

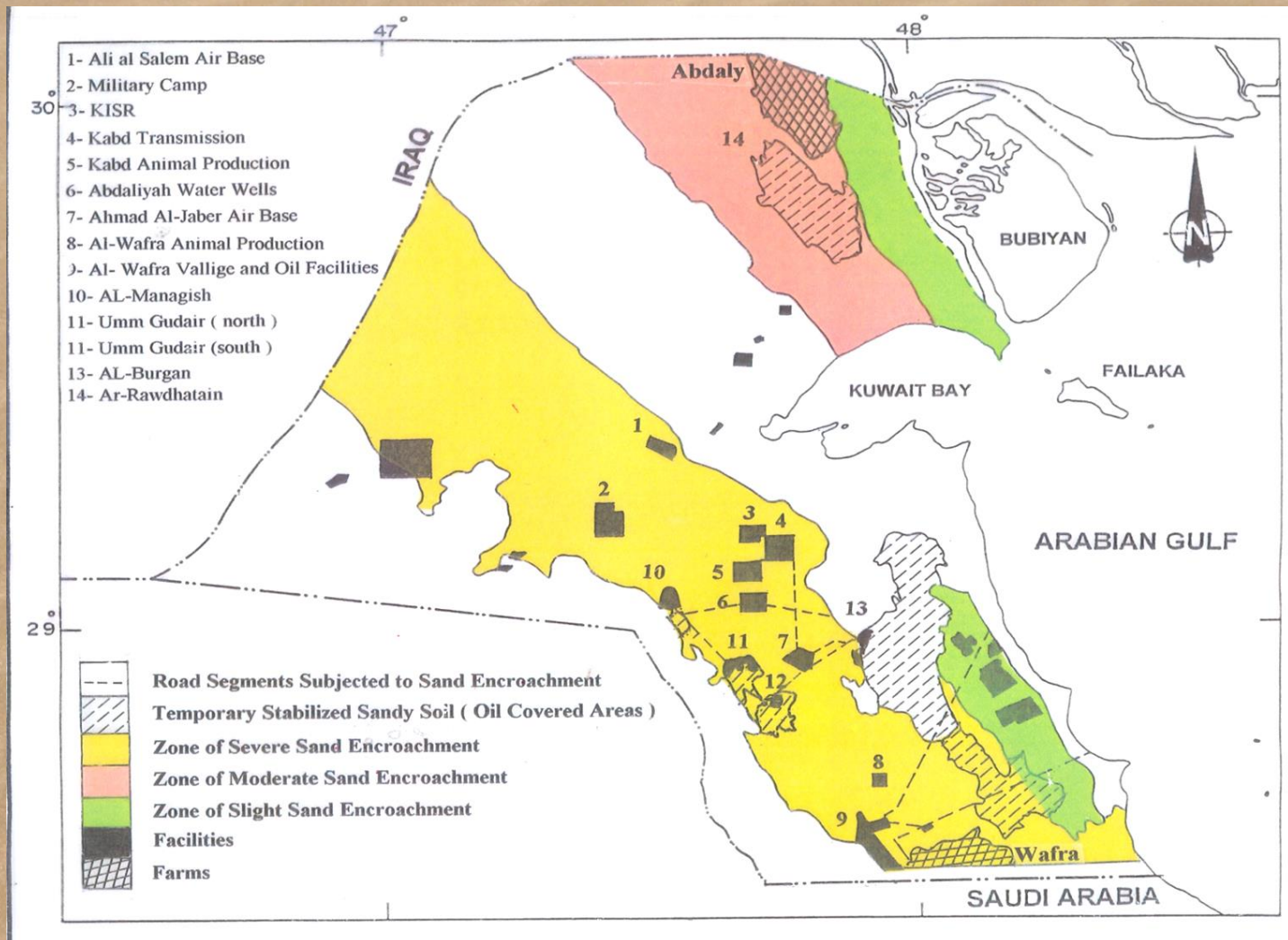
**Integrated System for
Controlling Mobile Sands in
KOC Operational Areas**

