Developing Green Roads in Assam, India

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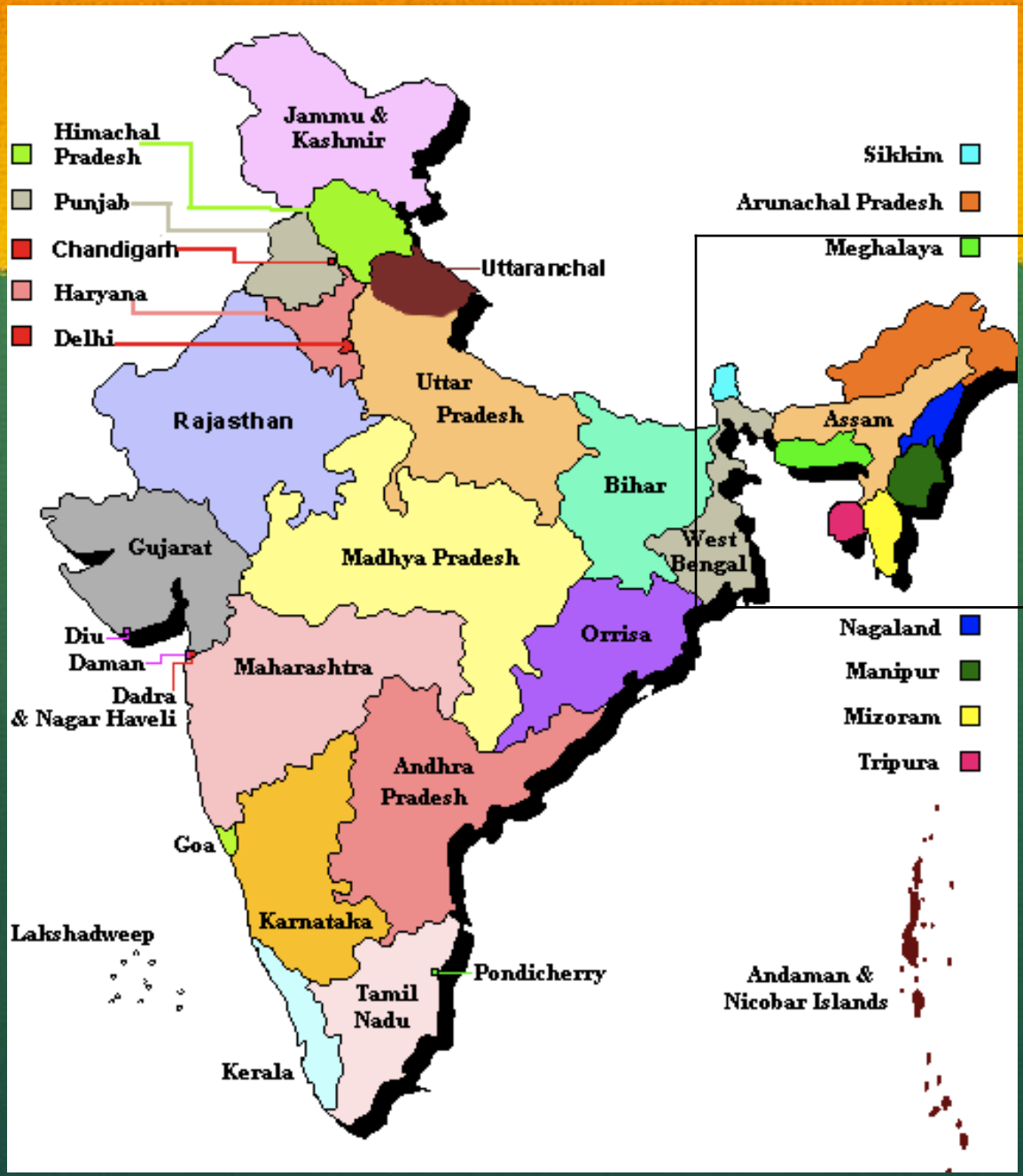
Concept of this presentation

