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APPROACHES & COMPONENTS OF RESTORATION OF RIPARIAN ZONES: LESSONS FROM CENTRAL WESTERN GHATS IN PENINSULAR INDIA

By

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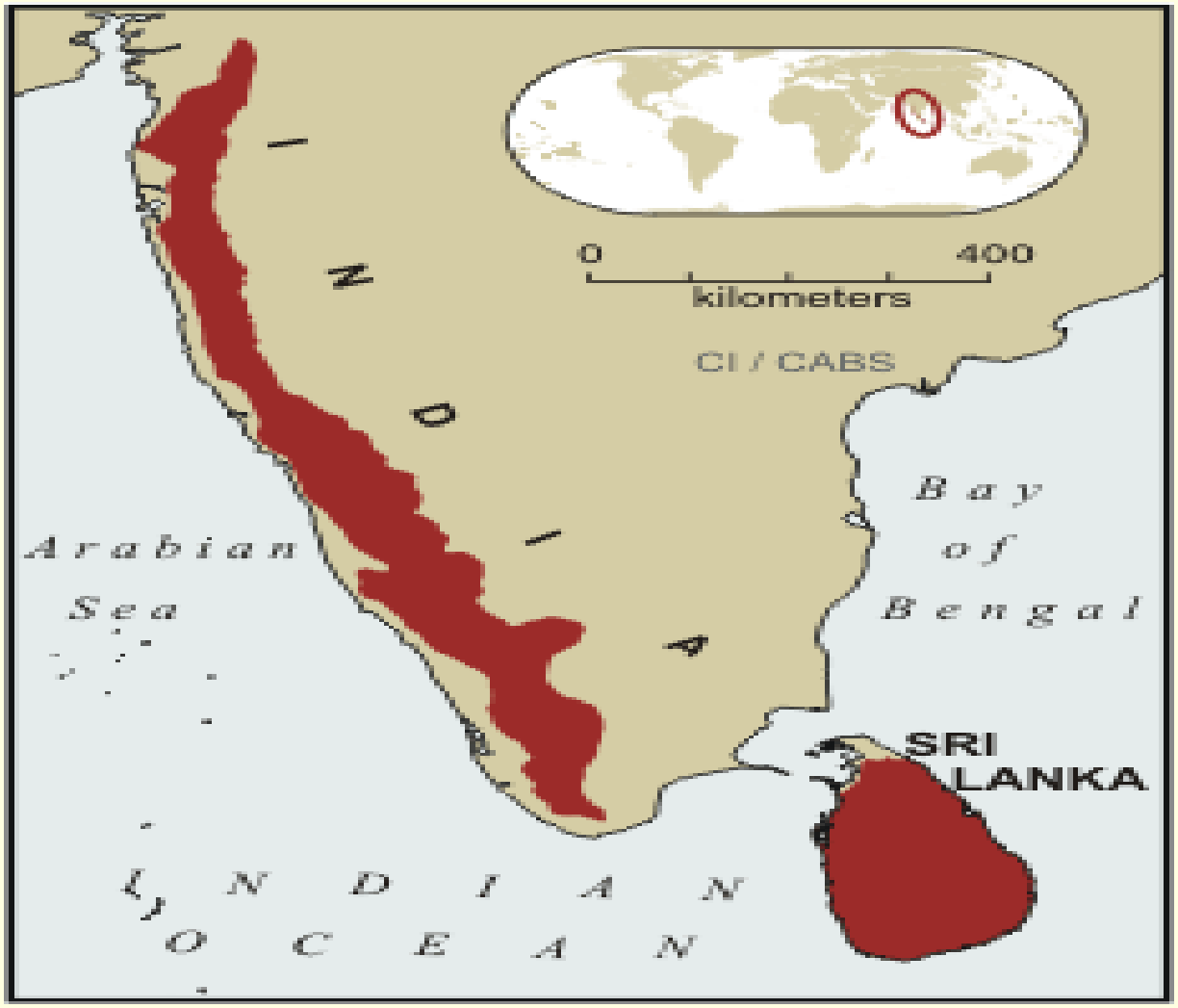
Objectives

- What is riparian flora?
- Why it is so important in *Western Ghats*?
- Is there any threat to this?
- How could it be protected?
- What could be the best possible choices for implementing conservation strategy?
- Why ecosystem approach is better than the conventional physical methods?

Riparian Plants: Significance of *Western Ghats* as one of the global hotspots of biodiversity

(Myers *et.al.*,2002)

