

# 8<sup>th</sup> Africa Transportation Technology Transfer Conference



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## A case study in Zimbabwe

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# Responding to climate change effects on rural roads through application of cost effective erosion control measures

## Presentation outline

- Introduction
- Scope of project
- Organisation & Methodology
- Conclusions

## Responding to climate change effects on rural roads through application of cost effective erosion control measures

### **Rural roads provide essential access to rural communities**

(it's estimated that 60 to 70 % of the population in Sub-Saharan live in rural areas)

- Roads open up access for new settlements and this puts pressure on the environment;
- Effects of erosion increase with additional land use and weather extremes resulting from climate change (cycles of drought and flood);
- These erosion effects cause extensive damage to road carriageway, drainage system and surroundings;
- The level of damage is usually beyond the scope of routine maintenance activities;
- Additional funding to remedy the situation is often not available resulting in deteriorating serviceability of road network;
- Appropriate methodologies and actions to deal with erosion effects are required to mitigate the situation.

# Responding to climate change effects on rural roads through application of cost effective erosion control measures

## The Zimbabwe Rural Roads Programme

- From 1982 to 2002 a massive Rural Roads Programme was carried out by the Zimbabwe Government to construct and/or rehabilitate some 23 000 km of rural roads;
- The project was co-funded by the government of Zimbabwe and KfW the German Development Bank;
- By 1995, 15 000 km of rural roads had been constructed/rehabilitated and a working Road Maintenance system had been established to look after the Rural Road Network. But there was a problem with increasing levels of erosion damage.

## The Problem

- The success of the program in improving access into the rural areas led to more settlements and more agricultural activities putting further pressure onto the land resources;
- This growing population and increased agriculture, coupled with lack of land-use planning, poor farming practices and increased cycles of drought resulted in severe deforestation and loss of vegetation cover in rural areas;
- When rain fell the lack of vegetation cover led to increased run off over the unprotected soils, which were then subject to severe erosion with major loss of top soils and formation of gullies.

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Erosion affects all levels of the community by damaging infrastructure, degrading the land and reducing farming yields

Specific erosion problems relating to roads include:

- Siltation of drainage systems blocking structures and causing flooding of drains, overtopping and breaching of the road carriageway and washing out structures;
- Uncontrolled water discharges from settlements and cultivation flowing onto the road and overloading the road drainage system;
- Encroachment of erosion channels and gullies into the road reserve damaging the drainage system and carriageway;

These effects tend to overwhelm the road maintenance system and lead to severe loss of serviceability on the road network.

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## The Erosion Control Programme

- It was apparent that the “erosion problem” needed to be urgently addressed.
- In 1995 a pilot project for erosion control was launched in Zimbabwe co-funded by the Government of Zimbabwe and the German development bank KfW.
- Its objectives were:
  - ➔ Evaluate various appropriate erosion control measures which could be used to protect drainage systems and road carriageway;
  - ➔ Develop an erosion control operation to mitigate the problem;
  - ➔ Integrate the erosion control operation into existing Road Asset Management operations.

## Selecting appropriate erosion control measures

Various erosion control applications being used locally were investigated. Considering international best practice it was decided to pursue 2 main areas:

- Use of bio-engineering methods to re-establish vegetation cover and improve soil stability;
- Placement of mechanical bolsters and retaining walls to stabilise drainage channels and erosion gullies to minimise further deterioration.

Two methods being used in Zimbabwe were settled upon.

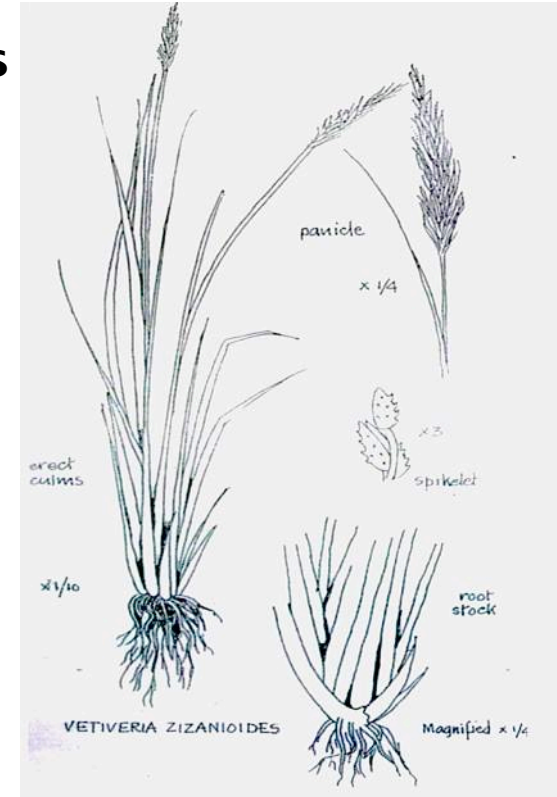
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## Bio-engineering: Vetiver Grass