- How to implement greener construction and align to Green public procurement policies by employ natural materials and innovative construction technologies

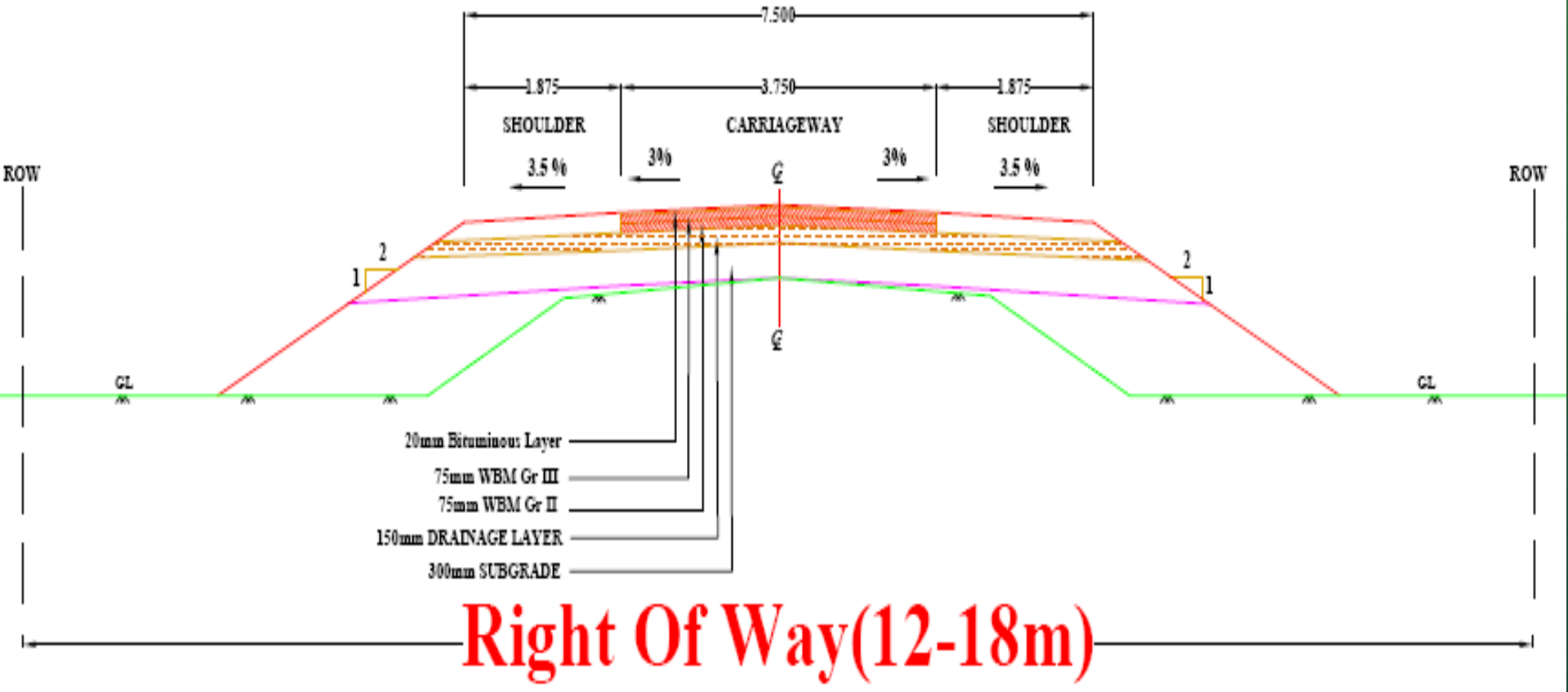

Jammu & Kashmir
Himachal Pradesh
Punjab
Chandigarh
Haryana
Delhi
Uttaranchal
Uttar Pradesh
Rajasthan
Bihar
Gujarat
Madhya Pradesh
West Bengal
Orrisa
Diu
Daman
Dadra & Nagar Haveli
Maharashtra
Andhra Pradesh
Goa
Karnataka
Lakshadweep
Pondicherry
Tamil Nadu
Kerala
Andaman & Nicobar Islands
Sikkim
Arunachal Pradesh
Meghalaya
Assam
Nagaland
Manipur
Mizoram
Tripura

