South East Asia Community Access Program

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"Building Back Better and Greener"

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Applications of selected research outputs for the Mitigation and Management of Crisis and Recovery Operations

Presentation

Overview of 4 areas:

1. Experience and techniques for risk and hazard assessment for managing mountain slope instability;
2. Bio-engineering for road embankment and mountain slope erosion protection and stabilisation;
3. The use of tsunami debris as material for constructing rural roads; and,
4. The development of standards and specifications that allow engineers to construct roads with available materials.

1. HAZARD AND RISK ASSESSMENT, LAO PDR

Dr. Gareth Hearn, Tim Hunt – Scott Wilson
John Howell – Living Resources

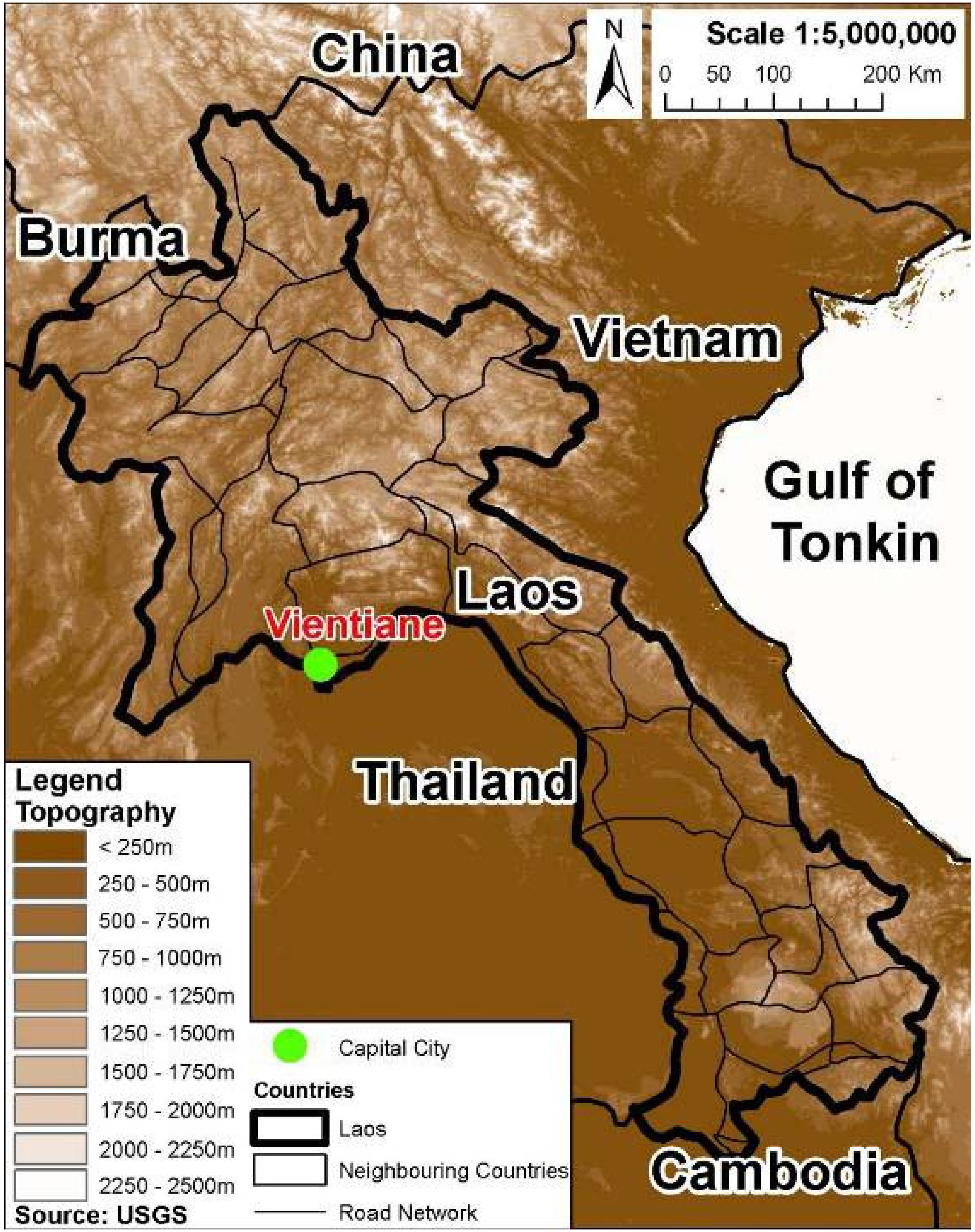
Landslide Preparedness and Recovery

- Regional key issue.
- Significant social, economic and engineering losses from landslides.
- Laos provides illustration of issues.
- Limited or no information where
  - Landslides are located, and
  - Potential high risk slope failures.