**Arabian scientific consultancy
Center ,Kuwait**

15,January ,2006

Main Topics

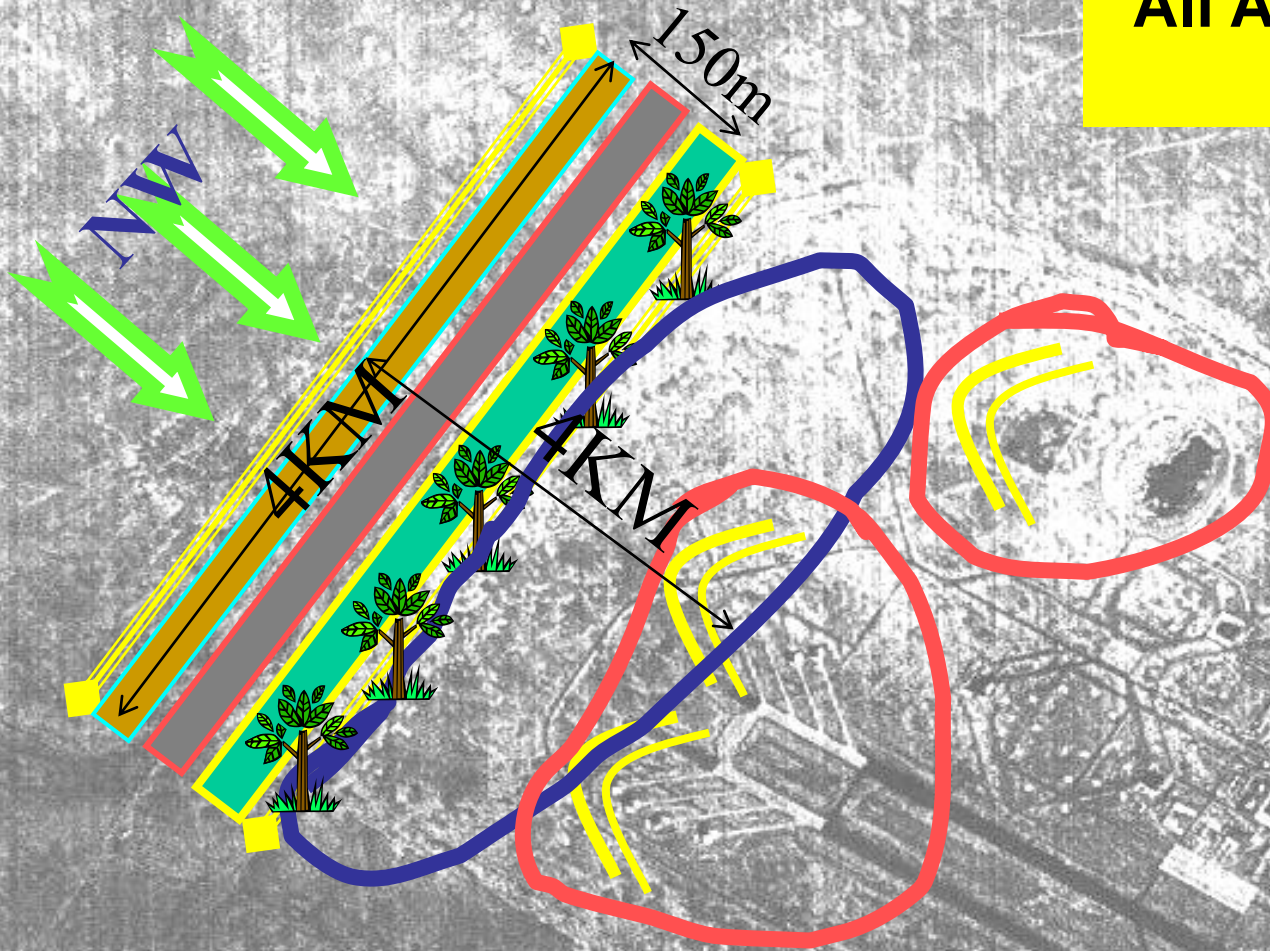
- **Magnitude of the sand Encroachment problem in Kuwait.**
- **The sand encroachment problem in KOC.**
- **Specific Objectives of the study**
- **Proposed Action Plan for Mobile Sand Control in KOC.**



Average Annual Amounts of drift Sands (million kg/m width/year)- (KISR , 1998)

- **Burgan : 7.6**
- **Managish : 12.8**
- **Raudhtain : 2.4**

Ali Al Salem Air Base Pilot Project



Oil Sector (oil fields)

Facility/Unit	Total Number	Number of affected facilities	Percentage affected	Sustainable Action Plan
Oil Fields	14	6	43 %	not yet implemented)



Specific Objective of the study

- **To select economically feasible, environmentally sound and effective measures for controlling mobile sands in KOC areas(after field tests and experiments under the environmental conditions of KOC areas)**

The sand encroachment problem in KOC

- Well heads ,pumps ,Gathering Centers , entrances and security fences in KOC operational areas in southeast , northeast , west and south of Kuwait are severely attacked by shifting sands.
- The magnitude of the problem varies in different areas depending on local conditions, e.g., geographic setting, topography ,geomorphology, land use, plant cover and soils.
- Managish oil field is highly vulnerable to shifting sands.

The sand encroachment problem in KOC (Cont'd)

- **Machinery and equipment suffer corrosion problems.**
- **Cost of mechanical sand removal from Burgan ,Raudhtain and Managish is more than 250,000 KD / year (2004)**
- **Mechanical removal of sand is time consuming, costly and environmentally destructive.**

Examples of affected facilities/infrastructures

- **Well heads, e.g. Burgan well 150 and Managish well 6.**
- **Pumps**
- **Water wells, e.g. Abdaliyah wells**
- **Gathering Centers ,e.g. GC5,GC2& GC16**
- **Roads ,e.g. Burgan –Managish**
- **Security fences & entrances ,e.g.western side of Magwa oil field**

Mechanisms of Sand Encroachment in KOC

- **The Most Common: Creeping sands (active sand sheets) in Managish oil and other affected areas.**



Mechanisms of Sand Encroachment in KOC(Cont'd)

- The Rare :Moving dunes (active Sand dunes) in Raudhtain &Umm Al Aish



Each mechanism has its own techniques of sand control.

