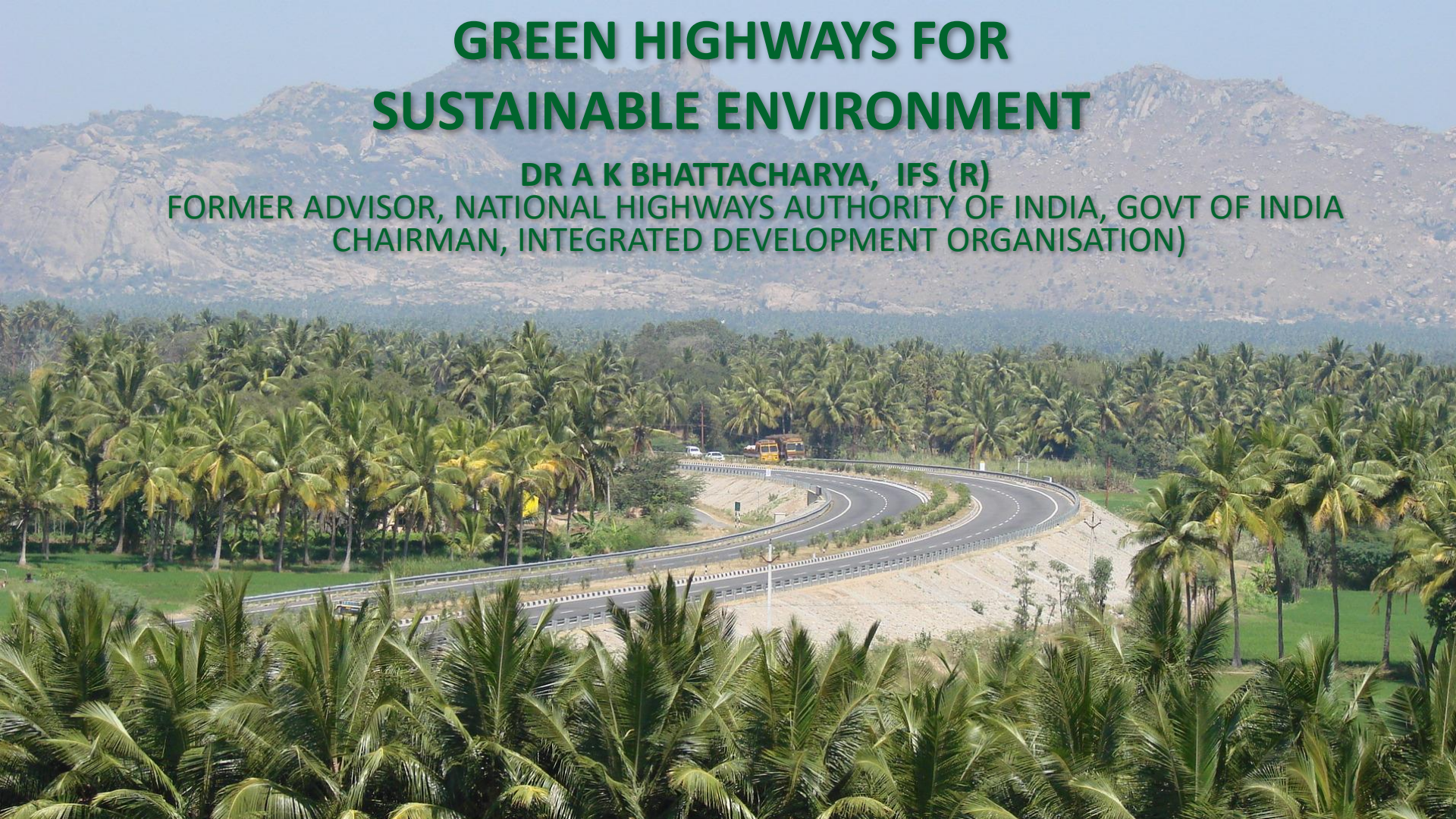
GREEN HIGHWAYS FOR SUSTAINABLE ENVIRONMENT

DR A K BHATTACHARYA, IFS (R)
FORMER ADVISOR, NATIONAL HIGHWAYS AUTHORITY OF INDIA, GOVT OF INDIA
CHAIRMAN, INTEGRATED DEVELOPMENT ORGANISATION)



THE GREEN PLEDGE

I pledge for my life time commitment for the cause of environmental protection and amelioration to sustain a safer environment for healthy life for all. I shall adopt myself and will encourage all stakeholders to adopt all the measures of best management practices to maintain the environment around us in the best possible conditions. I will reduce and help others to reduce our carbon footprint and shall make all efforts to achieve the carbon neutral lifestyle.

GREEN INFRASTRUCTURE

- Green infrastructure refers to an integrated network of natural and man-made assets that provide several environmental, economic, and social benefits. To combat the issues arising out of rapid urbanization and developmental plans, green infrastructure is a thoughtful substitute to it.
- GI objective is to strengthen the ecological connectivity across green areas, as well as to protect, restore and enhance biodiversity and ecosystem services (i.e. the goods and services the nature provides and upon which humans, as well as any other species, are dependent).

GREEN INFRASTRUCTURE EXAMPLES

- Downspout Disconnection
- Rainwater Harvesting
- Rain Gardens
- Planter Boxes
- Bioswales
- Permeable Pavements
- Green Streets and Alleys
- Green Parking
- Green Roofs
- Urban Tree Canopy
- Land Conservation

GANDHI'S PERCEPTION OF GREEN DEVELOPMENT

VILLAGES AND FORESTS – COEXISTENCE

AN IDEAL VILLAGE IS THAT WHEREIN THE DAY-TO-DAY GOODS OF BASIC NECESSITIES, VIZ., TWIGS FOR ROOF, BAMBOO, FUEL, FODDER ARE AVAILABLE WITHIN THE PERIPHERY OF FIVE MILES.

Earth provides enough to satisfy everyman's needs, but not everyman's greed

What will society be like in 2030?

MOBILITY

We will get around in shared **electric cars** equipped with **algorithms** that optimise the route to reduce consumption.

FOOD

We will eat **more fruit and vegetables** and less meat, fish and dairy products.

CONSUMPTION

Single-use plastics will have disappeared and buying sustainable products **in bulk** will increase.

URBAN PLANNING

We will live in houses powered by **renewable energy** and **urban vegetable** gardens will be found on rooftops and in the streets.

AGRICULTURE

The reduction in livestock farming will have a positive effect on **reforestation** and will **free up more land** for the cultivation of food.

Source: World Economic Forum.

GREEN REVOLUTION

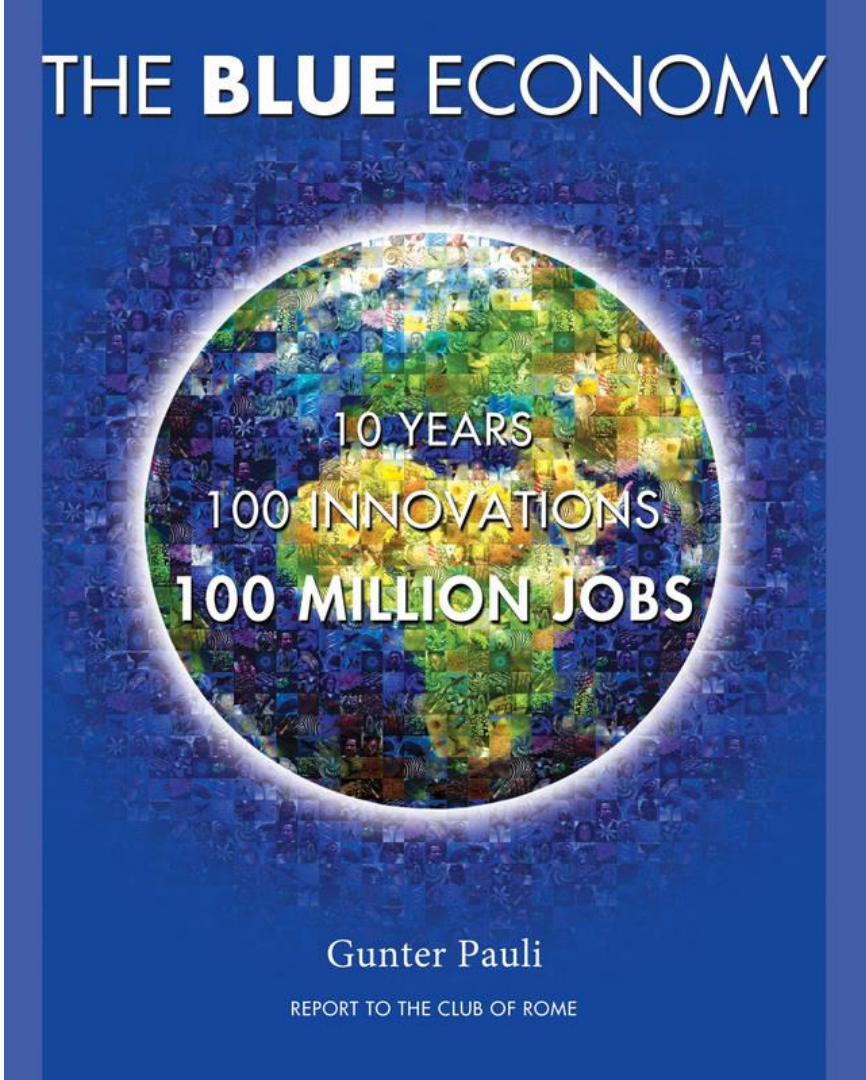
The Green Revolution, or the Third Agricultural Revolution, was a period of technology transfer initiatives that saw greatly increased crop yields. These changes in agriculture began in developed countries in the early 20th century and spread globally till the late 1980s.

GREEN ECONOMY

Green Economy is one that results in increased human well-being and social equity, while significantly reducing environmental risks and ecological scarcities**.**

BLUE ECONOMY

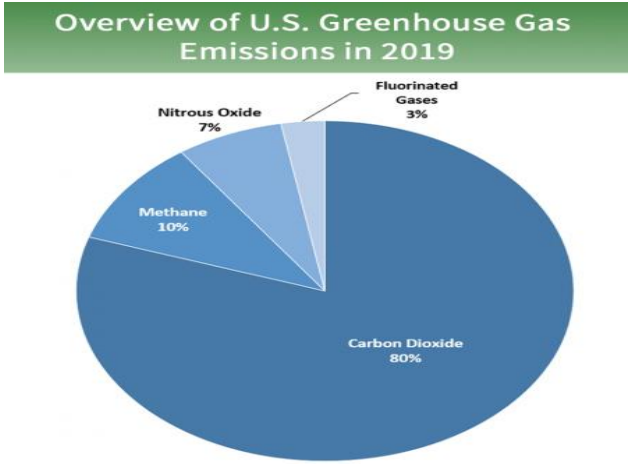
The Blue Economy permits to respond to the basic needs of all with what we have. As such, it stands for a new way of designing business: using the resources available in cascading systems, where the waste of one product becomes the input to create a new cash flow.



