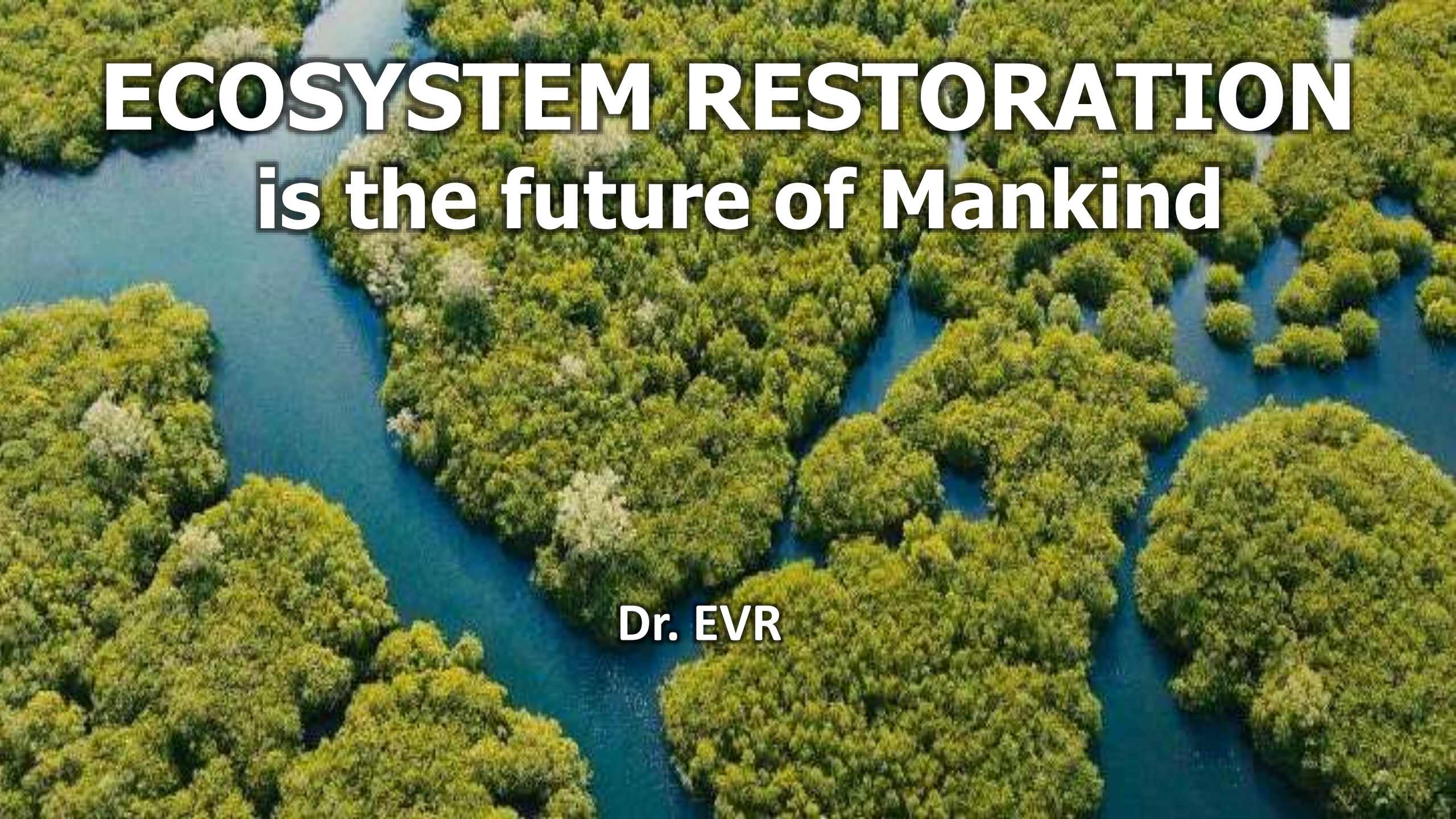

ECOSYSTEM RESTORATION
is the future of Mankind
Dr. EVR

ONE OF THE ENVIRONMENTAL CHALLENGES FACING MANKIND IS ENVIRONMENTAL DEGRADATION

- Land, air and water are environmental resources and support living organisms which also constitute environmental resource.
- All these four components interact and form a complex, dynamic, self sustaining functional natural systems known as ECOSYSTEMS.
- An ecosystem comprises all the living organisms and the interactions among them and with their surroundings in a given place.
- Ecosystems are the web of life on Earth. They include forests, rivers, wetlands, grasslands, estuaries, coral reefs, cities and farmlands.
- Interactions among the components generate a wide range of ECOSYSTEM SERVICES and ECOLOGICAL GOODS which are critical for human well-being.