The Current Approach of Mobile Sand Control

Main principles :

- settling the sands against physical barriers before reaching the point object (non-sustainable technique)
- Case of Gathering Centers :2-3 rows of sand ridges ,2-3 m high ,20-50 m length ,10-50m upwind from the affected gathering centre. sand ridges {Bund Walls} are also used to protect well heads
- No biological measures are currently applied in KOC

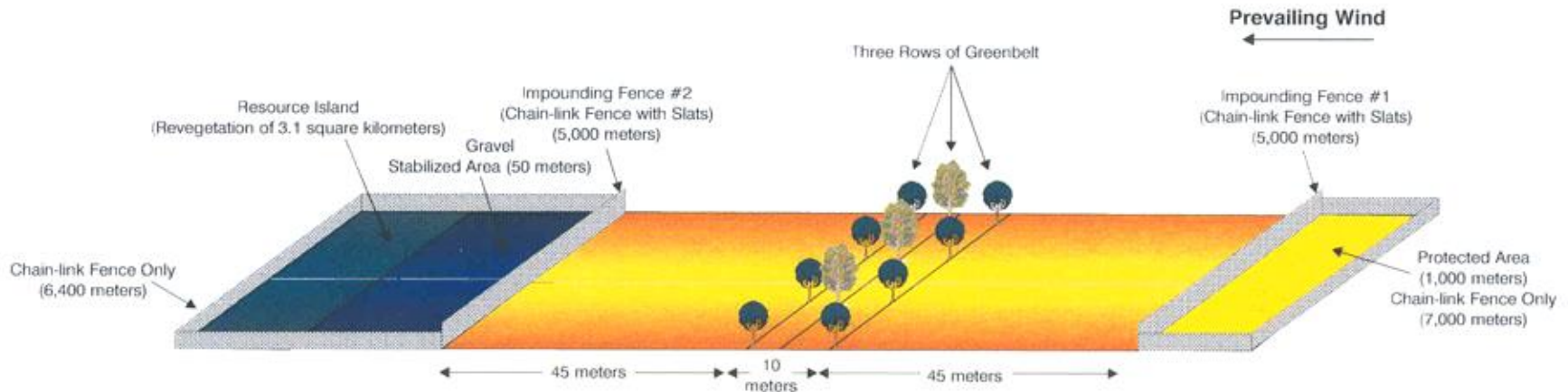
The Proposed Approach for Mobile Sand Control

- **Sustainable Measures of Mobile sand control (well designed integrated mechanical –Biological measures)**
- **Reduction the sand supply at the transportation and source areas (where applicable)**
- **Applying environment friendly materials such as Ecomat , soil-tac, Geomat, Coirmat and others**

- **We Propose a few environmentally friendly interventions**

Sustainable Measures for Mobile Sand Control (Al Sudairawi et al. , 1998)

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Fig4.CDR-10/12/02



Design may vary according to ecosystem

Note: The design may vary according to the ecosystem type.

NOT TO SCALE

Specifications & Benefits of Impounding Chain Link Fences

- Two meter high ,porous fence
- Very effective under the environmental conditions of Kuwait.
- Duration :12-15 years .

1989



1992



2003

**Impounding Chain-link
FENCES**

SULAIBIYAH (1989 – 2003)

Shelter Belts

- **Permanent sand control measures**
- **Enhance the local environmental conditions and the Public Health.**



Shelter belts

Mutlaa, 2002

Proposed Action plan for Mobile sand Control in KOC

Principles

- Assessment of the problem using recent techniques e.g, Remote Sensing ,GIS , modeling ,recent field data, etc.
- Pilot testing and selecting the most effective and environmentally sound control measures.
- Design and implementation of action plan
- Conducting EIA (Environmental Impact Assessment) & Cost benefit analyses
- Establishing a priority action program

This phase of the study is concerned with pilot testing and selecting the most effective control measures

KOC Action plan

Field Tests and Experiments (12 months)

- **Selection of pilot sites (worst conditions) for testing different sand control measures**
- **Design & implement the experiment.**
- **Monitoring and maintenance**

Proposed Pilot Experiments in KOC

- **Pilot Experiment 1 (Abdaliyah water field)**

Testing different materials for mobile sand control for one year (Ecomat ,soil tac ,etc)

- **Pilot Experiment 2 (Intersection of Kabd Road with GC 16 road)**

Road Protection against shifting sands (one year)

47° 0' 0" E

47° 30' 0" E

48° 0' 0" E

48° 30' 0" E

30° 0' 0" N

30° 0' 0" N

29° 30' 0" N

29° 30' 0" N

29° 0' 0" N

29° 0' 0" N

28° 30' 0" N

28° 30' 0" N

Areas Affected by Mobile Sand (Socio-economic Approach)

PE: Pilot Experiments

5

3

4

1

PE

2

1: Al Atraf-Kabd (1655 km²)

2: Al Qurain - wafra (915 km²)

3: Umm Naga, Sabiyah & Bahra (598.8 km²)

4: South Bubiyan (138.2 km²)

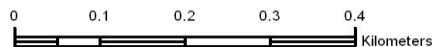
5: Al Huwaimiliyah (628.9 km²)