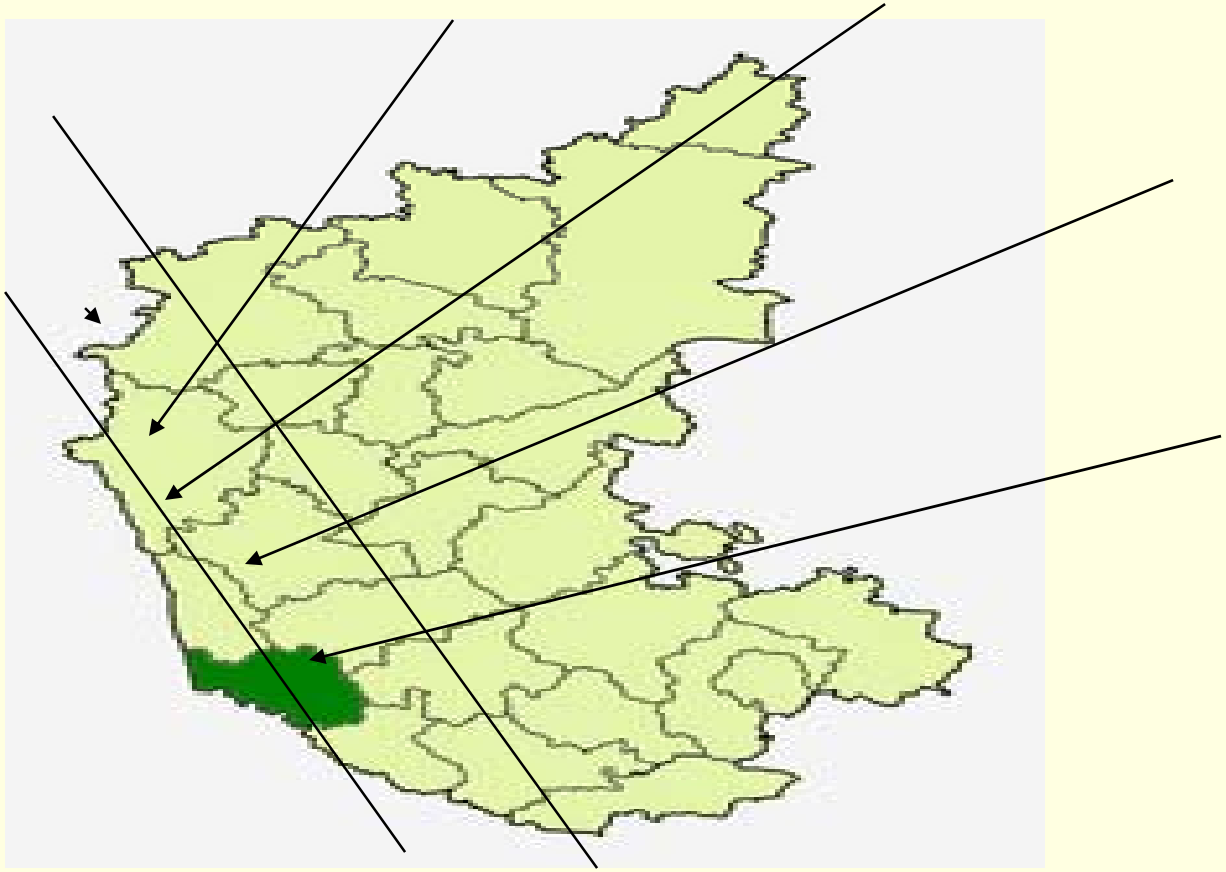


Riparian Ecosystem of Evergreen forest in *Western Ghats* region

- It is '*Ecotone'* having interface of water of land along a river corridor.
- Attributed vital functions:

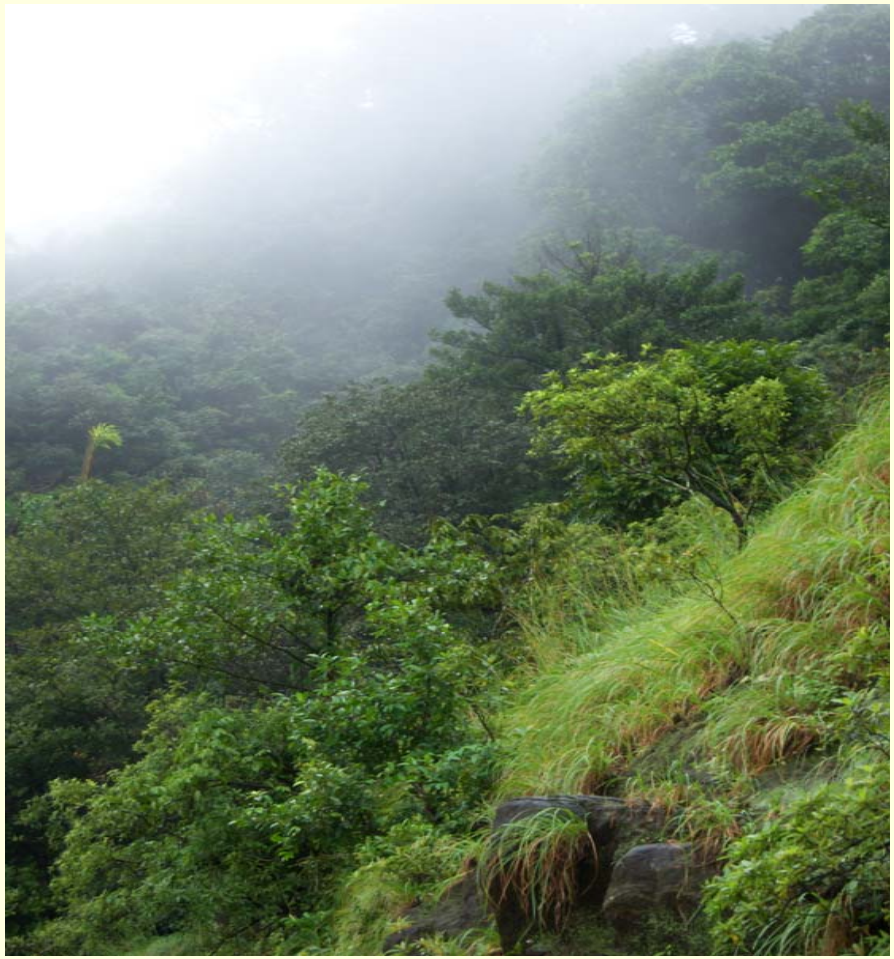
- Regulation of water cycle
- Regulation of nutrient cycle of lower commanding area
- Ground water recharging
- Breeding ground for many unique flora and fauna
- River bank stabilization
- Regular ecological services: Food chain, pollination . Seed dispersal, water security etc.