Vetiver grass was already being used in Zimbabwe at this time;

Some attributes

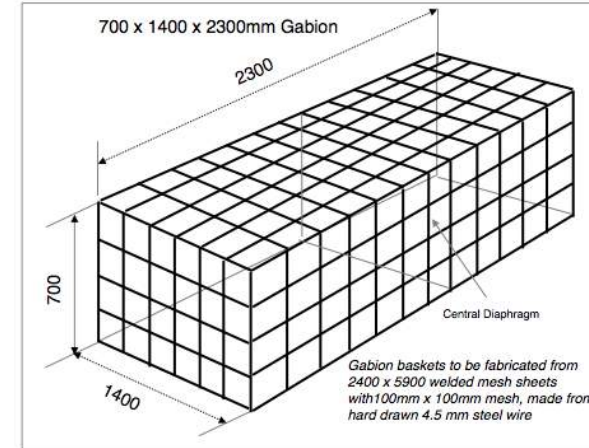
- A mass of fine roots going up to 3m in depth;
- Stiff and erect stems that can withstand up to 0.8m of water flow;
- Can endure extreme climatic variations;
- High tolerance to different soils;
- Propagated by root-stock making it non-invasive.



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## Mechanical Bolsters – Wire Mesh Gabions

- The gabions could be easily configured according to specific requirements of each damage;
- When properly constructed, provide a cost effective and robust structure to protect vulnerable areas;
- Use locally available materials such as mesh and stone.

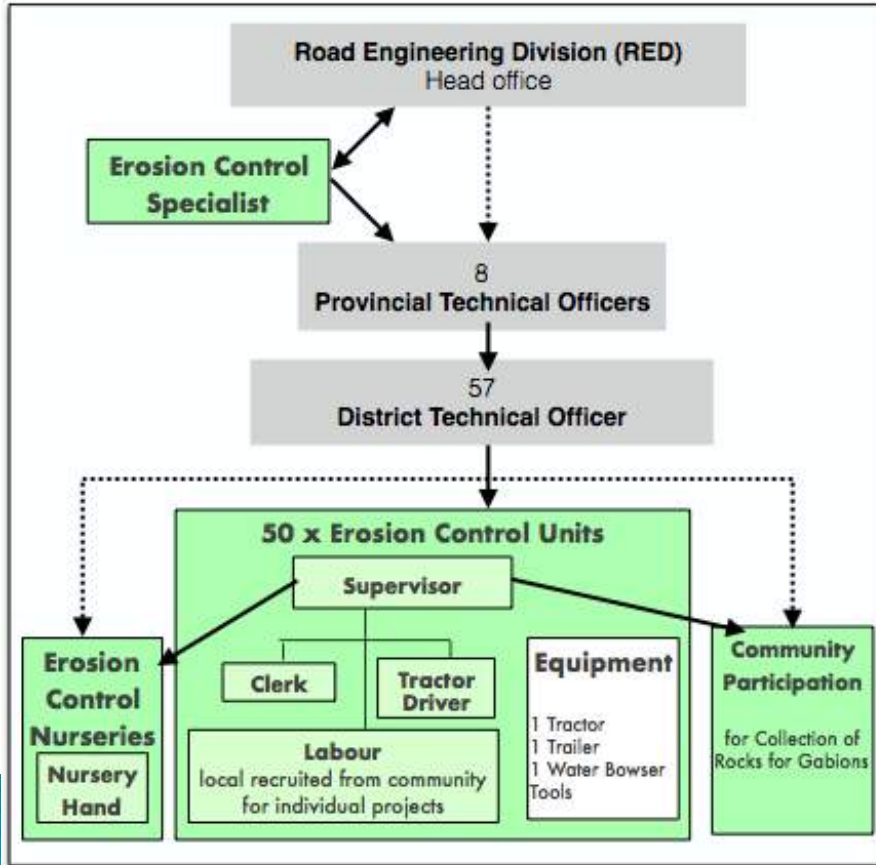


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## Management and Organisation

As erosion problems were widespread and varied this required individual attention for each damage. To achieve this an Erosion Control Operation was set up utilizing the existing RED organization:

- Provincial office responsible for preparing designs, work plans.
- District responsible for supervision of work
- Establishing Erosion Control Units to implement the work programmes.