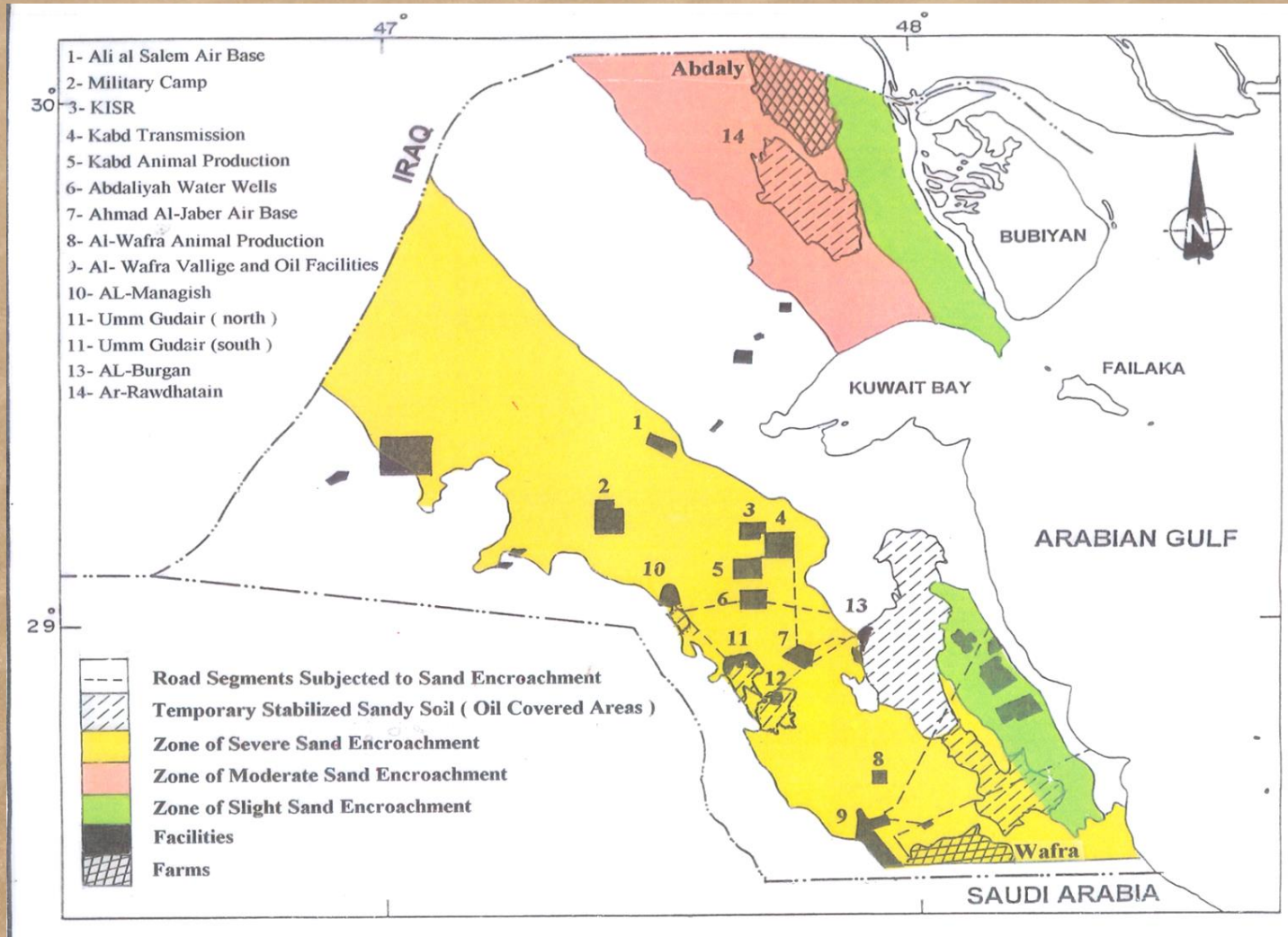
47° 0' 0" E

47° 30' 0" E

48° 0' 0" E

48° 30' 0" E





Design of Experiment 1 –Abdaliyah Site (Cont'd)

- Ecomat : Full Coverage
- Ecomat :50 % Coverage
- Ecomat : 25 % Coverage
- Ecomat with plantations of desert species
- Plantations without Ecomat
- Soil tac ; Full Coverage
- Soil tac ; 50% Coverage
- Soil Tac : 25 % Coverage
- Gravel :Full coverarge
- Gravel :50 % Coverage
- Gravel : 25 coverage%
- Mycorrhizal

Design may change after on site investigations

Design of Experiment 1–Abdaliyah Site (1kmx1km)

Site Investigation

- Classification of the site into 16 equal sections ,each is 250m x 250m (62,500 square meters)
- Collection of soil samples (for laboratory investigations & soil moisture measurements) from each section (5 soil profiles,3 samples from each profile (total number of samples 15 /section)
- Survey the vegetation cover (density and cover)
- Establish base line data on sand movement using graded sticks and sand traps.
- Testing different stabilization materials in 12 sections (from 1-12) keeping 4 sections for control(from 13- 16)



Checkerboard



Ecomat

















Benefits of Ecomat

- **Environmentally Friendly** : A natural fully biodegradable mulch to facilitate soil and plant growth.
- **Protection** : physically Ecomat protects the plant from infestation and general plant damage.
- **Erosion Control** : Reduces erosion by wind of the soil covered area.

Benefits of Ecomat (Cont'd)

- **Moisture Retention** :helps to retain soil moisture which improves plant growth in arid regions like Kuwait.