Assam road network

Total Road Network = 39,800 Kms (incl. State Highways, ODR, MDR, Rural Roads)

- Rural Roads Network= 30,844 Kms
- Rural Roads completed = 10,782 Kms
- Ongoing construction = 5,128 Kms
- Pending for construction = 14,934 Kms

Typical Rural Road Section



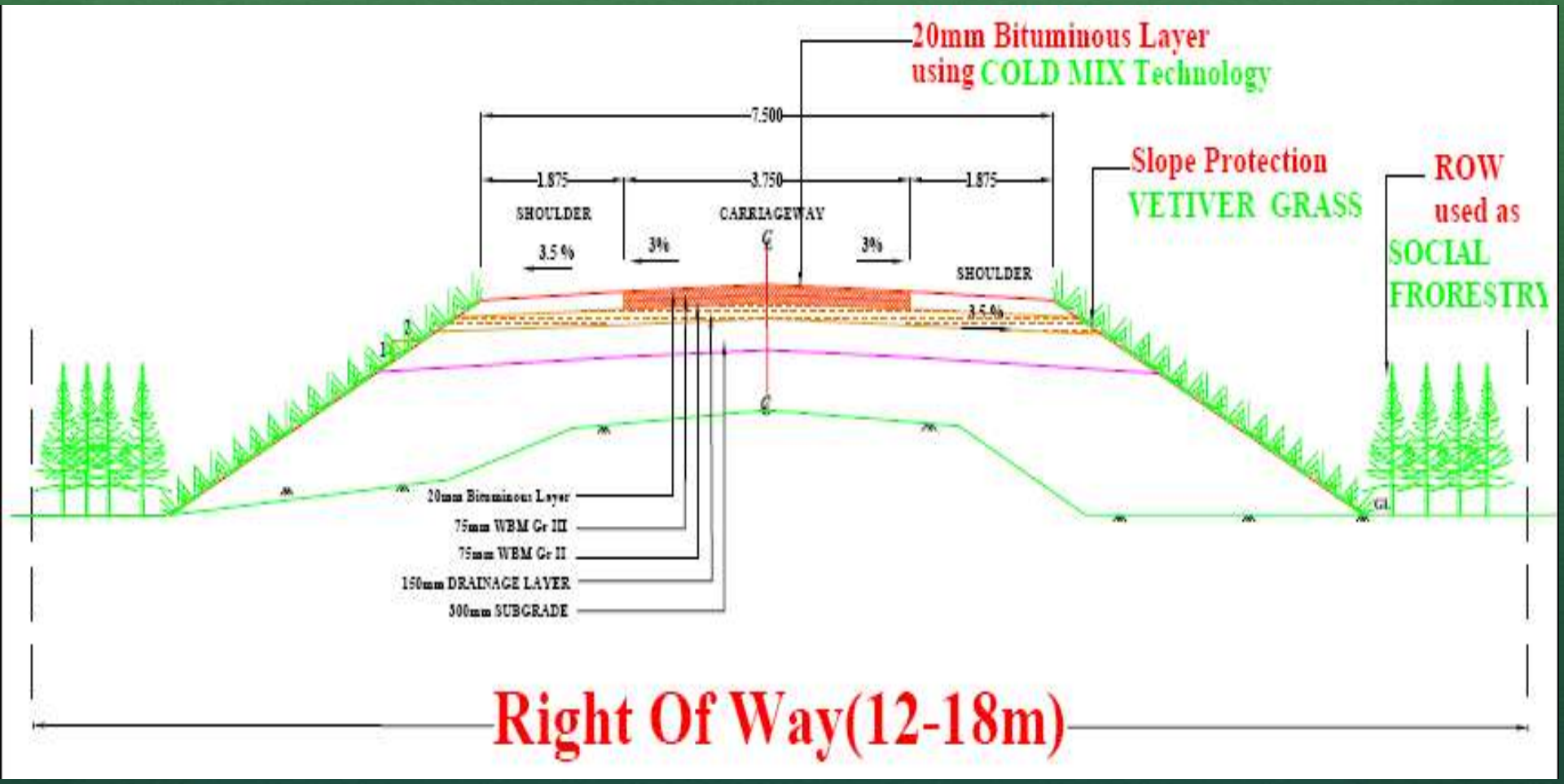
Innovative Policies for Developing Green Roads in Assam