Landslide Preparedness and Recovery

- Insufficient engineering, geological and hazard data for landslide management decisions at high risk sites.
- Seriously limit PREPAREDNESS for Landslide Hazards.
- Insufficient resources and technical expertise available for RECOVERY after Landslide Hazard events.

70% hilly-mountainous



> 50% forest


Heavy summer rains
4m in some areas

Typical Up-Slope Failures


Typical Down-Slope Failure

SEACAP 21 COMPONENTS

1. Slope Stabilisation Trials
2. Feasibility Study for a National Programme to Manage Slope Stability
3. Mainstreaming Slope Stability Options

FINDINGS - TRIALS

- MPWT - ok for small-scale/routine landslide problems (low-moderate risk).
- Serious problems - engineering geological interpretation and design.
- Can reduce risk - relatively low budgets.
- Good construction QA - essential.
- Management & maintenance manuals.

Outputs - Feasibility Study

- Landslide Inventory
- Risk Ranking for Prioritisation of Landslide Interventions
- Strategy statement for MPWT's service standards for slope failure mitigation

Inventory Analysis

Recorded landslides:

- > 70% - above road;
- ~ 60% - low risk categories;
- 4% - rock slope failures, i.e. the vast majority were in soil or weathered rock.
- 3% - movement of the entire carriageway width, i.e. entire hillside

Risk Ranking for Prioritisation of Landslide Interventions

Actual (current condition) or expected consequences (without mitigation)	Ranking				
	1	2	3	4	5
Road completely lost (including road subsidence greater than 1m)	✓				
Road partially lost		✓			
Road completely blocked		✓			
Road subsidence less that 1m		✓			
Road partially blocked			✓		
Productive agricultural or forest land lost or destroyed			✓		
Walls damaged or slope drainage blocked or damaged				✓	
Roadside drainage damaged or blocked					✓
Continued erosion without destroying vegetation cover					✓

Ranking

1. Top priority, emergency measures required immediately; buildings may need to be evacuated.
2. High priority; realignment may be necessary.
3. Moderate priority, but some temporary remedial measures are required immediately, such as slip debris clearance, emergency road signing etc.
4. Low priority, but some temporary remedial measures are required quickly, such as slip debris clearance.
5. Least priority, but should be tackled as soon as possible under routine maintenance.

Strategy statement for MPWT's service standards for slope failure mitigation

The Government of the Lao PDR aspires to a national highway network that remains free of slope failures. However, in view of the terrain and climate of the country, economic considerations mean that it must be accepted that, in mountainous and riparian areas, and with high rainfall, the management of slopes may be limited so that the following standards apply.

Category	***In most years***	***In years of exceptional rain or flood***
National	*Occasional blockages may occur for up to 3 hours.*	*Blockages for up to 3 hours may be common, with possible occasional blockages for up to 12 hours.*
Provincial	*Occasional blockages may occur for up to 6 hours.*	*Blockages for up to 6 hours may be common, with possible occasional blockages for up to 1 day.*
District	*Blockages for up to 6 hours may be common, with occasional blockages for longer.*	*Blockages may be common, some exceeding 12 hours. The complete loss of small sections of the road is possible.*
Village	*Blockages may be common for up to a day.*	*Blockages may be common, some exceeding 1 day. The complete loss of small sections of the road is possible.*

Damage to roads in exceptional conditions beyond these limits will be deemed a national disaster. The MPWT will review these standards periodically and amend them as the national economic situation improves.