Other benefits

Weed Prevention

Fertilizer (provides soil nutrients)

Less labour intensive

User Friendly







Ecomat-Kuwaiti Desert ,July 2004















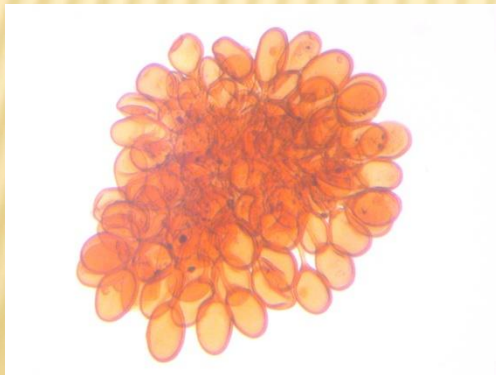
Benefits of Soiltac

- **Cost effective soil stabilizer.**
- **Environmentally safe and biodegradable.**
- **Easy to apply**
- **Vegetation safe (will not harm vegetation)**



Soil Bio-Engineering in deserts for protection from erosion and sand dust

Alok Adhikarya
Centre for Mycorrhizal Research,
The Energy and Resources Institute
New Delhi
INDIA



Mycorrhizal technology for stabilization of sand

Symbiosis

Fungus
(Mycorrhiza)

Nutrients

Carbohydrates

Host Plant



Mutualistic relationship between soil fungi and plants roots

What Mycorrhiza does for sand stabilization

- Produce glycoprotein extracellularly on the mycelia in bulk soil
- Forms network in soil
- Help aggregate sand particles
- Helps to store large amounts of nutrients and water in rhizosphere
- Buildup organic matter and soil microbial diversity in soil



Mycorrhizal inoculum

Forms of inoculum

- Root based
- soil based
- granular (tablets, pellets etc.,)
- seed encapsulation