This paper is part of a ongoing long-term studies on the riparian ecosystems and their floristic diversity in the perennial streams of evergreen forest in central *Western Ghats* in Karnataka (U.K., Shimogga & D.K.). The data here is of mid elevation zone sof Netravati River in Dakshina Kannada.



The montane ecosystem in the upstream of *Netravati* River valley: Main watershed of the I –order streams.

Altitude variation in short distance, high humidity & annual precipitation, high average temperature, etc. make this region to harbor so much ecosystem & species diversity & their endemism.



- 213 Endemic flowering species are documented in D.K. district alone. out of 1720 endemic species recorded in *Western Ghats* region.
- 4800 sp. of flowering plants are recorded in W.G. so far.

I –order streams of *Netravti*: The primary sources of water that mainly originate in the montane zone in higher elevations. They show unique ‘River Corridor’ characters.

Netravati River corridor at lower elevation in the *Western Ghats* zone (II to III Order streams)

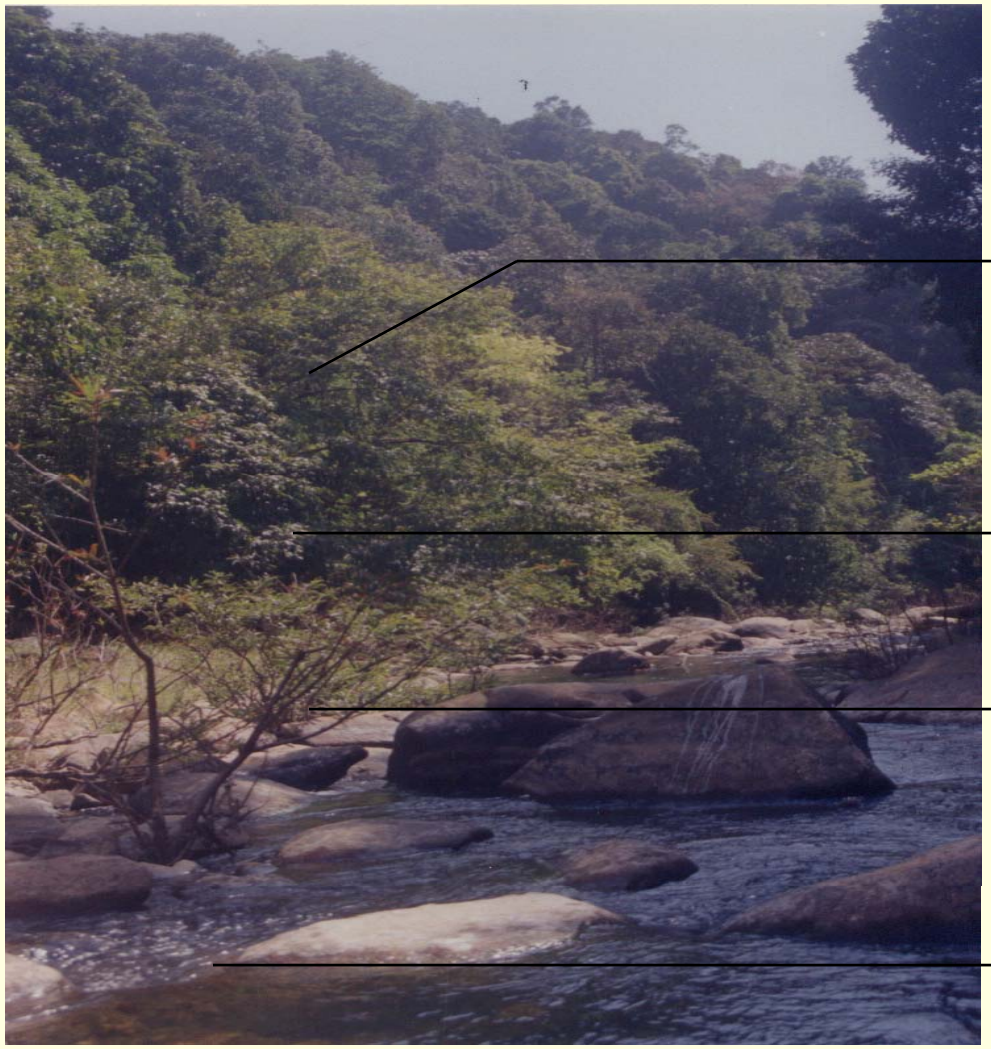
Green cover dominated by woody climbers due to abundant sunlight *('Canopy opening'* or '*Edge*' effect)

Highly aerated water, flowing in speed with spray on rock system create ecological niches.