Green House Gases

- Carbon dioxide
- Methane
- Water vapor
- Nitrous dioxide
- Ozone
- Sulphur Dioxide
- Human-made green house gases -

  (halocarbons and other chlorine and bromine containing substances)

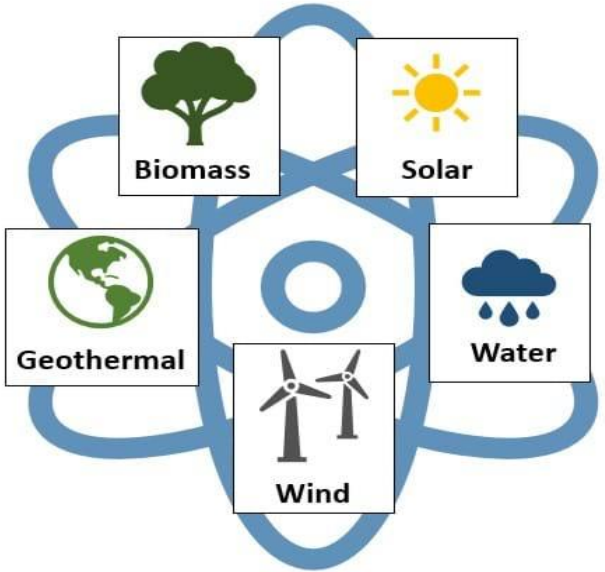


- **Green energy** comes from natural sources such as sunlight, wind, rain, tides, plants, algae and geothermal heat. These energy resources are renewable, meaning they're naturally replenished. In contrast, fossil fuels are a finite resource that take millions of years to develop and will continue to diminish with use.

- Renewable energy sources also have a much smaller impact on the environment than fossil fuels, which produce pollutants such as greenhouse gases as a by-product, contributing to climate change. Gaining access to fossil fuels typically requires either mining or drilling deep into the earth, often in ecologically sensitive locations.

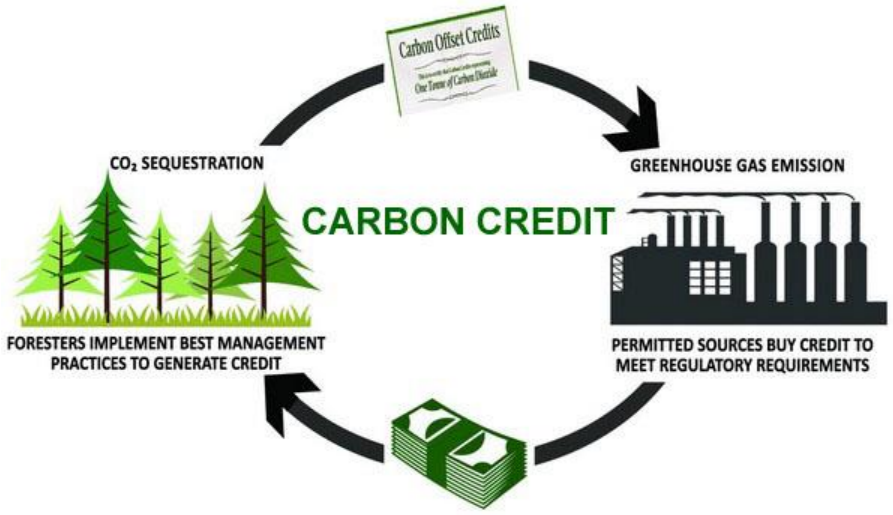
- **Green energy,** however, utilizes energy sources that are readily available all over the world, including in rural and remote areas that don't otherwise have access to electricity. Advances in renewable energy technologies have lowered the cost of solar panels, wind turbines and other sources of green energy, placing the ability to produce electricity in the hands of the people rather than those of oil, gas, coal and utility companies.

- Green energy can replace fossil fuels in all major areas of use including electricity, water and space heating and fuel for motor vehicles.



Carbon credit

Permit that allows an entity to emit a specified amount of CO_2. Also called emission permit. Carbon Catalog is a directory of carbon offsets. Carbon reduction projects include solar, wind, biomass, methane.

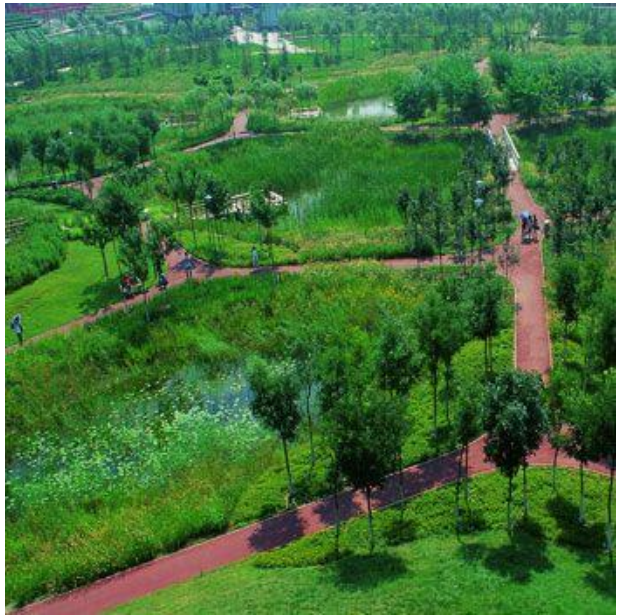


Green Development

Green development is a land use planning concept that includes consideration of community-wide or regional environmental implications of development, as well as site-specific green building concepts. This includes city planning, environmental planning, architecture, and community building.

GREEN DEVELOPMENT VS SUSTAINABLE DEVELOPMENT

- Green development is generally differentiated from sustainable development in that Green development prioritizes what its proponents consider to be environmental sustainability over economic and cultural considerations.
- Proponents of Sustainable Development argue that it provides a context to improve overall sustainability where cutting edge Green development is unattainable.



GREEN TECHNOLOGY

- The United Nations and Pacific Centre for Agriculture Engineering and Machinery (APCAEM) aims at promoting sustainable agriculture development for the eradication of poverty by guaranteeing environmental sustainability

- *Such agro–based environment–friendly technology has been termed as* ***Green Technology***

Green Technologies for Environmental Management and Sustainable Development

(Giving Better Quality of Life to People at Lower Environmental Cost)

Rajiv K. Sinha and Margaret Greenway, Jaipur, Pointer, 2004

- *Appropriate Technology*
- *Sustainable Development*

- "Green Technology", otherwise known as environmental technology, is basically application of our environmental sciences and technology to help save our environment.

- Sustainable development is the core of environmental technologies.

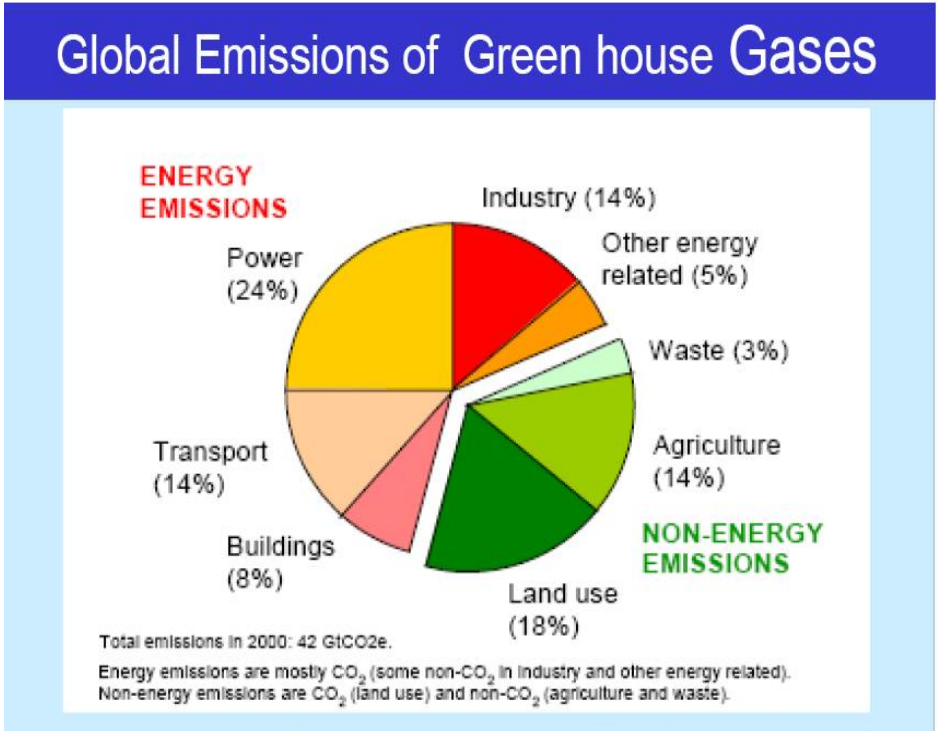
CARBON NEUTRAL ROADS

- Carbon neutrality means having a balance between emitting carbon and absorbing carbon from the atmosphere in carbon sinks. Removing carbon oxide from the atmosphere and then storing it is known as carbon sequestration.

- **A carbon footprint** is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions. The average carbon footprint for a person in the United States is 16 tons, one of the highest rates in the world. Globally, the average carbon footprint is closer to 4 tons.

BACKGROUND

- Transport sector is the second largest contributor to GHG emission.
- In India Road Transport contributes 73 % of the total transport sector GHG emission.
- These figures are conservative estimates as these do not include the carbon emissions generated due to **land use change**. (Deforestation caused due to road development / expansion)



INDIAN NATIONAL HIGHWAYS

- National Highways account for 2 % of Indian road network.
- Length of various categories of roads : National Highways: 1,46,145 km. State Highways: 1,79,535 km. Other Roads: 63,45,403 km.
- > 40 % of automobile traffic moves on NHs.
- It is also responsible for large scale environment degradation.
- Current CO_2 emission is 391 million tons, which is expected to reach 966 million tons by 2030.
- Recognising the imminent threat of global warming and climate change, Ministry of Road Transport & Highways has promulgated **Green Highways (Plantations, Transplantation, Beautification & Maintenance) Policy - 2015**

Target by 2025 - 1.8 Lakh KM

SHs ⇨ NHs

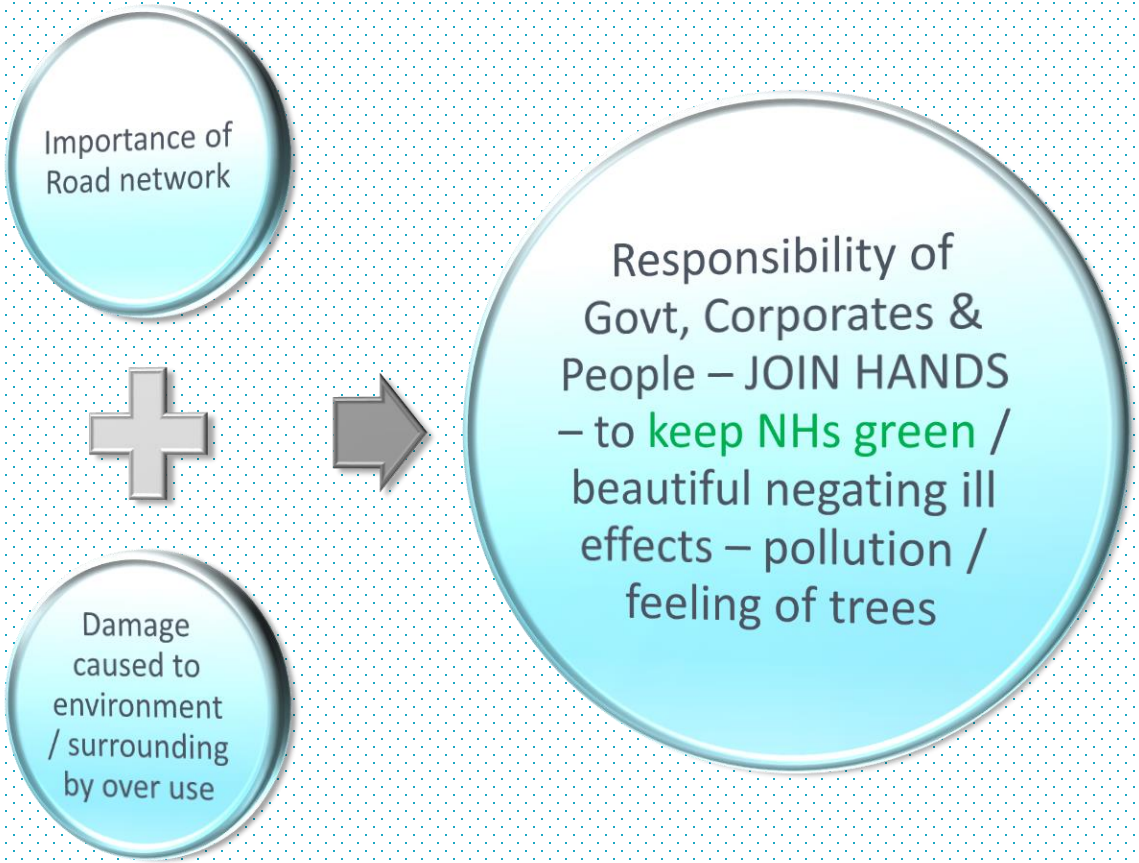
HIGHWAYS – ARE THEY IMPORTANT?