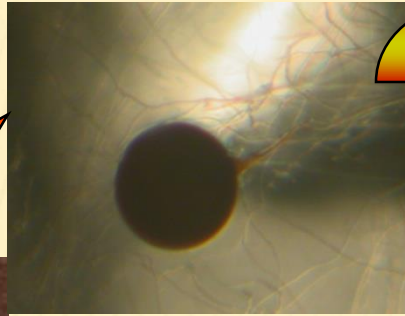
Choice of inoculum

- soil nutrient profile
- host preference

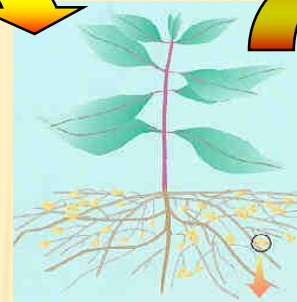
Mycorrhiza in nature



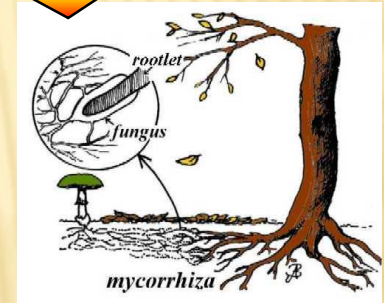
Mycorrhiza



Spore



Pre-symbiotic phase

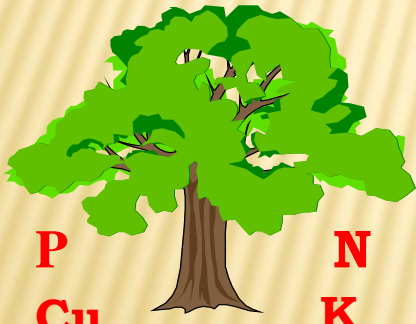


Mycorrhiza

MYCORRHIZA



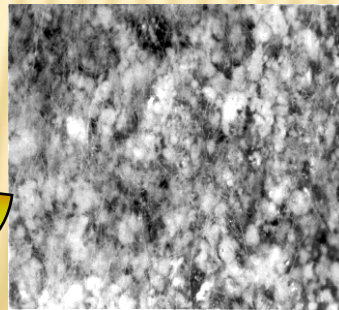
Plants extended arms



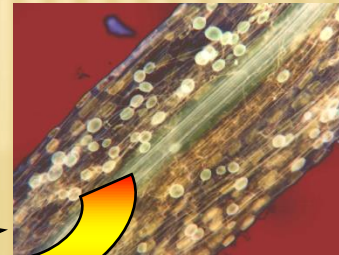
P N
Cu Mn Zn K

Heavy metals & trace elements

Mycorrhizal plant



Substrate binding



Active structure inside root



Mycorrhiza Technology developed by TERI



Optimization of surface sterilization protocols



Development of hairy root cultures

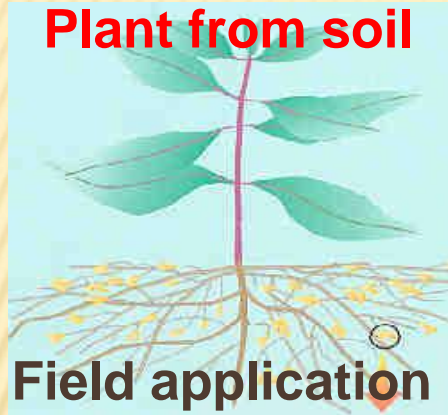


Mass production



back to

soil



Plant from soil

Field application



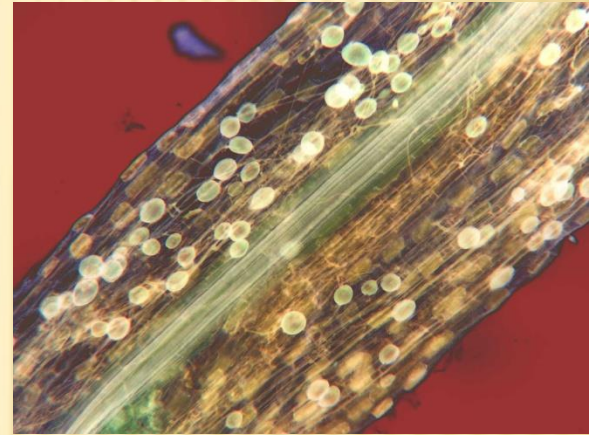
Finished product



Formulation

Mycorrhizal Technology cont...

- Large scale production (200 – 10,000 tons)
- Pure, high quality
- Pathogen free, viable
- Soil-less production

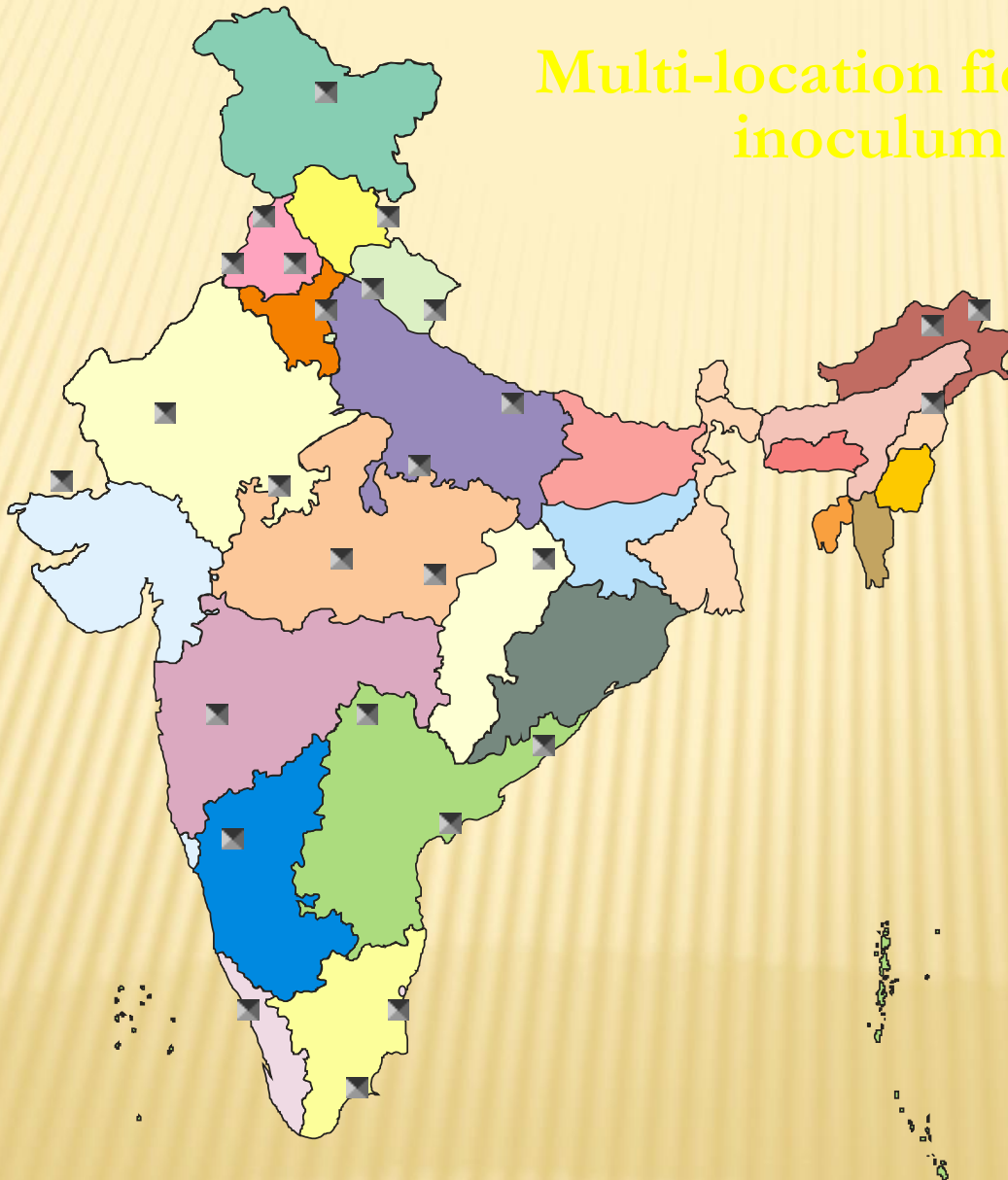


Offers biological means of assuring plant health in an economically profitable & ecologically friendly manner