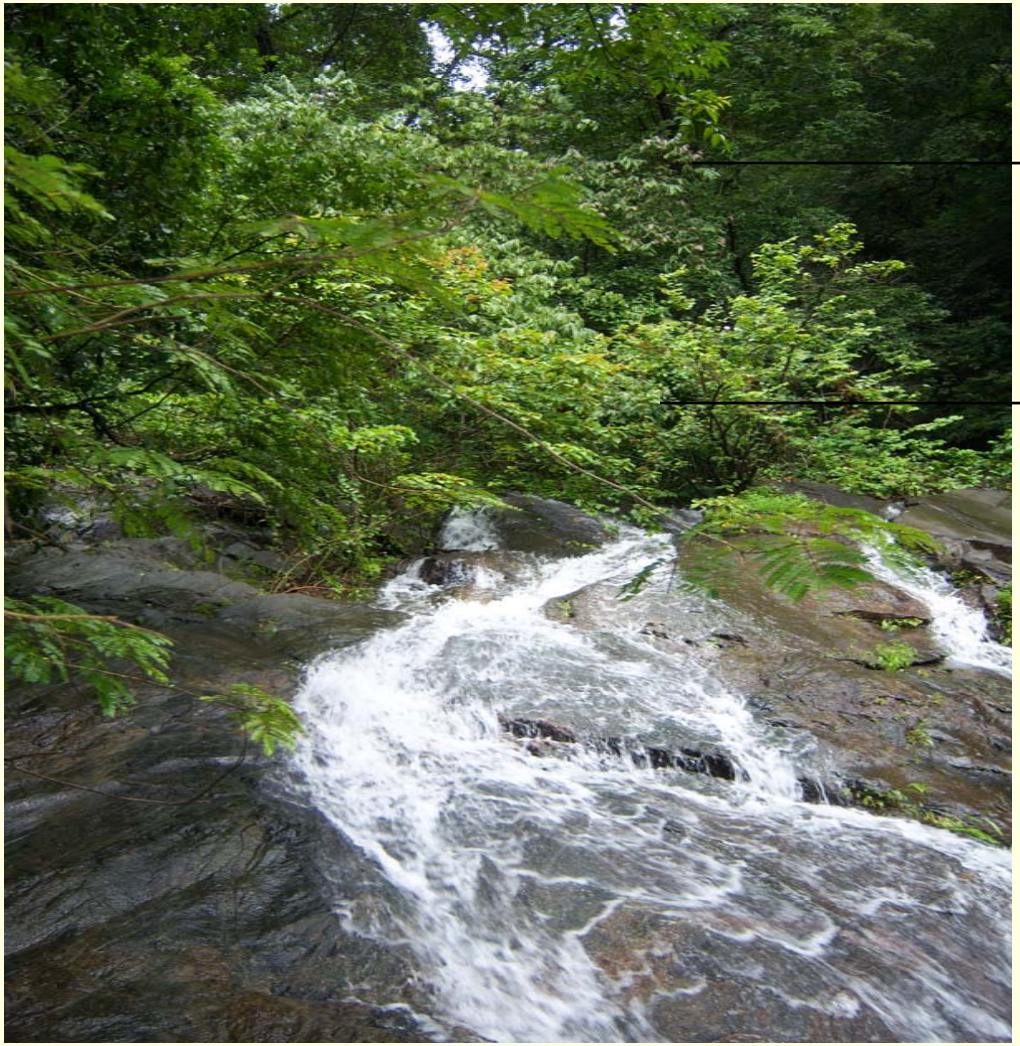
River corridor vegetation in *Netravati*: mid elevation view.

Typical physiognomy of a evergreen forest on the banks of *Netravti* river

Riparian ecosystem of *Netravati* in the foothills of W.G. (150 to 300 MSL)



Cascades would create the further ecological niches that harbor more herbaceous flora



Perennial trees on the banks

Seasonal herbs in the flood zone

What is riparian flora?
(How different from aquatic flora?)

- ‘All those terrestrial plant species that require presence of water, not only to complete their life cycle; but also to carry on their regular growth & differentiation functions in most of part of the year.
- Vital function for which they depend on the riparian ecosystem are:

- Roots flooded in flowing water
- Highly acidic sandy soil
- Requirement of direct sunlight for foliage proliferation
- Fruit & seed dispersal through water etc.