- Growth engine for economic development
- Promotes tourism
- Facilitates trade
- Bridges geographical divide
- Lifeline of Indian Road Infrastructure
- VALUED SHARED ASSET
- NHs are 2% of road network – carrying 40% of automobile traffic

HIGHWAYS – WHY NOT?

- **NHs created after clearing of land / tree felling**
  - National resources exploited
  - Ecosystem becomes vulnerable & susceptible to CC & Global warming
  - Biodiversity loss
- **Vehicles movement causes - Air, noise & dust pollution**
  - Irreversible effects on environment
  - Poses health threat to human & animal
- **Transportation sector emits 14% of global GHG out of which 73% is road transport**
- Current CO_2 emission is 391 million tons, which is expected to reach 966 million tons by 2030.

BIG CONCERN: Increased Pollution, Pressure on Environment, Loss of biodiversity


Importance of Road network
Damage caused to environment / surrounding by over use
Responsibility of Govt, Corporates & People – JOIN HANDS – to keep NHs green / beautiful negating ill effects – pollution / feeling of trees

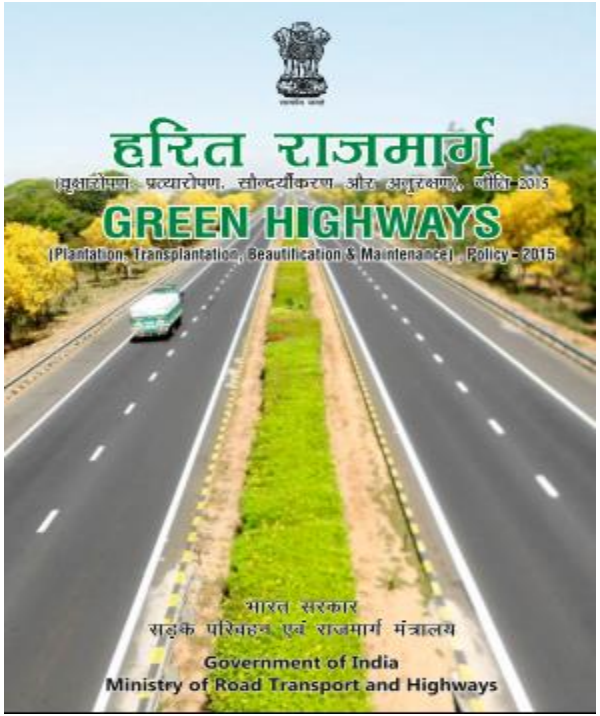
GREEN HIGHWAYS POLICY – 2015

MINISTRY OF ROAD TRANSPORT & HIGHWAYS, GOI

Vision: ***National Highways for Sustainable Environment & Inclusive Growth***

Objectives of GHP - 2015

- Develop a systematic framework for Integrated Green Corridor Development along National Highways
- Build resilient ecosystem in the form of **"Green Corridors"** along National Highways for
  - Combating global warming and climate change effects.
  - Optimum GHG sequestration
  - *Ex situ* conservation of native RET species of the region
- Develop unique green corridors with aesthetic appeal
- Reduce the impacts of air, noise pollution and dust
- Reduce soil erosion at embankment slopes
- Reduce the effects of wind and incoming UV radiation

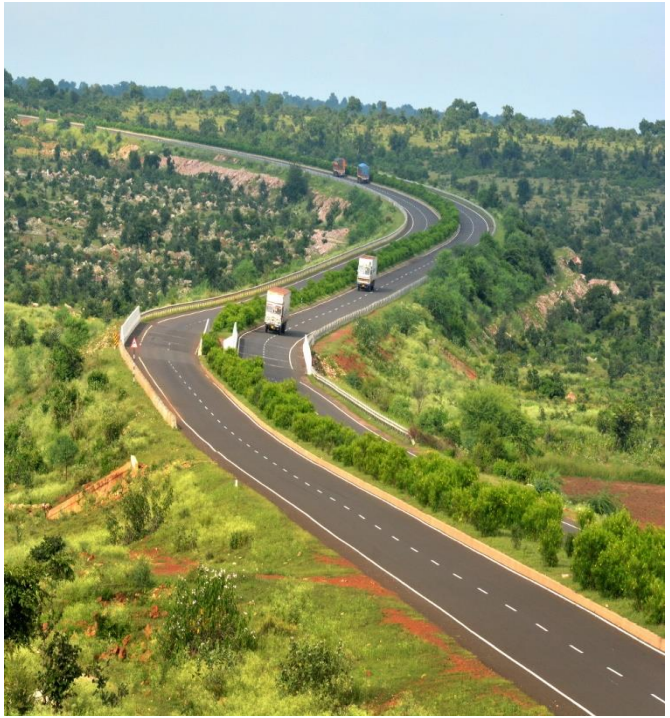


GREEN HIGHWAYS DIVISION- NHAI

Green Highways Division is vertical under National Highway Authority of India (NHAI) responsible for ***implementation*** of the Green Highways Policy.

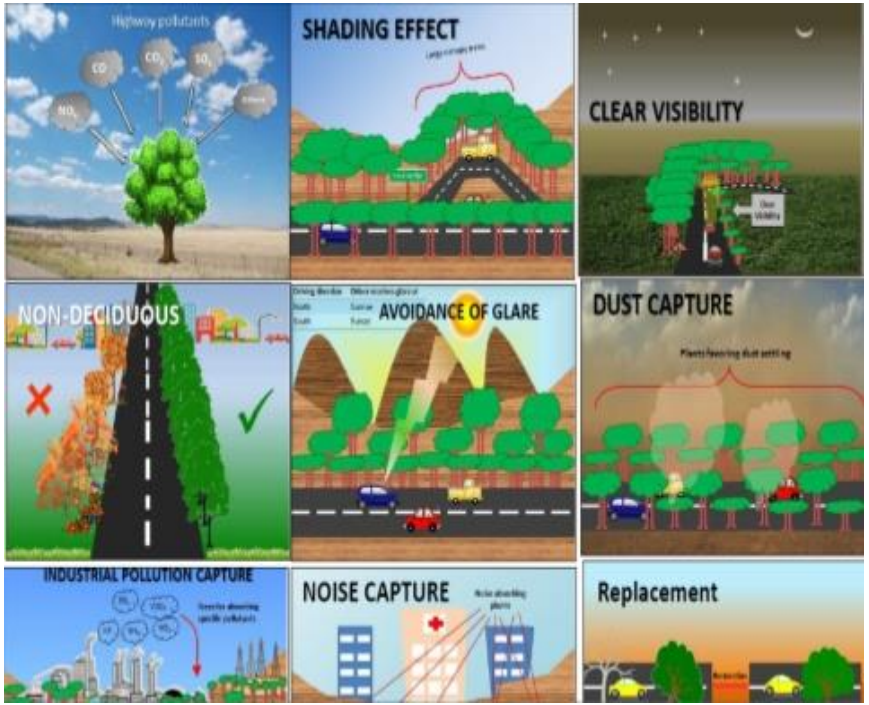
GHD - VISION

Development of ECO – FRIENDLY National Highways with participation of communities, farmers, NGOs, private sector, institutions, government agencies and forest departments for economic growth and development in a sustainable manner



GHD - MISSION

- Integrated Green Corridor Development and Management along existing 1.46 lakh **km** NHs network and upcoming NHs
- Make Green Highways Program self sustainable in next 10 years.
- **Reinforcing India's CoP 21 commitment** by developing additional carbon sink outside forest
- **Sustained employment for 100,000 people** for next ten years (min 200 days/year)
- Create platform for research and innovation in green pathways sector including roads, rail-sides and waterways.



SALIENT FEATURES

- Large amount of land available with NHAI / MoRTH / NHIDCL
  - Roadside Plantation (Median & Avenue Plantation)
  - Vacant land parcels near flyovers & road alignments for commercial plantations
- GHD is responsible for overall planning, implementation and monitoring of Green Highways Projects

CONVERGENCE OF GHPS WITH SDGS

- **Employment Generation:** 100,000 employment generation for semi-skilled and unskilled workers thereby aiding in poverty alleviation and economic growth.
- **Climate Change Mitigation:** Additional annual carbon sink of 2.13 to 2.46 million tons by 2030 thereby reinforcing CoP 21 **(NDC)** commitments and aiding climate action.
- **Sustainable Linear Infrastructure:** Institutionalizing Integrated green corridor development and management approach thereby aiding in sustainable infrastructure development in cities.

UN resolution for transforming world by 2030, through concerted efforts for achieving Sustainable Development Goals, specifically **SDG no. 1 (No Poverty), 8 (Decent Work & Economic Growth), 9 (Industry, Innovation & Infrastructure), 11 (Sustainable Cities & Communities) & 13 (Climate Action).**

SUSTAINABLE LIVELIHOODS FOR 100,000 PEOPLE

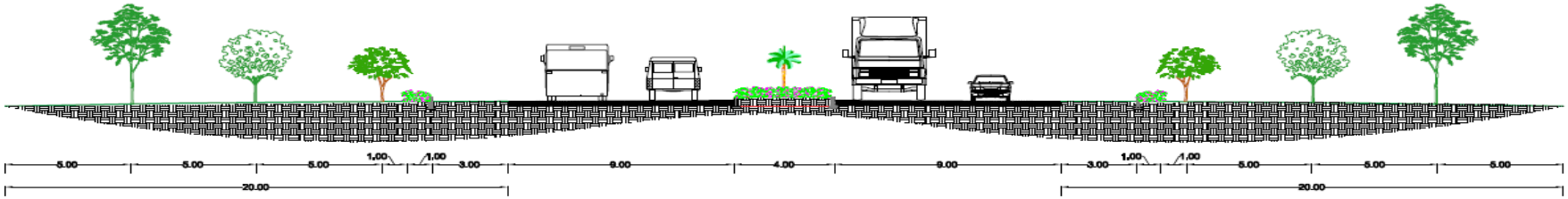
- GHD envisions a participatory approach for development of Green Corridors along NHs.
- Plantation and allied activities require large manual workforce, generating livelihoods opportunities for semi / unskilled workers.
- Highways plantations are expected to generate sustained employment opportunity for 100,000 semi / unskilled workers for minimum 250 days a year in next 10 years.
- Equal amount of self – employment / entrepreneurial opportunities in Nursery development, tree guard manufacturing, organic manure, agri-processing sectors etc.