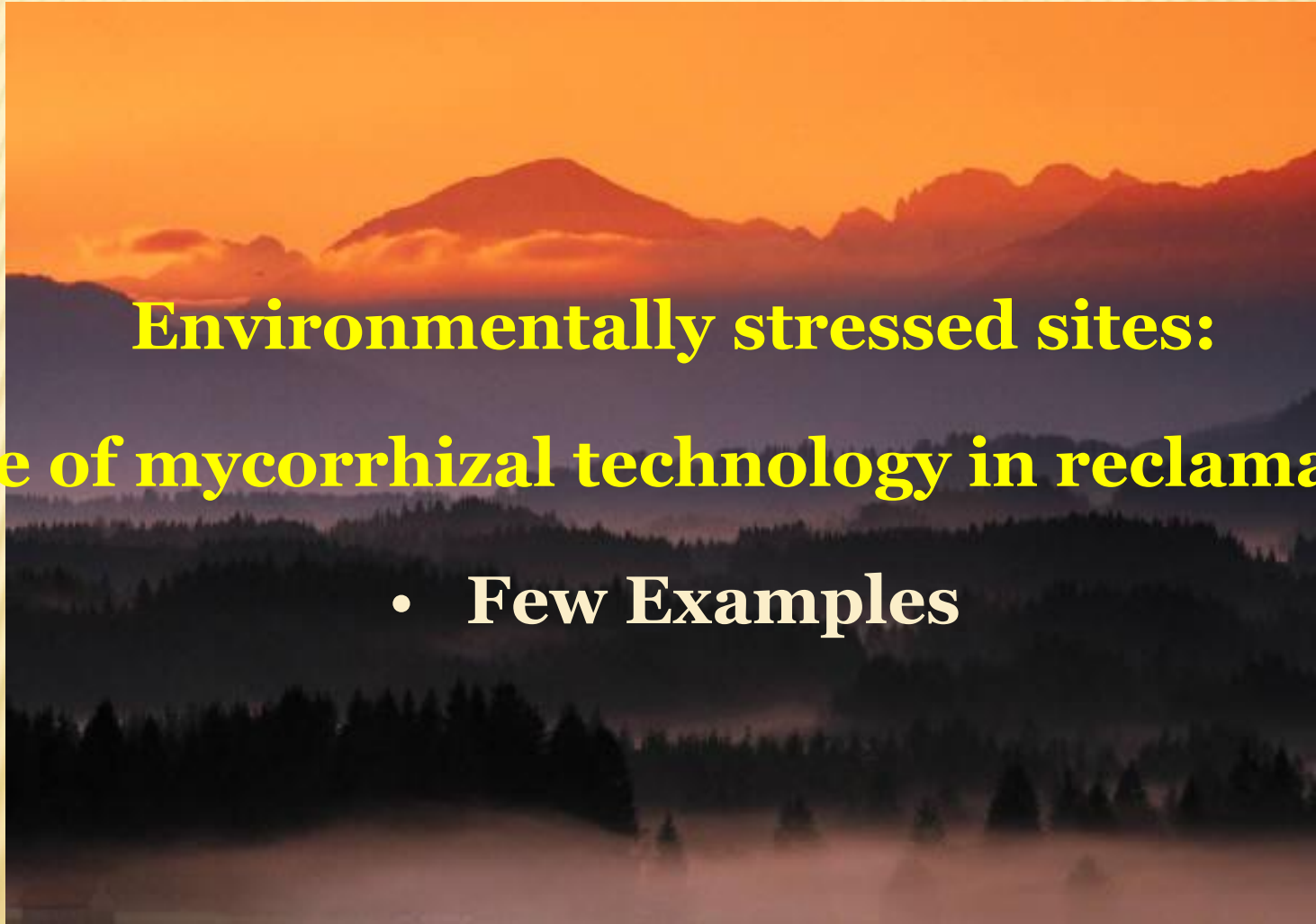
TERI Mycorrhiza Product

Multi-location field test trials of inoculum in India



■ = Field sites





Environmentally stressed sites:

Role of mycorrhizal technology in reclamation

- **Few Examples**



Associated Alcohol and Breweries Ltd, Barwaha, Indore, M.P.



A Site loaded continuously
with primary treated distillery
effluent for past six years
reclaimed in 6 months of
extensive efforts



Korba Super Thermal Power Station (KSTPS), Chhatisgarh

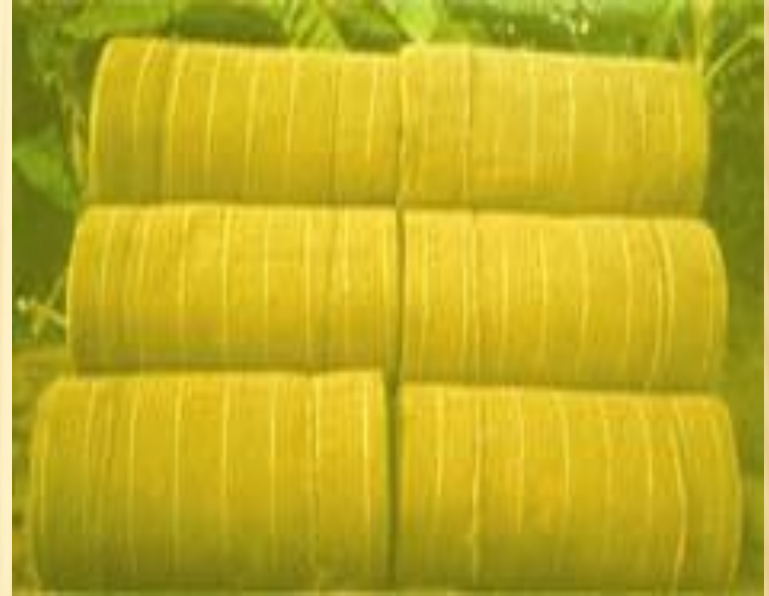


*After Fourteen months of
intensive efforts*



SOIL BIO-ENGINEERING WITH EROSION CONTROL BLANKETS

- **Faster Binding of Soil**
- **Excellent air and water permeability**
- **Enough sunlight passes through it**
- **Holds the seeds and saplings in place**
- **Excellent medium for quick vegetation**
- **Easy to Install**
- **Eco-friendly and non-polluting**



