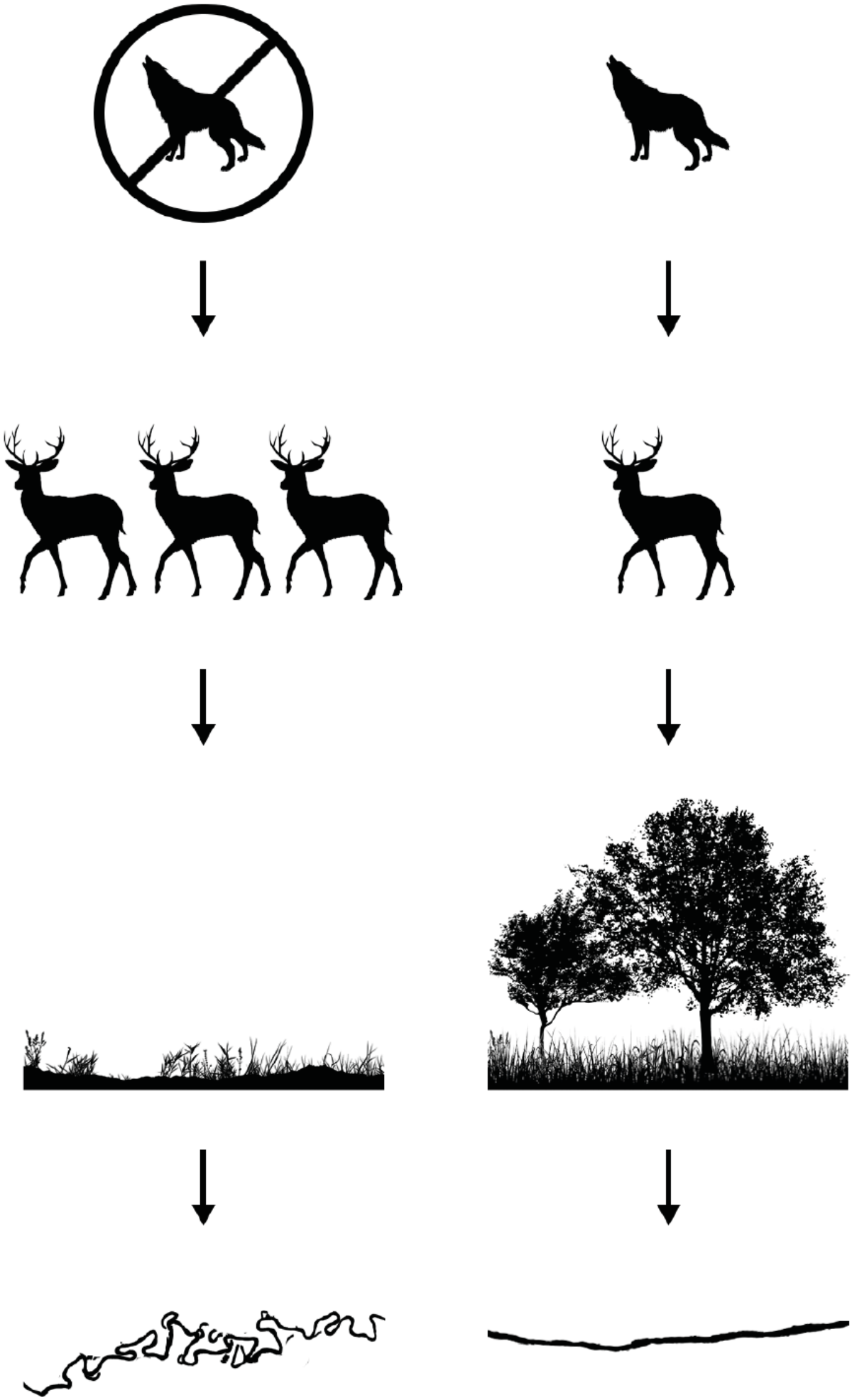
Keystone Species

A keystone species—which can be any organism, from animals and plants to bacteria and fungi—is the glue that holds a habitat together. It may not be the largest or most plentiful species in an ecological community, but if a keystone is removed, it sets off a chain of events that turns the structure and biodiversity of its habitat into something very different. Although all of an ecosystem's many components are intricately linked, these are the living things that play a pivotal role in how their ecosystem functions.

Trophic Cascades and Landscape Transformation

When predators are removed from an ecosystem their absence causes a domino effect which can have profound impacts on other species and the wider landscape. If large carniverous vertebrates (i.e. wolves, bears, coyotes) are wiped out, the herbivores and smaller carnivores on which they feed will be able to increase in population. Increased population of herbivores leads to the decline of certain plant species from overgrazing. The change in vegetation further impacts the structure of the ground, with forests giving way to grasslands, or changes in levels of erosion around rivers.

RIGHT.
The cascading effect of wiping out Keystone Species.
This is a study done on the Yellowstone National Park in the United States, nonetheless a relevant concept.