- Policy 1- Economic Corridor - Right of Way Land Use
- Policy 2- Replacement of stone boulder with Vetiver for slope protection of the road embankment
- Policy 3- Green Paving through cold black-topping in rural and district roads.

Opportunity and Green policy for ROW

- Topography based plant selection (either jute, bamboo or rubber) for high yield.
- Community based cultivation programme to prevent theft, destruction and any kind of pilferage.
- Plants would help in developing greener environment on the road side, which is otherwise undeveloped and encroached by local villagers.
- Plants shall help in absorbing CO2 emissions along the road side. IRF could hand-hold for calculating the impact of social forestry's green income.

PROPOSED GREEN ROAD SECTION FOR ASSAM RURAL ROADS



Policy No. 2

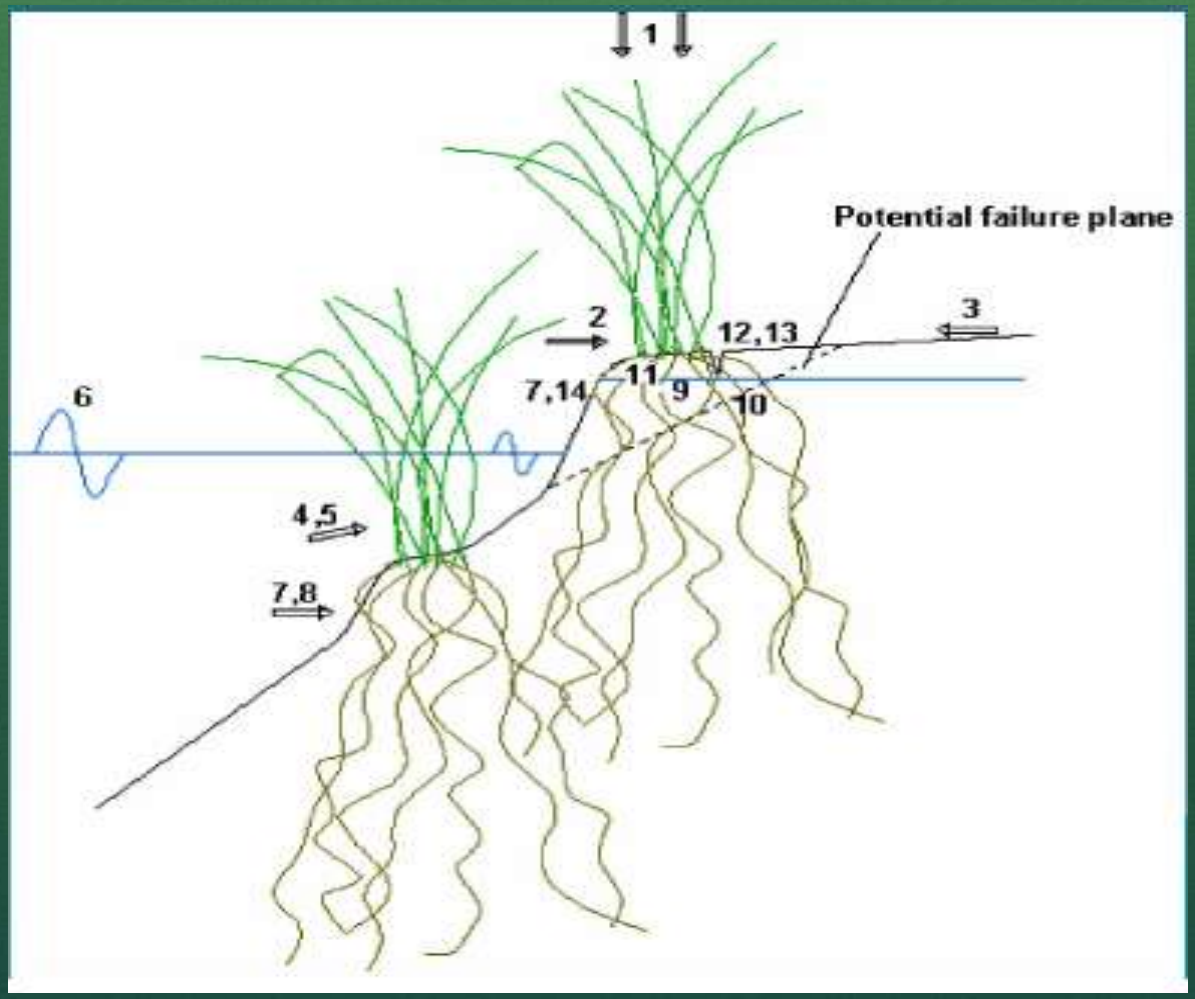
Vetiver- Using greener options for slope protection