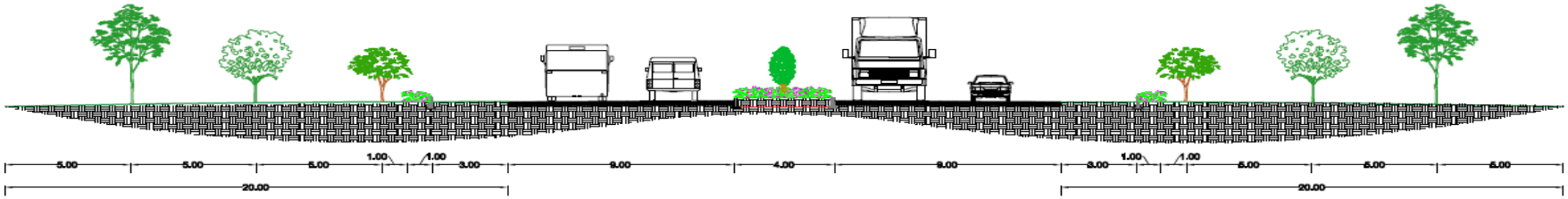
GUIDELINES FOR GREEN HIGHWAYS PROJECTS

Guidelines comprise following components –

- Green Corridor Development Methodology
- Empanelment / Registration procedure for implementing agencies
- Work Award Process
- Plantation Species Matrix for selection of trees / shrubs species for roadside plantation.
- Best Management Practices Manual
- Monitoring & Payment procedure of Plantation Projects

STANDARD DESIGN FOR 60 M ROW





WORK AWARD PROCESS

- State Government Agencies (Forest Department , FDC, etc) : Based on Project Proposal
- Private Agencies / NGOs: Based on competitive Bidding - Quality cum Cost Based Selection

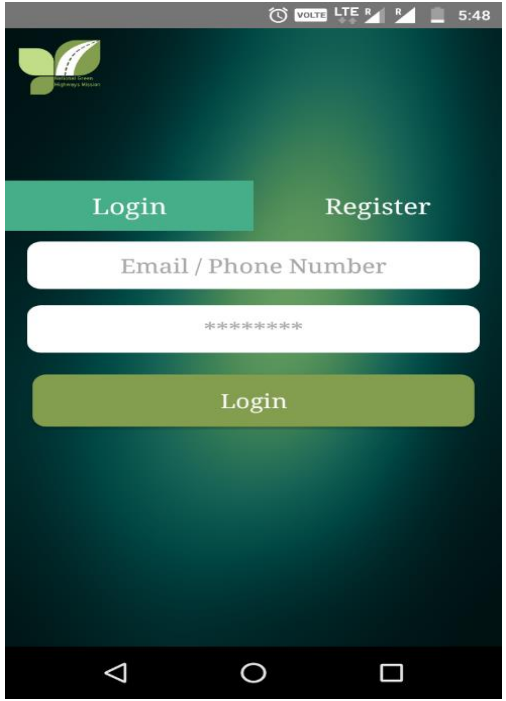
QUALITY ASSURANCE MECHANISM

MONITORING BY RESPECTIVE PIU/RO

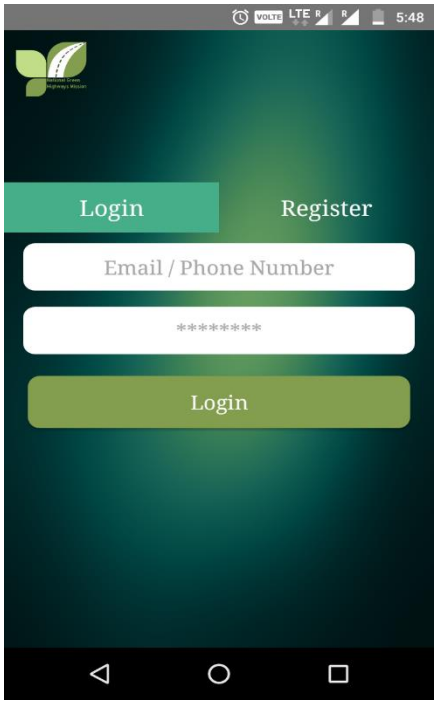
- Respective PIU/RO to ensure effective implementation and monitoring of the plantation projects.
- Field verification shall be carried out by Plantation Manager of respective RO / PIU with respect to survival, growth and size of plantation and compliance to maintenance schedule. The survival shall be 90 % after raising the plantation for one year at any stage during contractual period with normal shape and size.
- Progress report of every plantation project shall be prepared after field verification; Details of Plantation progress shall be uploaded on the website as well.

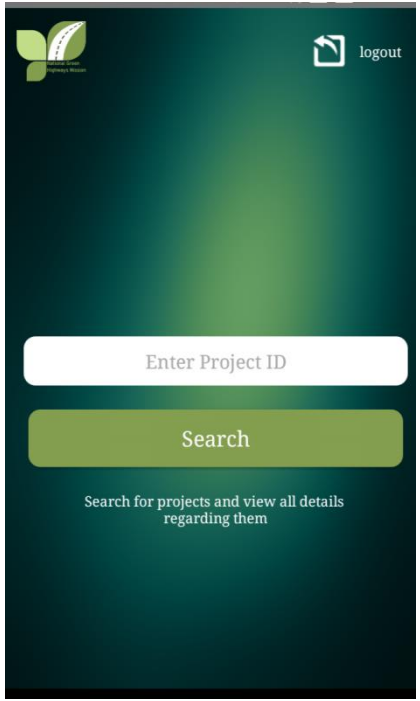
MONITORING PLANTATIONS THROUGH GREEN HIGHWAYS MOBILE APP & GIS BASED APPLICATION

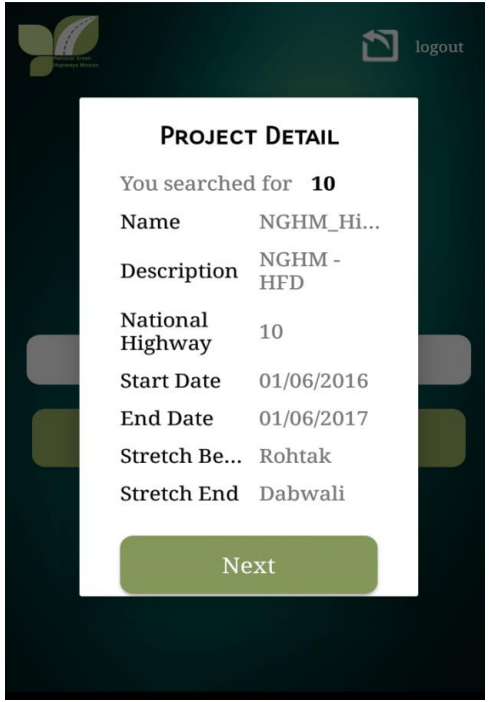
- Mobile app will act as an interface between the plantation agencies , field offices & HQ of NHAI.
- Plantation agencies will use this app to submit the status of plantation and project activities performed by them.
- Data generated through this app will help in monitoring of the project
- Moreover, Geo Spatial technologies and high resolution satellite imagery data will be linked with APP for real time monitoring of plantation activities
- The App will work in offline mode as well



BETA VERSION OF GREEN HIGHWAYS MOBILE APP LAUNCHED







Android App

GREEN HIGHWAYS PROJECT LAUNCHING

- **GHD has initiated plantations work along 2500 km stretch of NHs with an investment of 58 mill USD.**
- The Green Highways Projects phase I spans across 10 States and covers 25 NHs.
- **Projects for 1590 km were awarded in an event organised on 1st July, 2016 in the presence of Shri Nitin Gadkari, Hon Minister, RTH.**

STATUS OF GREEN HIGHWAYS PROJECTS AT NATIONAL LEVEL

Year	Type of Agency	Length of Project (in Kms)	Estimated Project Cost (INR Crore)	Plantation Progress	
				Target (No of Plants)	Achievement (No of Plants)
2016-17	Government Agency	933	149.10	8,55,640	3,09,457
	Private Agency	611	121.58	8,00,551	3,60,364
2016-17 Subtotal		**1,544**	**270.68**	**16,56,191**	**6,69,821**
2017-18	Government Agency	1,155	151.88	9,72,473	925
	Private Agency	40	3.00	20,000	7,800
2017-18 Subtotal		**1,195**	**154.88**	**9,92,473**	**8,725**
2018-19	Government Agency	538	52.46	3,57,017	-
	Private Agency	1.6	0.10	-	-
2018-19 Subtotal		**540**	**52.56**	**3,57,017**	**-**
Grand Total		**3,278**	**478.12**	**30,05,681**	**6,78,546**

Further additional plantation of 17.45 (10.18 + 7.27) lakh have been done through Concessionaire / Contractor during monsoon seasons in 2017 – 18 and 2018 – 19.

STATUS OF GREEN HIGHWAYS PROJECTS AT NATIONAL LEVELQ

Year	Type of Agency	Length of Project (in Kms)	Estimated Project Cost (In Crores Rs.)	Plantation Progress		Expenditure	
				Target (No of Plants)	Achievement (No of Plants)	NHAI (in Crore)	Other agencies (in crore)
2016-17	Government Agency	891.0	130.70	7,30,140	3,93,599	40.83	38.115
	Private Agency	387.0	46.92	2,99,756	2,43,587	10.54	5.68
2016-17 Subtotal		**1,278.0**	**177.62**	**10,29,896**	**6,37,186**	**51.36**	**43.80**
2017-18	Government Agency	880.6	87.51	9,72,473	1,09,017	14.89	-
	Private Agency	40.0	3.94	20,000	14,559	-	1.97
2017-18 Subtotal		**920.6**	**91.45**	**9,92,473**	**1,23,576**	**14.89**	**1.97**
2018-19	Government Agency	537.9	52.46	3,57,017	1,15,920	6.075	-
	Private Agency	323.1	50.63	26,000	26,000	-	3.00
2018-19 Subtotal		**861.0**	**103.09**	**3,83,017**	**1,41,920**	6.075	3.00
Grand Total		**3,059.55**	**372.16**	**24,05,386**	**9,02,682**	**72.32**	**48.77**

STATUS OF GREEN HIGHWAYS PROJECTS AT NATIONAL LEVEL

Type of Agency	2016 -17	2017-18	2018-19	Total	Agency % age
Government Agency	891	881	538	2,310	75.49
Private Agency	387	40	323.1	750	24.51
Total	1,278	921	861	3,060	