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## Planning and Preparation

Substantiate scope and extent of erosion damages:

- Inventory of identified erosion problems – location, extent, risk and type,
- Prepare priority listing for action;
- Carry out site surveys according to the priority listing;
- Prepare designs for each site detailing types of intervention;
- Prepare budgets, work plans and programs.

Establish Vetiver Grass supply

- Important to establish Vetiver Grass Supply which would provide adequate number plants within short distance of erosion damages. Network of nurseries established using existing maintenance infrastructure.

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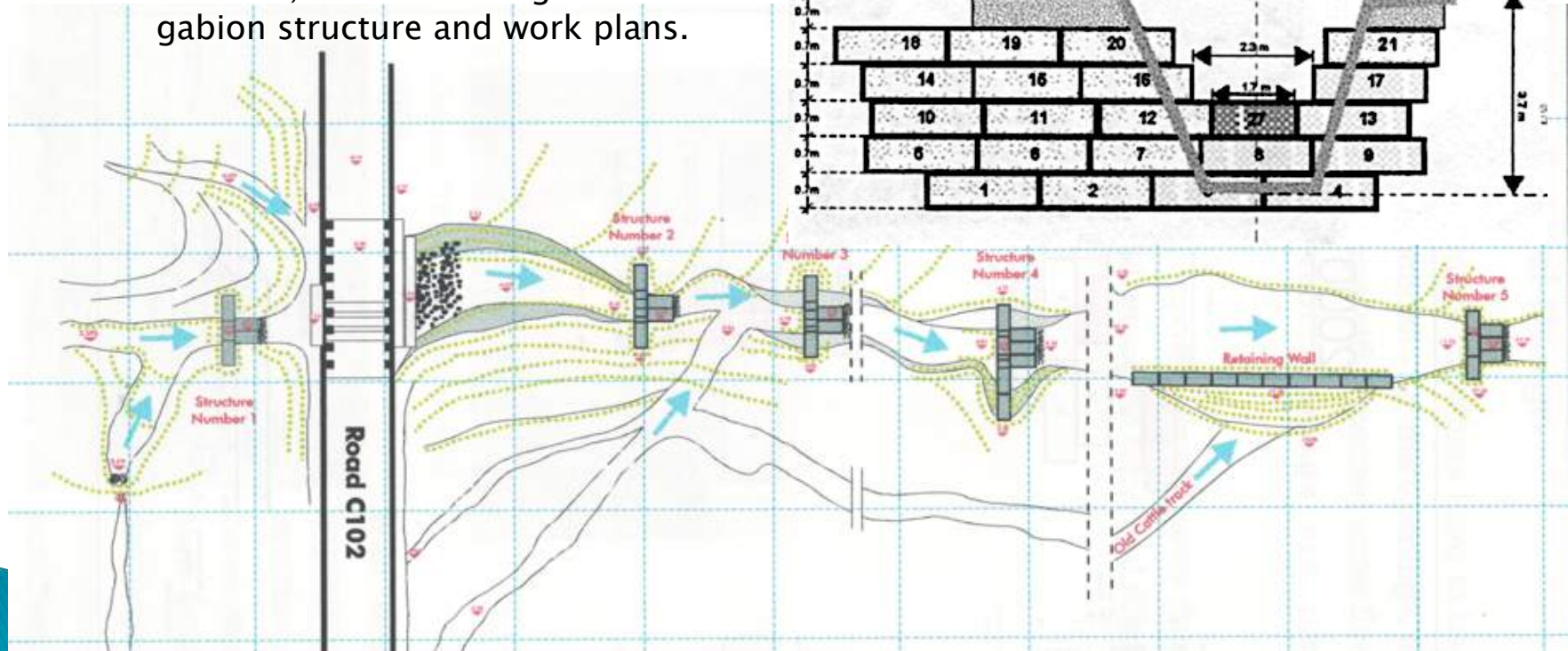
Use of Vetiver Grass to stabilise eroded areas