Ecological Succession

Succession is the process by which the species composition of a habitat changes over time towards a stable condition. Sucession can occur after natural disturbances like floods and fires, or in the aftermath of the withdrawal of human activity. The stable condition reached in the aftermath of sucession is known as a climax, or climax community.

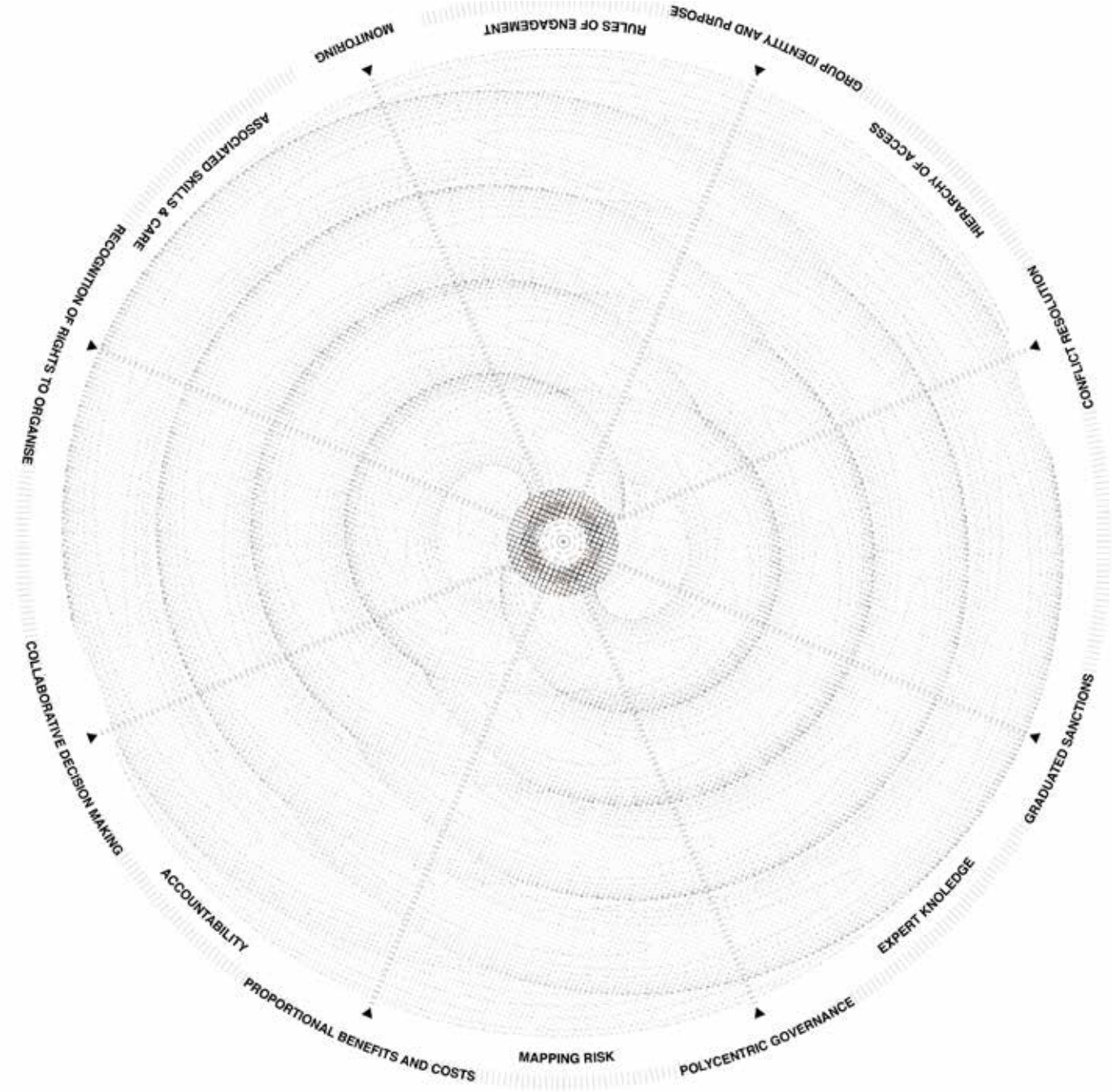
Climate change challenges the traditional notion of a climax community. As species and habitats will have to undergo constant adaptation to previously stable temperature, moisture, weather, and soil conditions, habitats will be undergoing a continuous process of succession.

Primary Succession

Primary succession occurs when organisms colonize a previously lifeless area where the substrate lacks any soil. In an abiotic environment, bacteria and other microorganisms become pioneer species, followed by fungi, lichens, and plants. Paved roads and the gravel which surround them are examples of this. The presence of lichens concentrates moisture and provides detritus for the further growth of plants and the slow penetration of their roots into the road surface.

RIGHT.
Forest Succession over time in six stages

CONSERVATION **INTERVENTION** **RESTORATION**



MITIGATION > **ADAPTATION** > **RESILIENCE**