Status of Post Policy Plantation

Avenue	Median	Total
25,91,776	25,18,971	52,16,920

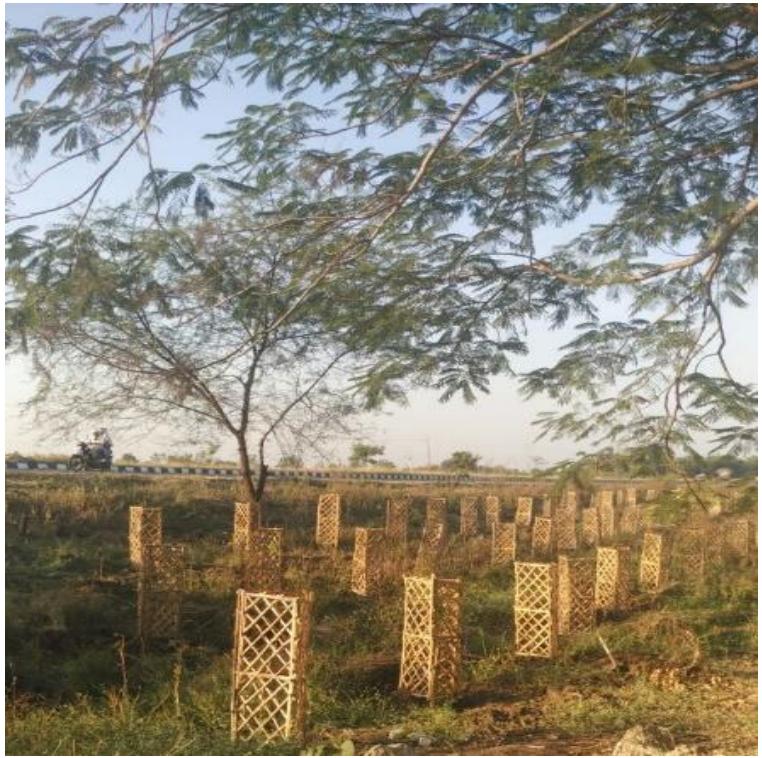
GREEN HIGHWAYS PROJECTS – HISAR

Plantations work in progress along National Highway - 10

GREEN HIGHWAYS PROJECTS – GUWAHATI

Plantation Work in Progress along National Highway - 31

GREEN HIGHWAYS PROJECT - NAGPUR

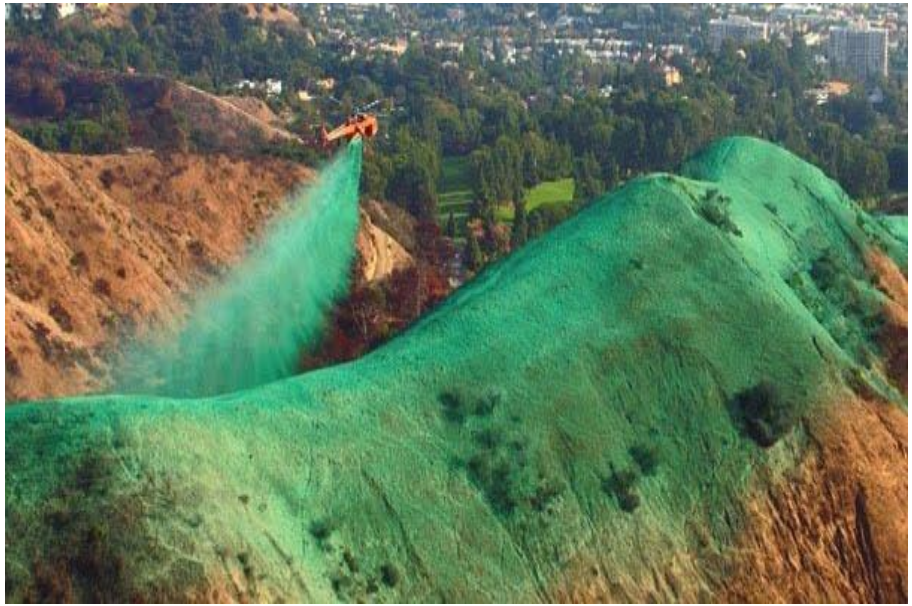


Plantations under progress along NH -7

HYDRO-SEEDING

- Hydro-seeding at embankments for biological soil water conservation as compared to mechanical method of stone pitching and gabions.
- Best suitable for hill terrains, landslide prone areas and embankments.
- Standard practice in various developed countries
- Economic and ecologically sound bio – engineering practice for greenery development.
- GHD is developing modalities for undertaking pilot project at Agra bypass and Parwanoo – Solan NH

HYDRO-SEEDING



TRANSPLANTATIONS

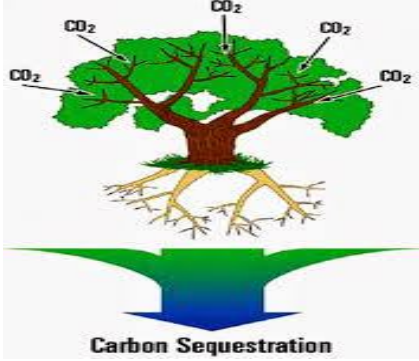
- **Objectives**
  - Feasibility of transplantations to minimize tree felling during highways development
  - Knowledge dissemination on transplantations
  - ToT for advance transplantation technology
- **Outcomes**
  - Recommendations and action points emerged during deliberations have been documented in the form knowledge report on Transplantations.
  - Transplantations will be promoted wherever feasible, with focus on survival after transplantation.

TRANSPLANTATION PROCESS

https://www.youtube.com/watch?v=-JJHgaNQBGI

INNOVATIVE INITIATIVES

CARBON NEUTRAL GREEN HIGHWAYS



- GH plantations, being outside forests and outside conventional green cover will be eligible for Carbon credits under CDM.
- Targeted Plantation on approx 400,000 acre (= 162,000 ha) land
- Total 100 million trees will be planted
- Carbon sequestration Capability: ~ 21 MT per acre/year –
  - *(Source Study report on Carbon Sequestrated in NHs ROWS - Federal Highway Administration, USA)*
  - *As per the study conducted by GHD across 10 NHs carbon sequestration potential is 21 MT per acre (15 MT per ha) / year*

- Total expected GHG emission - 1212 million tons. *(CPCB, MoEF report)*
- Annual Capacity to sequester Carbon from 400,000 acre (162,000 ha) land under vegetation: **2.46 Million MT / year**
- With the current rates in Voluntary Carbon Offset Market, estimated Annual Income: 89 mill USD

BASELINE STUDY FOR ASSESSMENT OF CARBON SEQUESTRATION POTENTIAL OF PLANTATIONS ALONG NATIONAL HIGHWAYS

Objective:

- Review existing methodologies for carbon sequestration assessment.
- Establish methodology for assessing carbon sequestration potential of existing plantation/vegetation along NHs.
- Take up field visits for collection of primary data regarding existing plantations.
- Assess current carbon sequestration potential of existing plantation/vegetation along NH.
- Provide recommendations and scope for further research in this direction.

SAMPLING METHODOLOGY

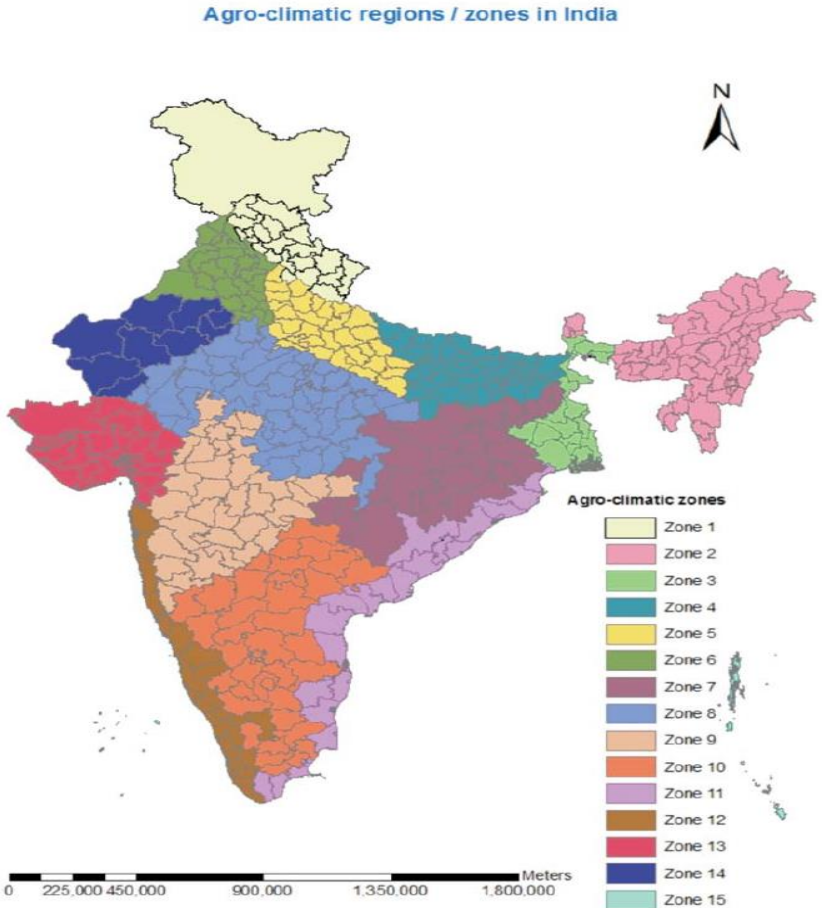
Multi-stage sampling approach

- Random sampling – for choosing 10 NHs out of 218 NH stretches
- Judgement sampling – for choosing sampling sites based on the inputs of
  - the concerned PD
  - Concessionaires' Site Engineers/maintenance team
- Quota sampling – based on representativeness of three categories of vegetation densities –
  - Sparse
  - Medium
  - Dense