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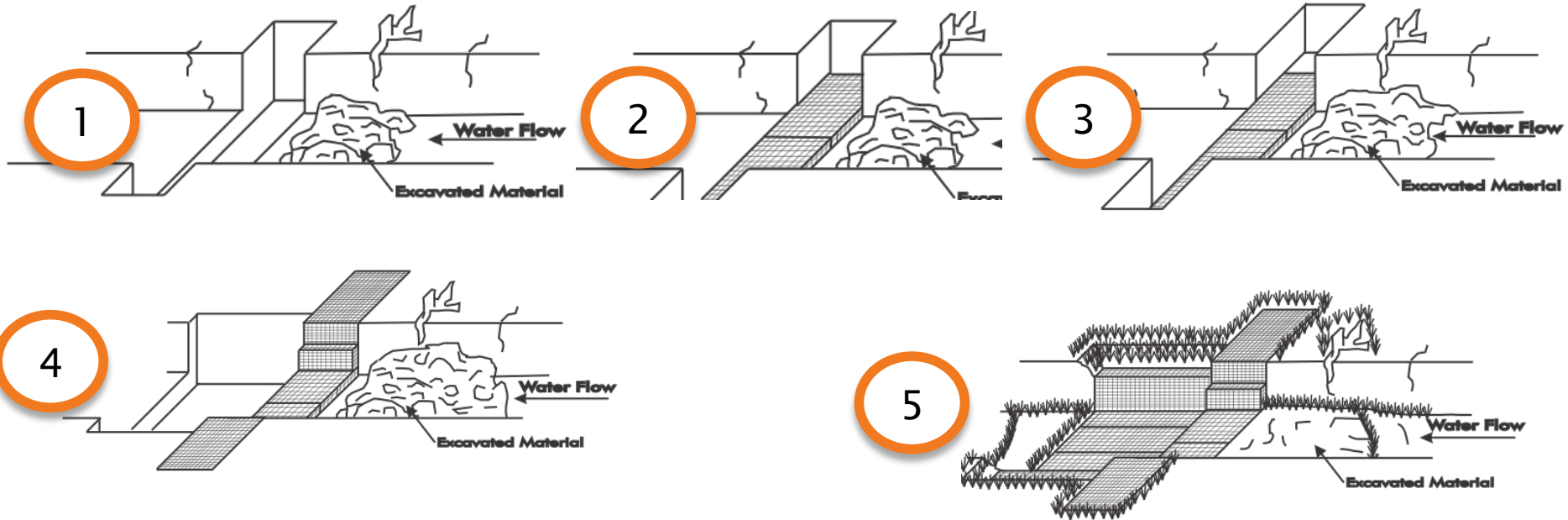
## Design

The design included checking hydrological data, preparing long sections, detailed designs of each gabion structure and work plans.



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## Placing Gabions for larger Gullies



The larger gullies may require a phased work programme over a number of years.

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The following 3 slides illustrate 2 gullies which were under the program.



Prior to work taking place 1998

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Completed Structures about 1999

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Recent Follow-up 2017

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## Logistics issues

- Gabion Baskets – Locally manufactured welded mesh sheets – transported flat and assembled on site;
- Stones for filling Gabion baskets – arranged through contracts with local communities;
- Vetiver Grass – Need to ensure adequate quantities of grass close to erosion sites so as to be cost effective as major erosion problems might require thousands of plants. Network of nurseries/vetiver fields established countrywide to provide this (82 main nurseries, 178 maintenance base camps and 274 pull in camps).

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## Project Achievements

The main implementation phase of the programme ran from 1998 to 2002. 50 erosion control units were established and operational country wide. They worked on 4,250 erosion damage sites involving the placement of some 7,015 gabion baskets (1.2m x 2,4m x 0.6m) and planting of 3.989 million vetiver grass plants.

### Erosion Control Costs

**Vetiver Grass** - Pull from nursery, transport to site, prepare planting trench and plant  
USD 32 for 10m of hedge line.

**Gabion Baskets** - transport, assemble, place and pack with stones  
USD 54 per 1.2m x 2,4m x 0.6m gabion.

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## The Need

***“Climate change is a direct threat in itself and a multiplier of many other threats.”***

*Quote from UN Secretary General António Guterres / 27 March 2017.*

Erosion control measures can make an important contribution towards the security of the road networks by providing a cost effective mechanism to deal with existing erosion damages affecting the roads and also improving the resilience of roads from future effects of extreme climatic change events.

Sub-Saharan countries are highly vulnerable to erosion effects and there is an urgent need to invest more effort into finding cost effective erosion control methodologies.

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## Scope for further research

- Development of additional Erosion Control Methodologies for different areas and conditions. Improvement of Erosion Monitoring Techniques – reporting and monitoring system using GIS type mapping;
- Appraisal of what makes certain areas more susceptible to erosion and what the anticipated effects of climate change may be;
- The costs and benefits of the erosion control for roads versus traditional road maintenance and upgrading of drainage structures;
- Improving production, planting and care of vegetation methods;
- Improving community participation and integration into the road erosion control operations.

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# Thank you