IMPORTANCE OF ECOSYSTEMS

- Ecosystems provide man with priceless benefits.
- They include a stable climate and breathable air; supplies of water, food and materials of all kinds; Life supporting services such as nutrient cycling, soil formation and primary production; and protection from disaster and disease. Natural ecosystems are important for our physical and mental health. They are home to precious wildlife. These ecosystem services generate ecosystem markets, for example water purification, carbon sequestration, etc.
- All over the world, ecosystems face massive threats. Forests cleared; rivers & lakes polluted; wetlands & peatlands drained; coasts & oceans degraded; mountain soils eroded; and farmlands and grasslands overexploited.
- Unless we protect and restore our ecosystems, we will not only destroy the landscapes we love, we will undermine the foundations of our own well-being and bequeath a degraded, inhospitable planet to future generations.

IMPORTANT ATTRIBUTES OF ECOSYSTEMS

- Ecosystem exists in the climax and degraded states.
- A dense **three-storeyed forest** can be degraded into a scrub which can be converted to a grazing land.
- **Resilience of the ecosystem** - the ability of ecosystem to bring back to its original state. If the disturbance is within the natural threshold of the ecosystem, the ecosystem has a resilience to go back to the original state. If the disturbance exceeds natural threshold, the ecosystem changes from original state to the new state.
- Size of the ecosystems vary widely from a few square meters to several thousand kilometers.

BRINGING BACK DEAD ECOSYSTEMS WHERE FEEDBACK LOOPS ARE DESTROYED

- There are two options : Leave it to natural processes i.e. succession. It would take 100 to 10,000 years.
- The 2nd option is **ECOLOGICAL RESTORATION** of dead or degraded ecosystems. We may call this mechanism as **RESTORATION ECOLOGY**.
- Restoration ecology is ecological engineering and involves assemblage of species leading to development of ecological communities that repair disturbed or destroyed feedback loops leading to restoration of biophysical processes and cut short the time required for different biophysical processes, leading to the development of a **functional ecosystem**.
- Its goal is re-establishment of the characteristics of the ecosystem such as biodiversity and ecological functions that were prevalent before degradation.

STEPS INVOLVED IN THE DEVELOPMENT OF SITE SPECIFIC RESTORATION TECHNOLOGIES

- Selection of appropriate plant species, their associated microbial communities and soil invertebrates
- Development of inoculation technologies
- Monitoring of habitat responses

BIOLOGICAL INPUTS FOR RESTORATION TECHNOLOGY

- Legumes and Grasses
- Microbes and Soil Invertebrates
- Pollinators and seed dispersers

A RESTORATION SUCCESS STORY FROM ONE OF THE WORLD's HIGHLY DEGRADED COAL MINING AREA

LAND DEGRADATION IN JHARIA COALMINES

- Jharia Coalfield is one of the oldest and important coalfields of India.
- It is located in the Dhanbad and Bokaro districts of Jharkhand State and is spread over an area of 450 sq.km.
- Mining was done by erstwhile private owners for more than 100 years without regard to safety, conservation and environment.
- Such type of 'slaughter mining' resulted in severe land degradation, numerous spoil dumps, subsidence, mine fires and socio-environmental problems.

WHERE COULD THIS FOREST COVER BEEN DEVELOPED ??

AND GUESS WHERE THIS PADDY FIELD WAS DEVELOPED ??

YES! THE FOREST COVER, THE LUSH GREEN VEGETATION AND THE PADDY FIELD WERE DEVELOPED ON THIS NAKED SPOIL DUMP WITH STONE BOULDERS AT GONDUDIH, JHARIA COAL MINES AS A RESULT OF ECOSYSTEM RESTORATION

ONE MORE LUSH GREEN RESTORATION SITE

THAT LUSH GREEN VEGETATION WAS DEVELOPED ON THIS NAKED SPOIL DUMP WITH STONE BOULDERS & SHALE FLAKES AT TETULMARI, JHARIA COAL MINES

LIKE THESE,

ME ALONG WITH MY TEAM HAD CREATED 60+ LUSH GREEN FOREST/ VEGETATION SITES ON SPOIL DUMPS & MINED OUT DEGRADED AREAS SPREAD OVER 300+ HACTARES

BUT HOW WAS THAT POSSIBLE ??