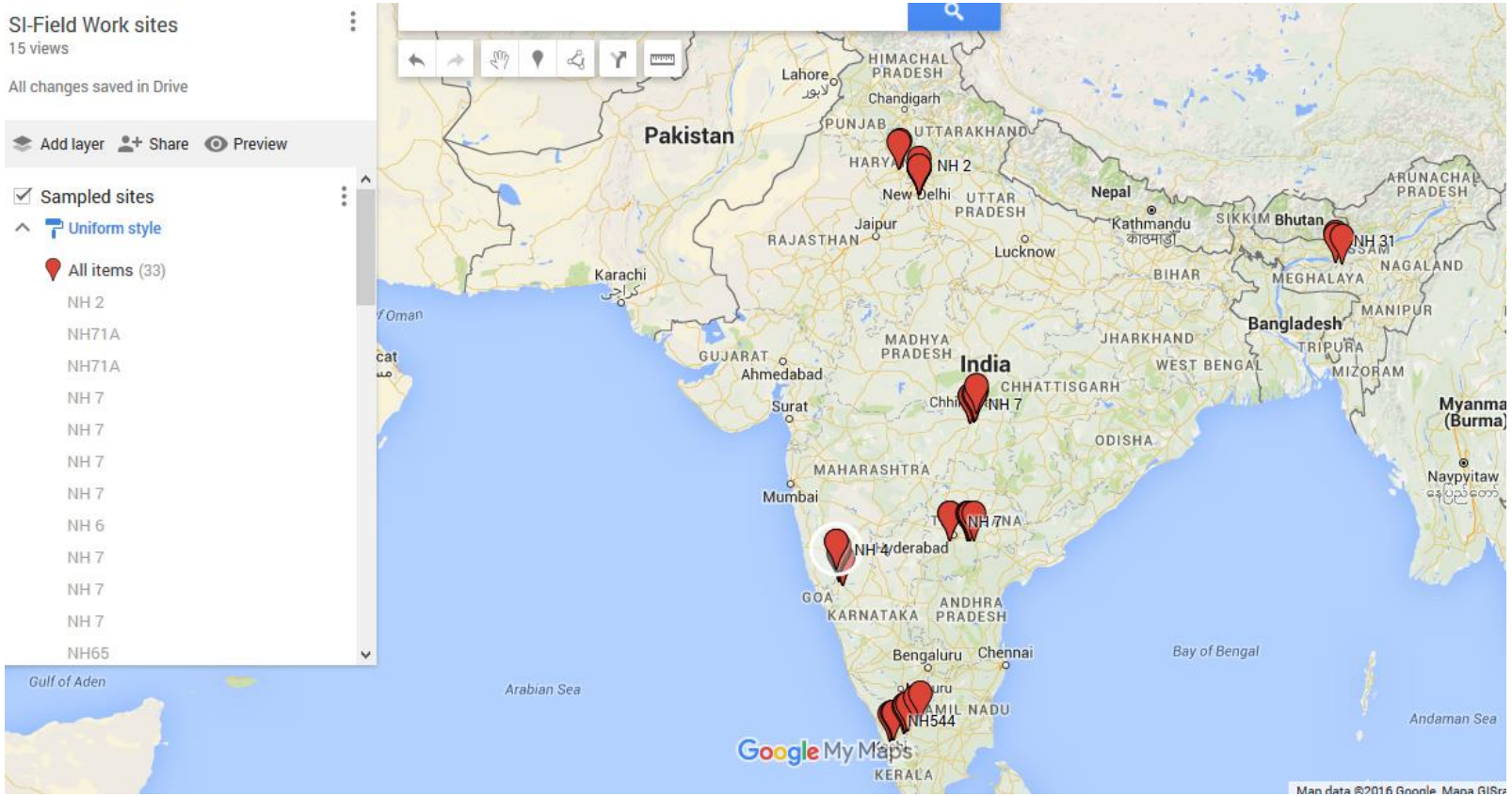
STUDY AREA

- 10 National Highways were selected across 4 agro-climatic zones of India.

S. No.	Agro-climatic regions/zones	States represented
II	Eastern Himalayan region	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, West Bengal
VI	Trans Gangetic plain region	Chandigarh, Delhi, Haryana, Punjab, Rajasthan
IX	Western plateau and hills region	Madhya Pradesh, Maharashtra
X	Southern plateau and hills region	Andhra Pradesh, Karnataka, Tamil Nadu



FIELD WORK SITE



DATA ANALYSIS

Methodologies to calculate carbon sequestration (AGB+BGB)

1. Based on Volume Equation (Forest Survey of India)
2. Based on Basal Area
3. Based on Diameter and Height

RESULTS & INTERPRETATION ON CARBON SEQUESTRATION ALONG NATIONAL HIGHWAYS

National Highway	Agro Climatic Zone	Carbon Sequestered (Tonnes Per Ha)			Total Sequestration (Tonnes Per Ha)
		Avenue	Median	Soil Organic Carbon	
NH-2, NH – 71 A	Trans-Gangetic Plain Region	28.47	0.47	5.55	34.50
NH-31, NH – 38, NH - 40	Eastern Himalaya Region	28.12	0.82	8.47	37.42
NH-65, NH – 4, NH - 7, NH - 544	Southern Plateau and Hills Region	23.42	0.62	9.12	33.17
NH-4, NH – 7, NH – 544, NH - 6	West Coast Plain and Ghat Region	23.07	0.65	9.85	33.55

RESULTS & INTERPRETATION

- Based on the normalized result of the findings carbon sequestered along the total NH stretch of approximately 31600 Km in four agro climatic zones was estimated to be 7,28,330 ± 53225 tonnes,
- This normalized result was extrapolated on the total extent of national highways of 100,000 Km to arrive at an estimate of **2.13 to 2.46 Million Tonnes** of carbon sequestration annually.
- The study shows that the National highways have great potential to be a significant and economic way to sequester carbon through scientifically managed roadside plantations.

INNOVATIVE INITIATIVES

ADOPT A GREEN HIGHWAY PROGRAM

- Corporate / Institutions can adopt particular stretch of highways for roadside plantations under their CSR program.
- Power Finance Corporation has adopted in 90 km RS plantations in Nagpur with an investment of Rs 2 mill USD
- Indian Oil & Numaligarh Oil Refinery has adopted 6 km stretch and 5 roundabouts respectively in Assam (NH -31)
- Coal India Limited is adopting 100 km stretch on NH – 78.
- Yes Bank has adopted 40 km stretch of Mumbai Nashik Expressway.

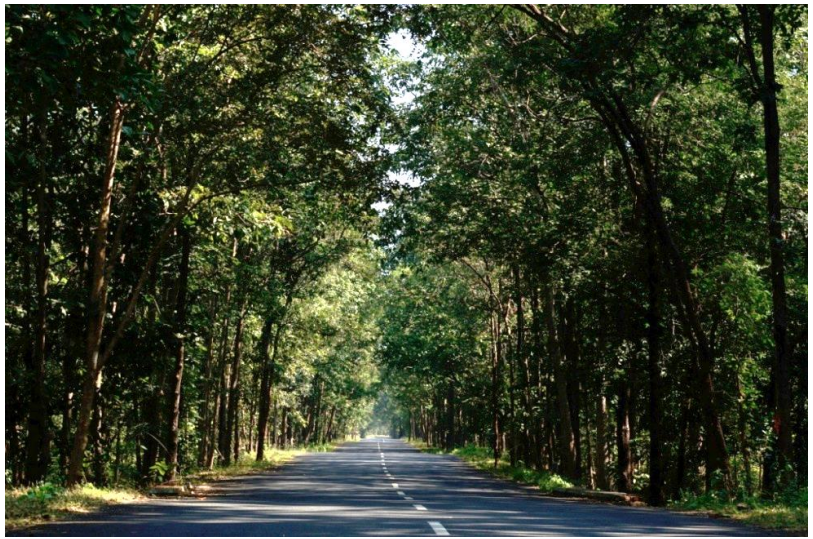
INNOVATIVE INITIATIVES

SALIENT FEATURE OF ADOPT A GREEN HIGHWAYS PROGRAM

- Adopt a Green Highway Program (AGHP) is a unique partnership program benefitting all stakeholders from government to corporate to community at large, in which, organizations and individuals can adopt sections of highways and contribute towards green corridor development.
- This initiative will help in ***fulfilling India's commitment at CoP 21 Summit for developing additional carbon sink of 2.5 billion tons annually.***
- Creation of valuable ecological asset by convergence of CSR funds.
- Participation in the program will help corporate in showcasing their efforts towards environment conservation and livelihood generation.
- **Funding Agencies will also be eligible for earning carbon credits.**
- **Branding opportunities along NHs for funding agencies.**

PPP Based Plantation, Maintenance and Sustainable Harvesting

- For Agro-forestry based industries (Pulp, paper, ethanol, floriculture, food processing, plywood etc)
- Concession to utilize large stretches of ROW alongside highways / vacant land parcels for plantation & sustainable harvesting
- Focus on Horticulture, floriculture and other important timber value crops.
- Investment, Management & Sustainable Harvest responsibility of Concessionaire
- **Swiss Challenge based Plantation**, Maintenance and Sustainable Harvesting
  - Entrepreneurs can submit their innovative proposals for median, avenue or block plantations.
  - Innovative proposals with respect to plantation, maintenance and sustainable harvesting.
  - Tree / shrubs of ecological importance & economic value



INNOVATIVE INITIATIVES

OMC PARTNERSHIP WITH AGRO-FORESTRY INDUSTRIES

- Indian Association of Paper Mills (IPMA) *(Association of ITC, JK Paper, BILT, International Paper etc)* has submitted its intention to take up plantations for agro forestry crops (*Melia dubia, Gmelina arboria, Casuarina, Eucalyptus, Bamboo* etc) along ROW.
- Plantations, Management and harvesting will be done by IPMA allied industries at their own cost.
- Minimum requirement 100 km contiguous stretch of NH for project feasibility.
- IPMA allied agencies will have user rights only and will have to clear the plantations in case of road widening / extension.
- **ITC has signed tripartite agreement with NHAI & REPL (Concessionaire) for undertaking plantations, management and sustainable harvesting activities along 200 km stretch in AP on PPP model.**

KNOWLEDGE PARTNERSHIPS SO FAR…..

- **TERI:** Policy Advocacy, Research & Innovations on climate change, forestry & carbon emission reduction
- **INBAR:** Role of Bamboos in development of Green Highways
- **CSIR-NEERI:** Research, Innovations & Capacity Building for Green Highways with focus on climate change, biodiversity, carbon emission reduction

<u>Partnership on anvil:</u>

- **The World Bank:** Support for Centre for Innovation; Joint research & publications; Technical & Financial support for pilot GHPs; and Knowledge Sharing
- **ADB, GCF, JICA on anvil**

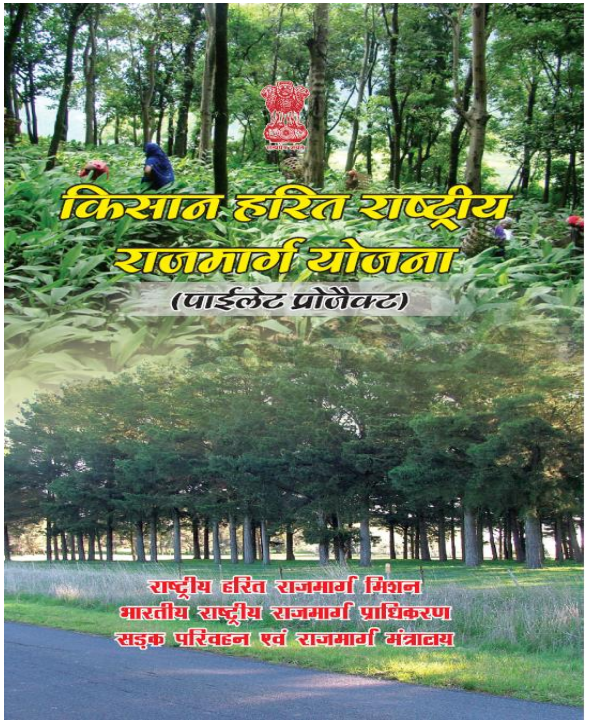
INNOVATIVE INITIATIVES

EXTENDING GREEN BELTS BEYOND AVENUE PLANTATIONS

Greening of Farmlands along NHs

(Kisaan Harit Rajmarg Yojna) - Pilot

- ~50 m on both side along NHs passing through forest and other rural farmlands can be taken up for plantations by farmers / JFMCs
- NHAI will fund the management of plantations.
- Farmers will be provided the usufruct right on the plantations.
- Tripartite agreement among NHAI, Farmer and Agro-forestry industries for Buy back of sustainable harvest



INNOVATIVE INITIATIVES

HIGHWAY WIND TURBINES

A WORKING PROTOTYPE OF A SERIES OF VERTICAL AXIS WIND TURBINES (5 NUMBERS) ON A HIGHWAY MEDIAN FOR GENERATION OF ELECTRICAL ENERGY FROM THIS MECHANISM

ESTIMATES:
ONE VEHICLE PASSAGE – 20 W ELECTRICAL
30 VEHICLES PER HR – 15kWhr / 15 UNITS
5 TURBINES – 75 UNITS PER DAY

LED's: 35 W X 2 = 70 W PER POLE
- 4 MONTHS OF LIGHTING OR
- 250 LEDS PER NIGHT

BUDGET: Rs. 20 lacs (lump sum inclusive of all taxes)