- Stone Boulder needs mining, crushing, truck transportation to the slope protection site. Further, it is expensive.
- Vetiver is a natural material which can retain the soil, needs no processing, very cost-effective.
- The plant is simply a greener alternative than a technological advancement as it absorbs CO2 and vehicular pollution.

Conventional Stone Works and their drawbacks

- Very expensive and budget is never sufficient.
- Not environment friendly.
- Concrete or rock retaining walls- The most common engineering method employed to stabilize road slope. Most of these walls are passive, simply waiting for the slopes to fail. When the slopes do fail, the walls also fall often.
- These structures are vulnerable to earthquakes.
- These measures do not absorb flow/wave energy and tend to displace erosion to another place, opposite or downstream.

Effects of Vetiver grass on bank/slope erosion



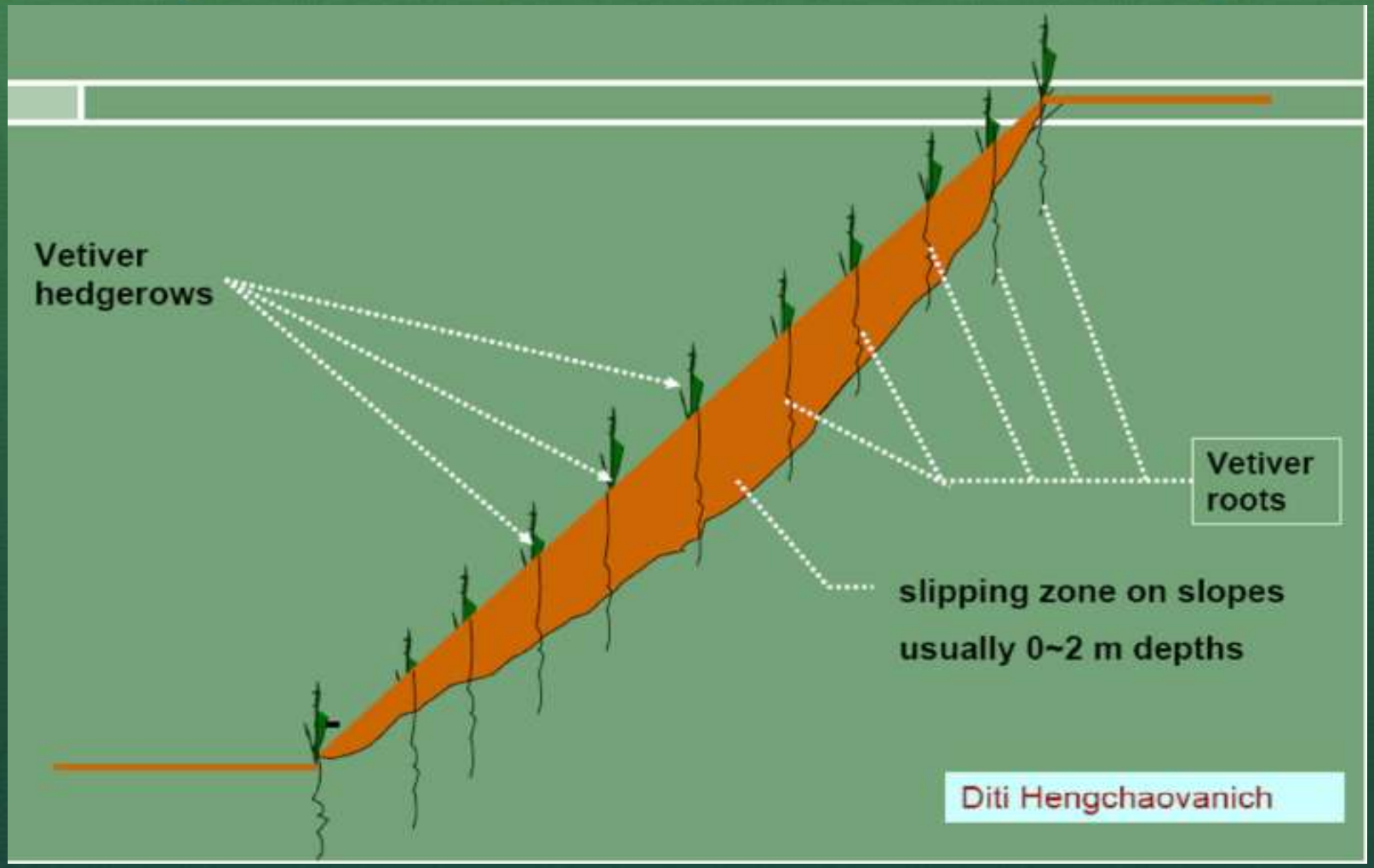
THE PLANT
Chrysopogon zizanioides
commonly known as Vetiver

The Root

China - excavated root. Average tensile root strength 75 MPa

Malaysia - longitudinal section through hedge note the root mass in the top meter of the soil profile. This type of root mass will improve soil shear strength by up to 39%

Soil stabilization mechanism by Vetiver



Ongoing projects : Hajo- Nalbari road

Hajo-Nalbari road
Rows 1m apart,plants@15 cm

Some Examples

Road embankment / bridge approach protection

Doria bridge approach in Majuli; during construction

Starting the plantation

The plantation in the 3rd month

The forward slope with toe protection

The forward slope toe protected with caged boulder

Same bridge approach now.

The other side of the approach

Bridge approach protection
Sesa-pani bridge near Marian

Same bridge approach

Technical precautions

- At least for the few months while the plant is becoming established, the site should be internally stable against possible failure. Vetiver manifests its full abilities when mature, and slopes may fail during the intervening period.
- It is applicable only to earthen slopes with gradients that should never exceed 45-50 degrees.
- Vetiver grows poorly in the shade, so planting it directly under a bridge or other shelter should be avoided.