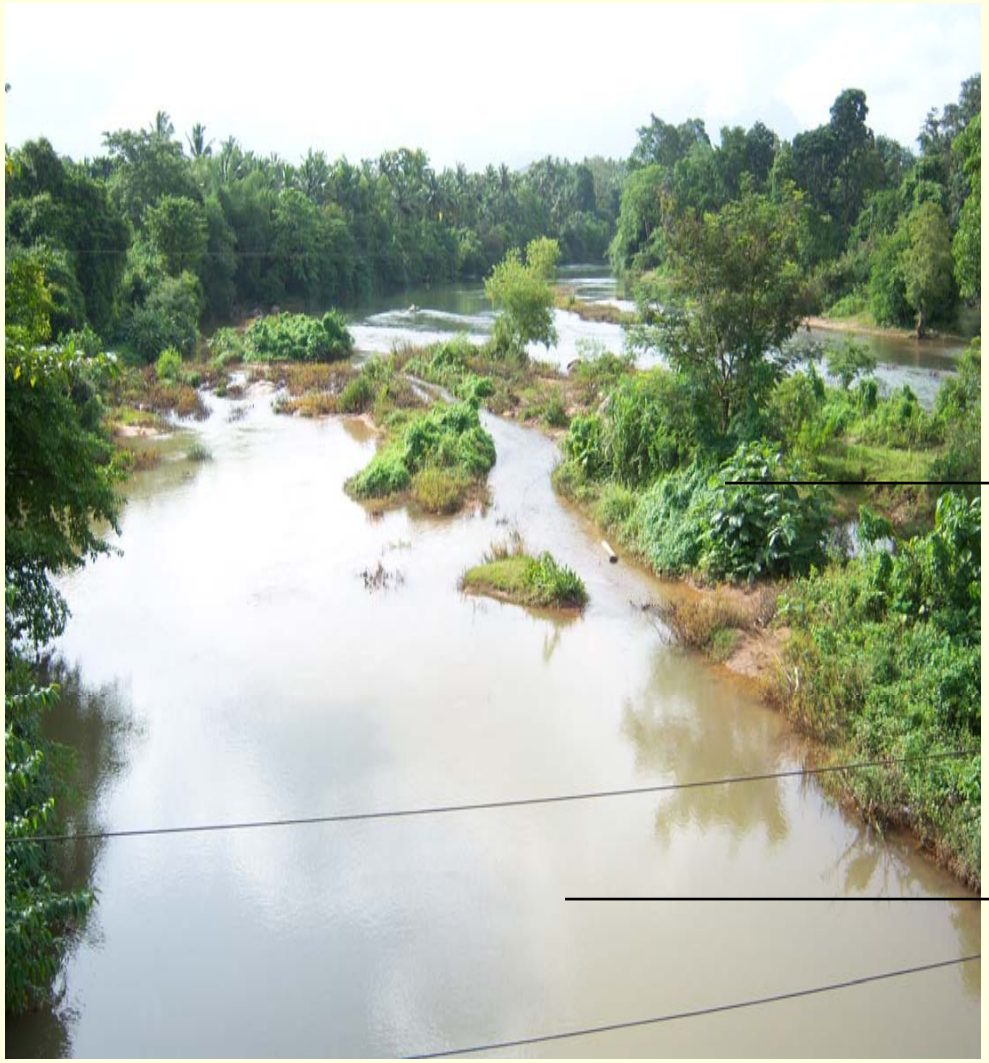
What constitutes *Riparian flora* study?

- Taxonomic study by Quadrate and transect methods
- Habitat characters like physiognomy, shade edge effect &species mosaics.& delineation riparian zones by using remote sensing images
- Species distribution studies like species richness, abundance, density & dominance
- Autecology's of selected species for leaf area index, chlorophyll estimation, cuticle thickness ,stomata type & distribution, bole stricture &texture
- Physico-chemical properties of water and river bed & tank soils : pH, temp, nutrient load, total alkalinity , average temp. etc.

Riparian flora of *Netravti* River system: A profile.

- 27 tree species, 8 woody and herbaceous climbers and 5 herbs or shrub species are recorded so far.
- 10 tree species , 2 shrubs and 1 herb are being intensely studied in this project because of their acute riparian characters (restricted distribution along river belt alone), endemic & threatened nature and well established medicinal properties & also for their potential for bio-prospecting research for therapeutically active ingredients
- Now the efforts are on to correlate those characters to define the ecological uniqueness of these species.

Riparian ecosystem in foothills of the *Western Ghats*: Water spread & slow flow rate supports higher herbaceous & shrub species.



Riparian plants are terrestrial, but need direct water.

Aquatic plants

The river spreads in wider area in coastal region, where the '*Riparian Ecotone*' disappears or diminishes

Riparian ecosystem is either limited or taken over by the true land plants

Destruction of riparian zones : Main reasons

- River course modification by developmental works
- Sand mining quarry: Mainly illegal
- Tree felling: Legal & Illegal, Dead & Fall
- Encroachment: Mainly for agriculture purpose
- Water pollution: By direct sewage discharge
- Soil pollution: solid & municipal waste

Restoration : Physical approach

- Concrete wall building
- Concrete stone pitching
- Concrete culverts
- Mud bunds & trenches

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- *75% Construction works*
- *10% Soil works*
- *10% Planting*
- *5% Organizational / local people empowerment.*

Alternative way: Ecosystem approach

- Soil bunds & trenches
- Soil and stone pitching
- Terrace forming
- Making pits for planting
- Fencing

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- 40% Nursery works
- 20% Bund and soil works
- 10% Planting related works
- 10% Protection works like fencing, approach roads etc.
- 10% Construction works like concrete pitching
- 5% Local people empowerment
- 5% Organizational expenses

Riparian species like

- *Madhuca nerifoila*
- *Syzygium heyneanum*
- *Holigarna arnotiana*
- *Ochreinauclea missionis*
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- *Ochlandra scriptoria*
- *Neolamarkia cadamba*
- *Callophyllum apetalum*

Syzygium heyneanum Duthie.
(Myrtaceae)

Endemic & threatened shrub species growing in flood zone of the perennial rivers.