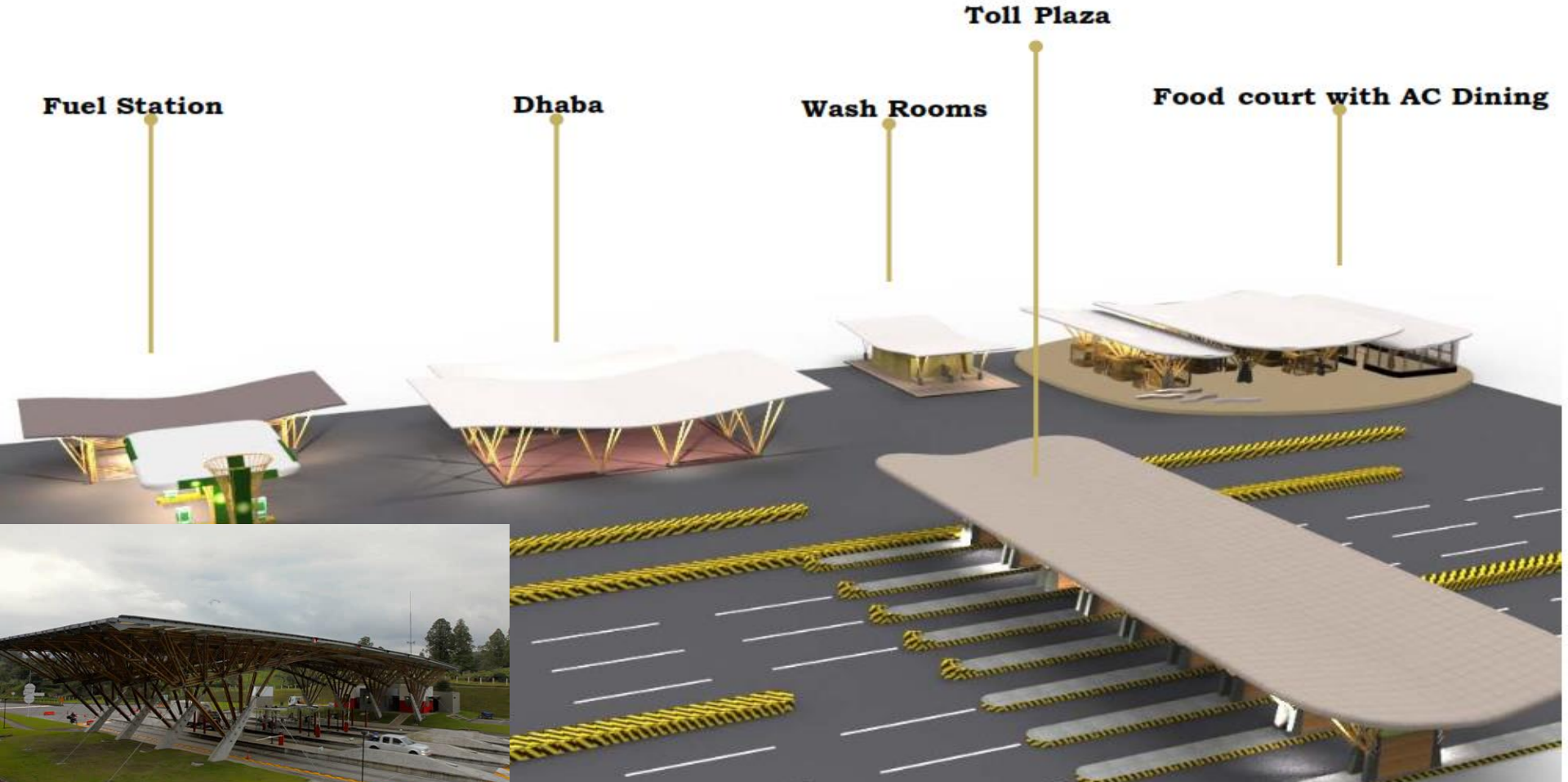
NOTE: TURBINE PHOTO IS INDICATIVE FROM REF. : Mashyal & Anil (2014), Highway windmill, American Journal of Engineering Research, Vol-3, Issue 7, pg 28-32.

BAMBOO BASED TOLL PLAZA & WAYSIDE AMENITIES

- Bamboo based toll plaza on Delhi Eastern Peripheral Expressway is proposed.
- Bamboo based Wayside amenities along NHs.

PROPOSED – Bamboo Toll Plaza

INNOVATIVE INITIATIVES



Bamboo for Roads – 45 mill USD

CORPORATE SOCIAL RESPONSIBILITY SUMMIT

- **Theme:** CSR for Inclusive Growth & Sustainable Environment
- **Participants:** Corporate / PSUs / Govt. agencies / Institutions/ Individuals
- **Objectives:**
  - Deliberate on the role of CSR in inclusive growth & sustainable environment
  - Explore opportunities for partnering with Corporate/ PSUs for enhancing the scale of Green Highways Program

INNOVATIVE INITIATIVES

NATIONAL CONVENTION ON "**INNOVATIONS IN GREEN HIGHWAYS**"

NEW DELHI – (7-9TH NOVEMBER, 2016)

- Promote research, innovations and global best practices in Green Highways
- Establishment of Centre for Innovation in Green Pathways (Waterways, Roadways & Railways)
- Outcomes
  - MoU signing with Corporates, International Institutions.
  - Deliberations on research needs & global trends in greening highways
  - Focus Group Consultation for training need analysis.

Ministry of Road Transport and Highways
Government of India

www.nhai.gov.in

PLANTATIONS

As A Tool for Road Safety

Green Highways Division

National Highways Authority of India

NITIN GADKARI
Minister of Road transport, Highway,
Shipping & Water Resources &
Ganga Rejuvenation, Govt. of India

FOREWARD

Trees and plants are one of the most precious gifts of nature to the mankind and they are an innovative technology on their own. Efforts should be made in the direction of adjusting anthropogenic techniques and design to conform to that of nature and get the best out of it. Instead of solely trying to balance economic activities and environment protection, one should integrate environment protection and enhancement as a part of it. In terms of highways, plantation shall be taken up as a technology for road designing.

Building road, builds the economy of a nation but building safer and greener roads boost healthy economy. Roads are valued and shared assets that provide accessibility, promote trade and tourism, and bridges geographical divide. It is the responsibility of the highway fraternity to join hands in building and maintaining safer and greener roads. To address this, Ministry of Road Transport and Highways has recently promulgated the **Green Highways (Plantations, Transplantations, Beautification and Maintenance) Policy – 2015** and established the **Green Highways Division** for developing green corridors along the National Highways contributing towards better environment and meeting the CoP 21 commitment of India. This document will provide a kick start towards planning and implementation of using plantation as part of road design, particularly with respect to safety.

It is needless to say that India has a rich pool of engineers and environmental experts and I am confident they will contribute together towards realization of the objective to integrate plantation as a safety tool for roads. I also congratulate the team of GHD for taking the first step towards it.

(NITIN GADKARI)

COP 22 MEETING (7TH – 18TH NOV 2016) MARRAKESH, MOROCCO

- Green Corridor development Program of NHAI was acknowledged as a unique & distinctive program : policy, implementation and beneficiary
- Road Transport Department of no other country has followed such a concept of greening
- GHPs were acknowledged as Potential contributors towards India's commitment at CoP 21 for generating additional carbon sink
- Representatives of Green Climate Fund find GHP as a complete project and eligible for receiving funding under it

‘STRATEGICALLY DESIGNED GREENBELT DEVELOPMENT ALONG HIGHWAYS AND ITS PERFORMANCE EVALUATION TOWARDS ECO-CAPITAL BUILD UP’

- *A PILOT DEMONSTRATION BY NEERI, NAGPUR, INDIA*

Objectives:

Highways – for Environment and Socio-economic development

Develop designed green belt with site specific appropriate vegetation strand for

- Mitigate the environmental losses
- Enhance Sink for GHGs
- Attenuation of vehicular pollution
- Renewable resource generation
- Value addition for safe transportation - Enhance the aesthetics

Develop man made linear Ecosystem for

- Air-purification (SO_x, NO_x, CO_2, SPM capture)
- Ambient temperature amelioration
- Humidity build up during drift
- Surface water runoff prevention
- Enhanced underground recharge potential
- Soil enrichment
- Biodiversity buildup
- Biomass generation
- Noise reduction

Habitat Fragmentation

- Roads, railroads, and the incessant traffic disrupt ecological processes; increase anxiety /mortality in animals, lead to degradation, loss and isolation of wildlife habitats (cover, breeding niches, forage & food, solitude), and broadly alter/ fragment the landscape, in a literal sense. The wildlife corridors, in particular, are in crying need of scientific attention/ solutions, as the animals face /negotiate fast traffic on NHs, while habitually ambulating through natural habitats in search of food, water and cover.
- Even the night tranquility of forests , which is an activity period for the wildlife, is lost with unending stream of powerful and glaring halogen lamps, humming engines and blaring pressure horns.
- Mitigating adverse impacts, euphemistically categorized as greening, particularly in and around ecologically sensitive areas, requires to be internalized in designing, planning, execution and maintenance of highways.
- Habitat fragmentation due to transport infrastructure is receiving growing attention/ concern among ecologists and civil engineers. Much data has been gathered that gives evidence of the complex impact of infrastructure on wildlife, landscapes, including alteration of drainage patterns and channel flows.
- This calls for designing, both engineering and aesthetics, of seamless green foot over bridges (and underpasses) for safety of wild animals. Our bright engineers owe this to the nature, as a debt to maintain this planet habitable in perpetuity.

Primary ecological effects

- Habitat loss more than 10 ha of land per kilometer road (?)
- Corridor – especially the ROWs with grassy corridors road verges and roadsides can however provide refuge to the wildlife
- Disturbance: noise, hydrocarbon and light pollution
- Mortality
- Barrier
- Edge effect leads to fragmentation of continuity (secondary sociological effects) of forest blocks. Where roads cut through forested habitats, microclimatic conditions are strongly altered. Increased wind and light intensity, reduced air humidity and temperature disfavor forest interior species that are more mesophytic and shade loving (change in species mix)
- Proliferation of encroachments, habitations and commercial kiosks along the roadside, become expanding cancerous nodes, eventually coalescing and becoming a source of escalating biotic activity in the area. ~~Algorithm linking loss of forest cover in direct proportion to increasing road density~~
- Roads as life lines of social development and movement of population

Animal Bridge , Flyovers & Eco Tunnels

- Ecological tunnel refers to integrating ecological principles into tunnel design, construction and operation to create a balanced and sustainable tunnel-nature system. It consists of four elements: green tunnelling, green lighting, green lining, and green recycling of excavated material
- It requires integrating scientific knowledge of ecology and energy-conservation within tunnel design, construction and operation towards the major goal of striking a careful balance between human beings, tunnels and nature,