THE ANSWER IS

"ECOSYSTEM RESTORATION"

PROCESS OF ECOSYSTEM RESTORATION OF DEGRADED MINED OUT AREAS, JHARIA COAL MINES INTO FUNCTIONAL FOREST ECOSYSTEMS


Physical reclamation


Fencing and Weeds removal


Mulching over slopes


Seed balls preparation


Seed balls broadcasting over the dump


Sapling plantation


Establishment of 3-tier ecological restoration system


Establishment of biodiversity

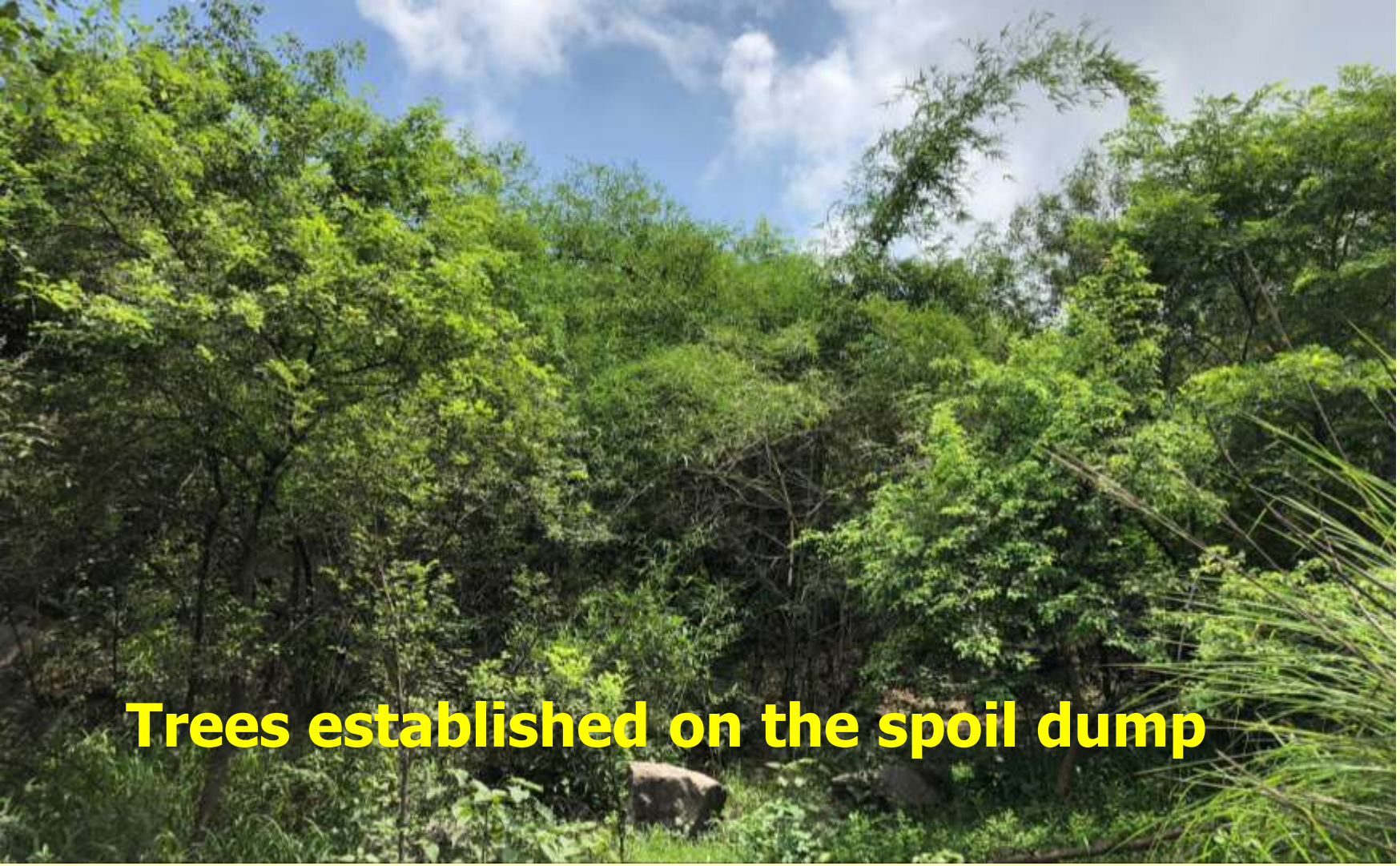
Grass cover established on the spoil dump