Medicinal Value

- Bark: astringent, to treat mouth ulcer.
- Bark & leaf in Diarrhea.
- Seeds in Diabetes.
- Fruits for controlling *Polyurea* & promote *Vata* nature.

Syzygium heyneanum Duthie.

(Myrtaceae) (‘Kannada: ‘*Hole Nerala*’)

Fruit & seed mature monsoon so that the seeds are spread in the flood

Syzygium heyneanum Duthie.
(Myrtaceae)

Fruiting stage at the peak of summer; reducing the vegetative growth in the water less conditions

Ochreinauclea missionis Ried. (Rubiaceae)

Endemic & Threatened tree species

Medicinal Value

- Seed oil in Leprosy treatment
- Bark extract as Astringent and to treat GIT disorders

Ochreinauclea missionis Ried. (Rubiaceae)

Root system submerged in water

Ochreinauclea missionis Ried.

(Rubiaceae)

Fruiting Stage

Ochreinauclea missionis Ried.

(Rubiaceae)

Fruit mature in summer and dispersed through water to get distributed on the downstream banks

Seed can germinate on the wet sand of the river buffer zone

Neolemarkiana cadamba Ried.

(Rubiaceae)

Tall, deciduous, large leaves, strictly riparian, locally threatened species

Medicinal Value

- Orange flowers in globose head used aphrodisiac
- Bark extract as antipyretic, tonic, galactogogue, astringent,
- Seeds in uterine infection
- Leaf in stomatitis (inflammation in mouth)
- Fruit: Aphrodisiac

Dipterocarpus indicus Beddome.

(Depterocarpaceae) (Yenne Mara)

An endemic & threatened tall tree species

Medicinal Value

- Balsam or gum obtained from the stem is used as diuretic, urinary infection, gonorrhoea (Genital infection)
- Oleo resin used in rheumatic pain

Rotula aquatica Lour. Boraginaceae

Flood zone, perennial herb with high flexibility adaptation

Medicinal Value

- Root used in Piles, Stone in Bladder,
- As diuretic & Laxative

Rotula aquatica Lour. Boraginaceae

Medicinal Value

•Root is very well established substitute as '*Pashana Bedhi*' in Ayurveda'

•It is highly adapted flood zone herb with 360 ^{0} flexibility against tides& waves

Rotula aquatica Lour. Boraginaceae

One site experiment to study its strength in preventing the tidal effect & thereby soil erosion in river bank : Planted by using root cuttings in a II – order stream of *Netravati* River.

Cassia alata L. *(Caesalpinaceae)*

(Kannada: Ane-tagache)

Widely distributed flood zone shrub

Medicinal Value

- Leaf in skin diseases like ring worm
- Seeds as vermifuge (intestinal worms)

Pandanus fascicularis Dennis. (Pandanceae)

(Kannada: ‘Kedige’)

Locally threatened woody shrub distributed in stream bed and banks.

Medicinal value

- Leaves in treating leprosy, syphilis, leucoderma and as sedative.
- Bark oil as stimulant
- The flowers as antispasmodic & controlling polyurea.

Pandanus fascicularis Dennis. (Pandanceae)

- Fruits take over five months to matures
- Edible both by animals and human.
- Poor distribution of seeds due to flooding & early harvest by the local community (Cultural & economical)
- Mainly vegetative propagation

Homonoia riparia Lour. (Euphorbiaceae)

(Kannada: *Holenaage*)

Widely distributed river bed – flood zone shrub.

Medicinal Value

- Root as laxative, diuretic, antidontage (Against tooth decay)& emetic.
- Leaf in skin disorders.
- Flower in hair oils.
- Well known substitute for *Aerva lanata* in Ayurvedic pharmacy.