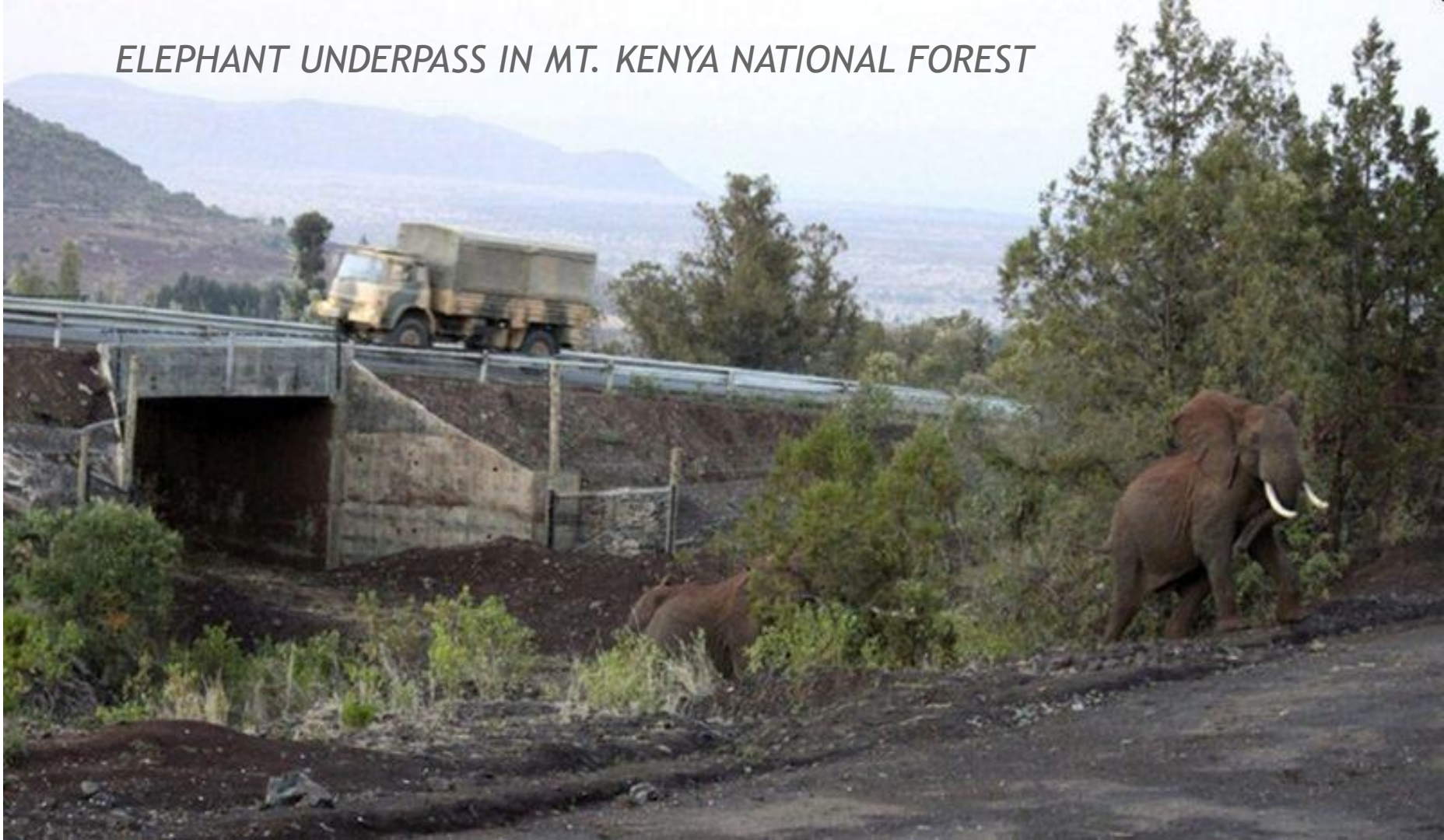
WILDLIFE CORRIDOR OVER TRANS CANADA HIGHWAY IN BANFF NATIONAL PARK, CANADA |

NATUURBRUG ZANDERIJ CRAILOO WILDLIFE CROSSING IN NETHERLANDS

UNDERPASS CRAB CROSSING ON CHRISTMAS ISLAND NATIONAL PARK

5-m high crab bridge crossing

ELEPHANT UNDERPASS IN MT. KENYA NATIONAL FOREST

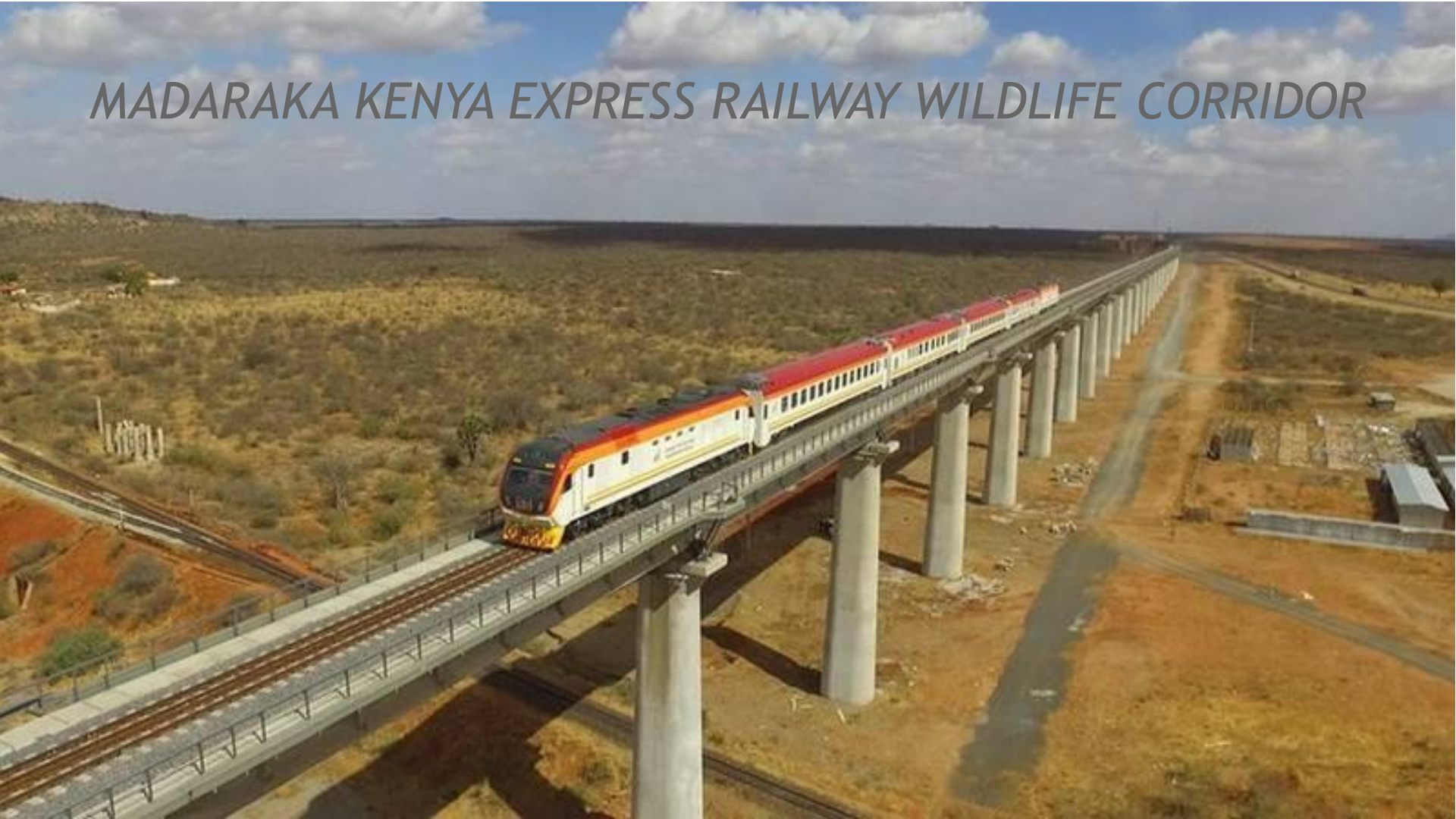


WILDLIFE PASSING BRIDGE SPANNING THE BUKIT TIMAH EXPRESSWAY (BKE) IN SINGAPORE

BURNHAM WILDLIFE CORRIDOR

KALLHÄLL BRIDGE PROVIDES A CORRIDOR FOR WILDLIFE TO SAFELY PASS OVER THE TRACKS STOCKHOLM

MADARAKA KENYA EXPRESS RAILWAY WILDLIFE CORRIDOR



MANDAI WILDLIFE BRIDGE

SINGAPORE

The Terai Arc Landscape spreads across810 km of the Indian states of Uttarakhand, Uttar Pradesh, and Bihar, and the low-lying hills of Nepal. The biological corridor covers 14 different protected areas in India and Nepal.

Sawantwadi-Dodamarg Wildlife Corridor connects protected preserves and sanctuaries in Southwestern India

Kaziranga-Karbi Anglong corridor helps animals traverse back and forth in the landscape

Biodiversity offsetting

- A biodiversity offset is a way to demonstrate that an infrastructure project can be implemented in a manner that results in no net loss or a net gain of biodiversity. BBOP (Business Biodiversity Offset Programme) defines biodiversity offsets as "measurable conservation outcomes of actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken. The goal of biodiversity offsets is to *achieve no net loss and preferably a net gain of biodiversity on the ground with respect to species composition, habitat structure, ecosystem functions, people's use and cultural values associated with biodiversity".*
- To be an offset, these conservation outcomes should be quantifiable, since the purpose of a biodiversity offset is to demonstrate a balance between a project's impacts on biodiversity and the benefits achieved through the offset. This involves measuring both the losses to biodiversity caused by the project and the conservation gains achieved by the offset.
- A big challenge but doable, if there is a will. NHAI morally obligated for atonement and /or reparation debt.

Bamboos in greening

Ubiquitous & Quintessential
Easy to propagate
Fast grown

- Tunnelling tendency of bamboo groves
- Heavy leaf & litter fall
- Potential fire hazard
- Subterranean spread of rhizomes, could lead to invasion along the un-metalled ROWs and even into the carriage ways
- Increased maintenance
- Gregarious flowering (choice of species) could cause problems of harvest, exploding rat populations, fire hazards (exhaust sparks) and replanting.
- Bamboo attracts elephants (as food) and invasion by a herd could be serious threat to traffic in elephant habitats/ corridors.

Themes:

- How to create a monitoring and reporting mechanism for roadkill and accidents
  - Identify black spots
    - Adopt preventive measures such as real time monitoring systems.
    - Identify causes – e.g. traffic faults, design faults, etc.
- Identifying data collection and analysis methods
  - Integration with existing platforms and improve systems according to the campaign's priorities
  - Identify gaps in existing platforms
  - Revamp algorithms to improve data input and analysis
  - Improve data collection process, involve NGOs and citizens for reporting

Themes:

- Possible measures to prevent roadkill and accidents
- Innovative tools to enhance awareness
- Institutional partnerships to create a long-term mitigation program
- Capacity building and skill development programs for commuters, drivers, staff at toll plazas etc.
- Engaging automobile companies as part of their CSR activities.
- Policy and Advocacy:
    - o Identifying existing legal issues and compensatory mechanisms
    - o Identifying existing schemes/programs for prevention of roadkill

Focus

- Initiatives undertaken by your organization
- Envisaged role that your organization can play in this initiative – mode of collaboration
- Highlight some of the existing works that your organization has been doing in these areas.
- Any other action points to make this program successful

Communication Tools and Media

S No	Tools	Mode of Circulation
1.	Animated videos	National TV Channels, Internet, Display screens along major roads and highways
2.	Radio jingles	All AIR radio stations across the country, can be extended to private channels
3.	Illustrated posters	Toll Plazas, Driving Training Schools, Offices and Educational Institutions
4.	Car/ Truck Bumper Stickers with Catchy Slogans	Commercial and Private Vehicles
5.	Social media posts/ tweets	Government and UNDP social media handles


Thanks
www.nationalgreenhighways.org
ajoykb@gmail.com