Botanical name of grasses	Common name
Cenchrus ciliaris	Anjan grass
Cenchrus setigerus	Dhaman grass
Cynodon dactylon	Dub grass
Panicum nitidum	Panic grass
Saccharum benghalense	Kans grass
Stylosanthes hamata	Stylo grass
Pennisetum pedicellatum	Deenanath grass
Pennisetum purpureum	Napier grass
Cymbopogan martin	Aghin grass

Establishing grass cover on the spoil dump, after deweeding is the most important eco-restoration activity. Grass cover acts as the lower most tier ie., 1st tier in the 3-tier ecological restoration. Grass cover helps soil moisture conservation and also by mulching with dry grass. It adds biomass and organic matter to the stratum, helps to form soil. It triggers microbial activity in the ground cover and invites soil invertebrates. Grasses are introduced on the spoil dump by broadcasting grass seed balls and planting grass clumps directly on the site.

Botanical name of shrubs	Common name
Denrocalamus strictus	Lathi bans
Dendrocalamus asper	Kaghzi bans
Bamboosa bamboos	Thorny Bamboo
Adhatoda zeylanica	Vasaka
Calotropis procera	Aak
Datura stramonium	Datura
Zyzyphus nummularia	Beri
Indigofera trita	Indigo
Dodonaea viscose	Vilayati mehandi
Vitex negundo	Nirgundi
Agave sislana	Gwarpatha
Crotolaria juncea	Sanai

Establishing shrubs on spoil dump is another most important eco-restoration activity. Shrubs acts as the middle tier ie., 2nd tier in the 3-tier ecological restoration. These shrubs help in establishing bio-diversity and food chains. They add biomass and organic matter to the stratum. They become home to insects and birds. Shrubs are introduced on the dump by broadcasting seed balls and direct planting.



Trees established on the spoil dump

Establishing trees on the spoil dump is the final eco-restoration activity. Trees acts as the upper tier i.e., 3rd tier in the 3-tier ecological restoration. Trees help in establishing bio-diversity and food chains. They add biomass and organic matter to the stratum. They become home to insects, birds and animals. Trees are introduced on the spoil dump by broadcasting seed balls and direct planting.

Botanical Name	Common name
Maduca indica	Mahua
Albizia procera	Siris
Dalbergia sissoo	Seesam
Psidium gaujava	Amrut
Phyllanthus embilica	Amla
Albizia lebbeck	Kala siris
Bahunia variegate	Kachnar
Mangifera indica	Mango
Artocarpus hetrophyllus	Kathal
Bombax ceiba	Seemal
Cassia fistula	Amaltas
Butea monosperma	Palas
Ficus glomerata	Gular
Aegel marmelos	Bel
Ficus religiosa	Pipal
Azadirachta indica	Neem
Pongamia pinnata	Karanj
Ailanthus excelsa	Mahanim
Ehretia laevis	Chamror
Melia composita	Bakain
Spondias pinnata	Amra

CHRONOLOGICAL STEPS OF ECOSYSTEM RESTORATION (in 4 years)


BEFORE
ECO-RESTORATION


AFTER
ECO-RESTORATION


BEFORE
ECO-RESTORATION


AFTER
ECO-RESTORATION

FOOD CHAIN & BIO-DIVERSITY RESTORATION

Food chains are being established with different trophic levels. Second to Fourth Trophic level organisms are now seen on the once sterile spoil dump. Porcupine as the second trophic level eat bamboo shoots, Jackals as the third trophic level eat porcupines and eagles could be the fourth trophic level of one food chain. This eco-system process rejuvenated the bio-diversity on the restored dump.

Food chains are being established with different trophic levels. Different Trophic level organisms are now seen on the once sterile spoil dump. Porcupine as the second trophic level eat bamboo shoots, Jackals as the third trophic level eat porcupines and eagles could be the fourth trophic level of one food chain. This eco-system process has rejuvenated the bio-diversity on the restored dump.

THANK YOU

The local villagers were behind the success of this Ecosystem restoration