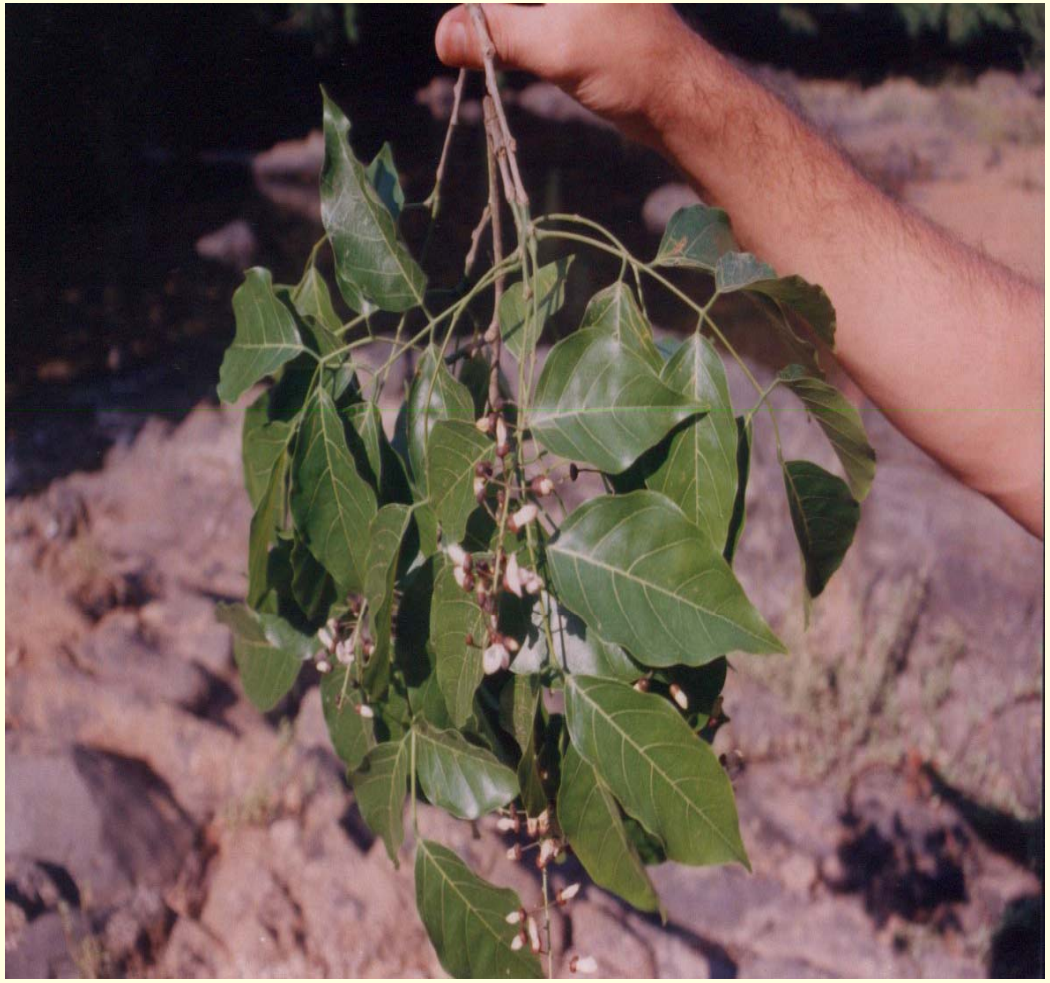
Homonoia riparia Lour. (Euphorbiaceae)

Root system is firmly rooted in soil; but needs constant water flooding or spray for survival & flowering& fruit setting.

However dwindling due to excessive harvest by the local communities mainly for fencing purpose.

Pongamia pinnata *L. Pierrie.* (Papilionaeae)

(Kannada: Honge)



Locally restricted river bank tree species

Medicinal Value

- Root juice in ulcer, fever, bleeding piles, gonorrohea (genital infection)
- Leaf as galactogoguue, in diarrhea, rheumatic pain,
- Seed oil in scabies, herpes, leucoderma, wounds etc.