<i>Naturalization</i>	<i>Hard Armoring</i>
<ul style="list-style-type: none"> ➤ Naturalization also called bio engineering, Involves working with Natural materials such as live vegetation and re-vegetation with the help of coco erosion control blankets 	<ul style="list-style-type: none"> ➤ It refers to solid installations of concrete, rip rap, or metal pilings
<ul style="list-style-type: none"> ➤ Immediate stabilization that strengthens over time 	<ul style="list-style-type: none"> ➤ Immediate stabilization
<ul style="list-style-type: none"> ➤ Economical 	<ul style="list-style-type: none"> ➤ Expensive
<ul style="list-style-type: none"> ➤ Provides fish and wildlife habitat 	<ul style="list-style-type: none"> ➤ Destroys fish and wildlife habitat
<ul style="list-style-type: none"> ➤ Decreases water velocities 	<ul style="list-style-type: none"> ➤ Increases water velocities
<ul style="list-style-type: none"> ➤ Provides shading and decreases water temperature 	<ul style="list-style-type: none"> ➤ Warms stream water
<ul style="list-style-type: none"> ➤ Works with natural forces rather than fighting them 	<ul style="list-style-type: none"> ➤ More likely to cause downstream erosion
<ul style="list-style-type: none"> ➤ Aesthetically pleasing 	<ul style="list-style-type: none"> ➤ Aesthetically displeasing

Economics Of Soil Bio-Engineering In India

Cost Per Square Meter.



Coco Erosion Control Blanket (Soil - Bio Engineering) vs. Hard armor

Revegetation On Mine Rejection Dump



Coco Filters For Arresting Silt



Slope Stabilization



Stabilization of sand dunes in deserts using coir mates



Re-vegetation measures using combination of mycorrhizal technology & Soil Bio-engineering offers fast restoration of terrestrial and aquatic riparian habitat.



Using vegetation for erosion and sediment control does more than just keep our waterways clean. It enhances recreation and preserves the environment for future generations.

Public Works Sector (Highways)

Facility	Total Number	Number of affected facilities	Percentage affected	Sustainable Action Plan
Desert Highways	7	4	57%	Not Avail.



Kabd Road (July, 2005)



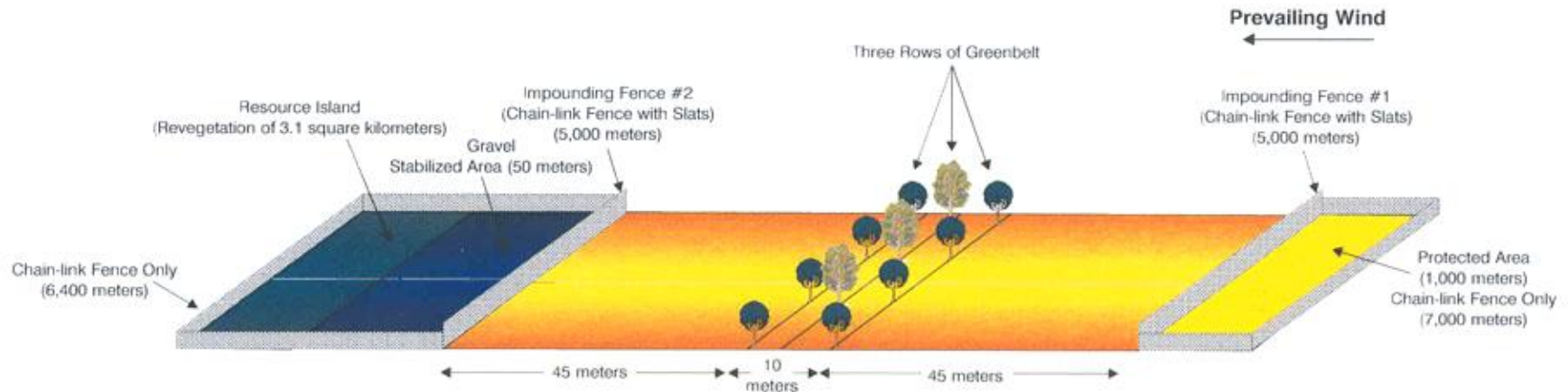
Experiment 2 (Kabd Road Protection)

Pilot test for road protection against shifting sands:

**500m segment of the road to GC 16
(about 1km from its connection with
Kabd Road (Road 604)**

The Proposed Design for Experiment-2

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Fig4.CDR-10/12/02



Design may vary according to ecosystem

Note: The design may vary according to the ecosystem type.

NOT TO SCALE

Thanks For Attention