Precautions for decision-making, planning and organization:

- **Timing**: Planning should consider the seasons and the time it takes to grow planting materials.
- **Maintenance and repair**: Planning and budgeting should anticipate replacement, replanting ,watering ,manuring at the early stage.
- **Procurement** :All inputs can and should be procured locally (labour, manure, planting materials, maintenance contracts). Employment opportunity provides an incentive for the local community to protect the plants during their infancy and adolescence, and to maintain the quality and sustainability of the works.

Precautions for decision-making, planning and organization:

- **Community involvement** : As much as possible local communities should be included in the design, materials procurement, and maintenance stages.
- **Integration**: Policy makers should recommend Vetiver System as part of a comprehensive approach to infrastructure protection ,applied on a scale large enough to ensure a tangible increase in expertise and a gradual, spreading effect.

Policy No. 3- Green Black-topping technologies

Current paving System used in Assam and many parts of India for rural roads

- Assam is a State where the construction industry uses conventional site mixing for black topping activities of 2cm thickness on rural roads.
- As Assam is a high rainfall area, the paving window is for short period of 4-5 months only.
- Further, the conventional hot process consumes 1,200-1,500 litres of fuel oil per Km
- Assam constructs around 2,000 kms rural roads per year.

Resource partner- Bitchem, India

- Bitchem Asphalt Technologies Limited- Central Road Research Institute, New Delhi Licensee for Cold Mix technologies
  - Completed more than 1700 Kms of rural road black-topping activities by their revolutionary road paving system called “Bitchem Green Roads Carpeting”.
  - Selected for their paper on this road paving system in 7th ISSA, World Emulsions Congress held in Lyon, France on 13th Oct, 2010

CONVENTIONAL METHOD OF ROAD CONSTRUCTION

PROBLEMS ASSOCIATED

- Emission of Air Pollutants
- High Energy Requirement
- In-effective temperature control
- Low Output for Mix Production and Laying Work in rains & cold weather
- Loss of Adhesion at High Altitude- Due to sudden drop of Temperature

Energy Facts of Hot Mix system

- Rural Roads through conventional site hot mixing consumes 1500 litres of (FO) fuel using mobile mixing equipment.

- It also uses firewood and scrap tires as alternatives in various places for heating of bitumen openly for small works.

What is Green Roads® Carpeting ?

The simple process of mixing unheated mineral aggregates with suitable grade of Bitumen Emulsion engineered to having suitable workability during mixing at plant or site, and finally maintaining specified residue Binder content.

Mixing with Concrete Mixer

Plant Mix- In a WMM Plant

Experiences and Observations

Socio-Environmental Impact

Total Works	Kms Done till August 2012	Fuel Oil Saved @ 1500 lt/ km	CO2 Emissions Saved	Green Jobs Created
Assam	1400	2 million litres	8 million Kgs+	1,40,000 Mandays
Other States of India	250	0.75 million lts	1.5 million Kgs	27,500 Mandays

Cold Mix Road- 4 Years old

Work done at Sibsagar, Assam

Work done at Barpeta, Assam

Benefits of Faster Connectivity

- Faster linkage of farm produce to the markets.
- Faster unlocking of the real estate potential of the block.
- Faster absorption of funds, more funds for the States- More work in the State.
- Faster access of healthcare and education to the rural poor.

Future prospects of developing Green Infrastructure in India

- Concept of road-assets to be changed to road-economic corridor. E.g.- social forestry, way side amenities like highways also on rural and district roads.
- Incentivize the use of Green technologies through a nodal agency for increasing fund allocation to States adopting to green technologies.
- Reviving carbon credit mechanism and inclusion of road projects and schemes for eligibility in claiming CDM.

What is PPP landscape?

- Due to a transition in PPP concept, India is currently taking time to adopt private players whole-heartedly
- Simple method of PPP concept in roads sector other than BOT projects can be to engage Next-Gen technology providers into a technology management model wherein they provide efficient field-systems to scale-up and let States benefit from the socio-environmental and economic advantages.

Lets build Greener Roads… Smarter Roads !

Thank You!