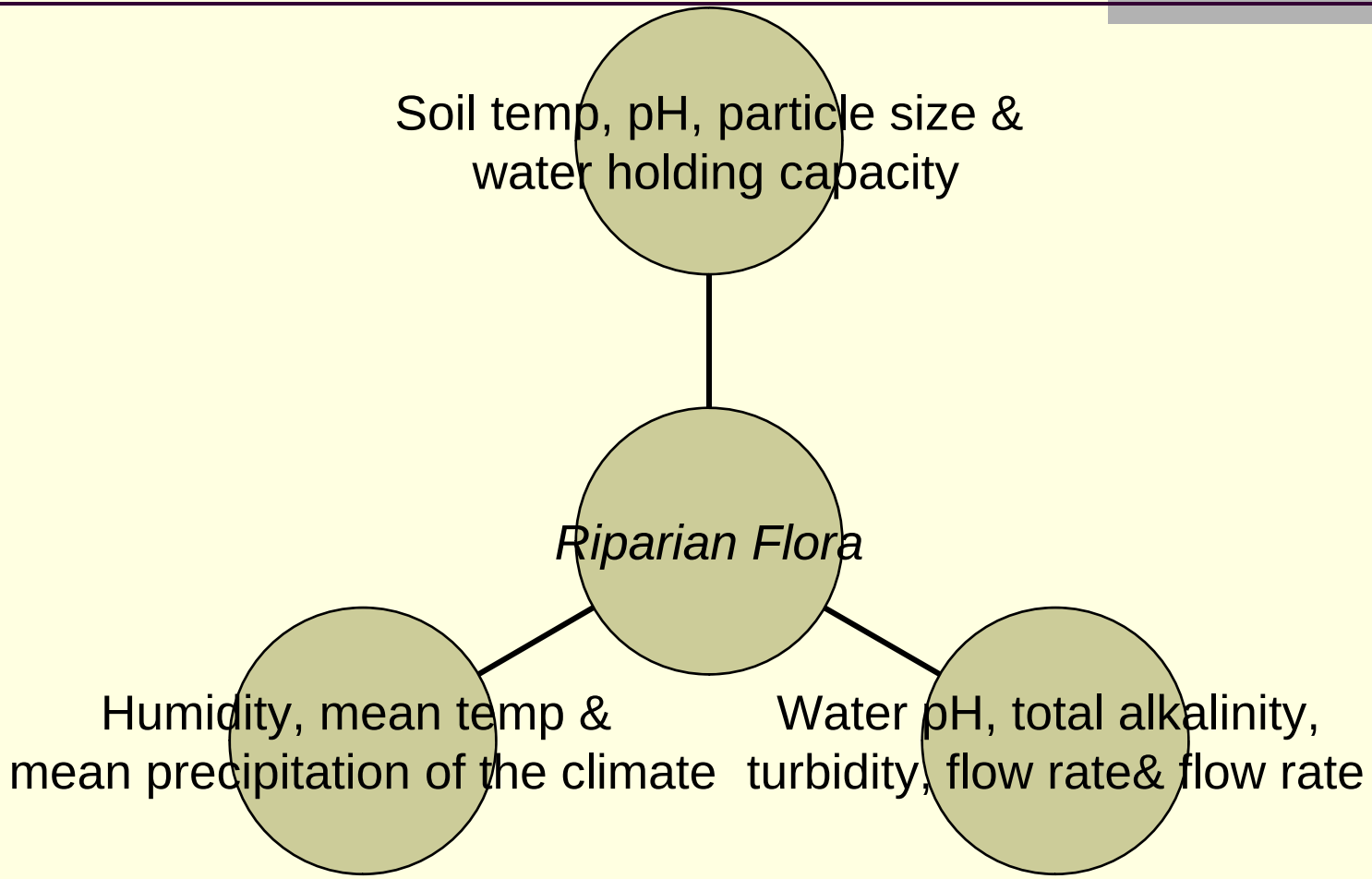
Enteda pusaetha DC. (*Mimosae)*

Endemic, threatened , evergreen woody climber, found commonly on the riparian tall trees in undisturbed area,

Medicinal Value

- Bark extract in anti-rheumatic and antiviral preparations
- Leaf ass emetic, wound healer.
- Seed in bechic (cough medicine)

What Environmental factors govern the riparian flora most?



Propagation through vegetative modes: the works are going on

Seedlings of *Calophyllum apetalum* *L.* *(Guttifere)*

(Kannada: Holehonne)

Endemic, threat red tall tree species

Medicinal Value

- Root extract in ulcer
- Resin as purgative
- Seed oil in rheumatism, leprosy, dysuriya (Difficulty in passing urine)

Saplings for reintroduction *Calophyllum apetalum*

The efforts of re introducing to the wild habitat- that is disturbed river bed zone is in progress in (Streams of Netravati in foothills of *Western Ghats* in Belthangady, D.K.)

Contributing to *in-situ* conservation efforts.

Ex-situ conservation efforts: Propagation in Green House (SDMC Green House)

Dipterocarpus indicus Beddome.

(Depterocarpaceae) (Yenne Mara)

•Saplings are maintained in the green house as germ-plasam collection,

Being used for research, education, awareness building and extension activities.

Ventilago madaraspatrana Gaertner.

Rhamnaceae

- Endemic , threatened woody shrub
- Often found on the riparian trees.

- Root bark is used atonics and skin nourishes.
- In *Ayurveda* it is used in the preparations for Athama, worm infection and piles.

Many other species…

- *Madhuca neerifolia* H.J. Lamm. (Sapotaceae) : White flowers used in reneal diseases, fruits as ant-irheualmatic medicine, seed oil in leucoderma and other skin diseases.
- *Cinnamomum riparium.* Nees. (Lauraceae) : Bark is used in as antispasmodic, astringent, Leaf as anti-diabetic. Dark purple fruits as carminative agent
- *Crateva magna* (Lour.) (Capparaceae) : Bark used as stimulant, laxative; flower as astringent, cholagogue (Promoting bladder seceration).
- *Ochlandra scriptoria* L. (Graminae) : Leaf used in bleeding.
- *Mimusops elengi* L. (Sapotaceae) : Used in treating tooth root problems& blood impurity.
- *Holigarna grahmii* Kurz. (Anacardiaceae)
- *Holigarna arnotiana* Hook (Anacardiaceae) Used as effective agent in foot & mouth diseases of domestic animals, fungal infection.

Lessons

Ecosystem approach is more effective.

Why?

- Restoring is nothing but facilitating natural rejuvenation process.
- Conservation of biodiversity & wildlife (Including RET sp.)
- Participation of local people & institutions.
- Sustainability : Ecological & Economical.
- Ensuring the ecological services : prevention of soil erosion
- Ecological &livelihood security: eg. Downstream aquatic organisms as well as fishermen

thank you

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