Recommended Mainstreaming Activities

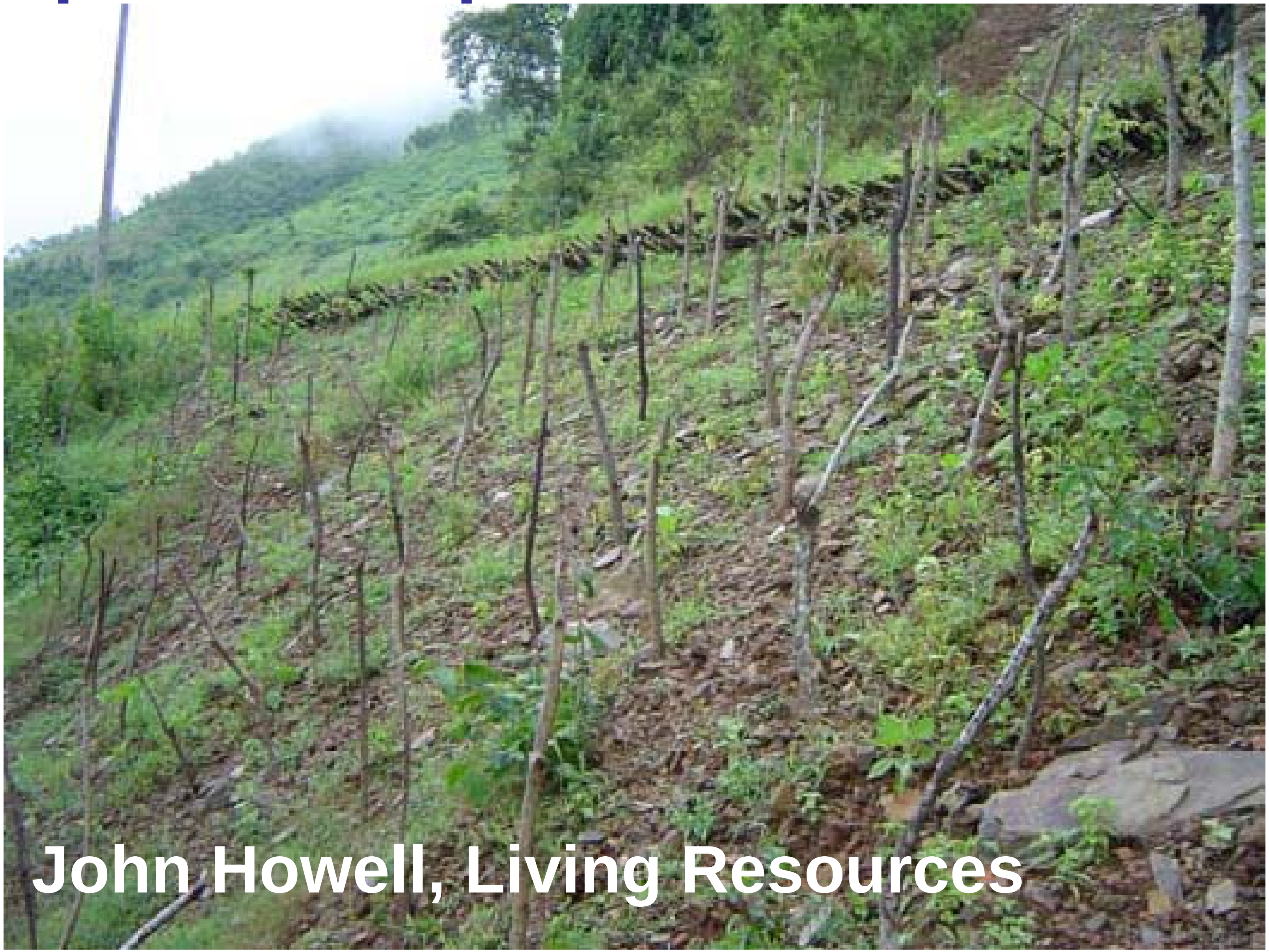
- Management program is feasible.
- Landslide inventory for entire road network.
- Database of landslide risk locations and impacts.
- Implement priority works at high risk sites.
- Strength engineering geological capability within MPWT & contributing organisations.

Recommended Mainstreaming Activities

- Apply Engineer-Geological Capability to Investigate High Risk Sites for Landslide Management Decision-Making.
- Development of Procedures for Pro-active and Reactive Landslide Mitigation.
- Strengthening of Emergency Management and Response by Integrating the Above points.

→ Max PREPAREDNESS & RECOVERY

2. Bio-engineering - embankment and slope erosion protection & stabilisation



Bio-engineering

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Use of live vegetation in civil engineering to protect earth surfaces.

Bio-engineering

SEACAP:

1. Landslide minimisation in mountainous parts of the road network of the Lao; and
2. Protection of road embankments on the floodplains of Cambodia.

Use of bio-engineering for landslide

Bio-engineering - Main findings

- Can contribute significantly to civil engineering - extensive, low cost protection of earth slopes and embankments.
- Methods can be adopted from other areas - careful experimentation needed.
- Crises such as landslide damage to roads can be averted or minimised if appropriate strategies are followed.
- Many environmental and institutional factors remain to be understood, research is required to fill gaps in existing knowledge, concerning both techniques and systems.

Suggested Bio-engineering applications

- Not rapid - 2 to 10 years.
- Preventive.
- For the two extreme situations studied:
  - technical models understood; or,
  - trials to develop the details are clear.
- Surface protection – component of long-term rehab package following crises.
- **Low cost approach BUT requires long-term vision and commitment.**

3. The use of tsunami debris as material for constructing rural roads in Sri Lanka.

Fergus Gleeson

United Nations Office for Project Services

Sri Lanka - Community Access Project

Background

Large coastal population.

- Large scale destruction of public infrastructure:
  - ➢ Tsunami debris - brick & concrete.
- Lack of appropriate standards - guidelines:
  - ➢ Inappropriate use of:
    - tsunami debris;
    - gravel as a wearing course

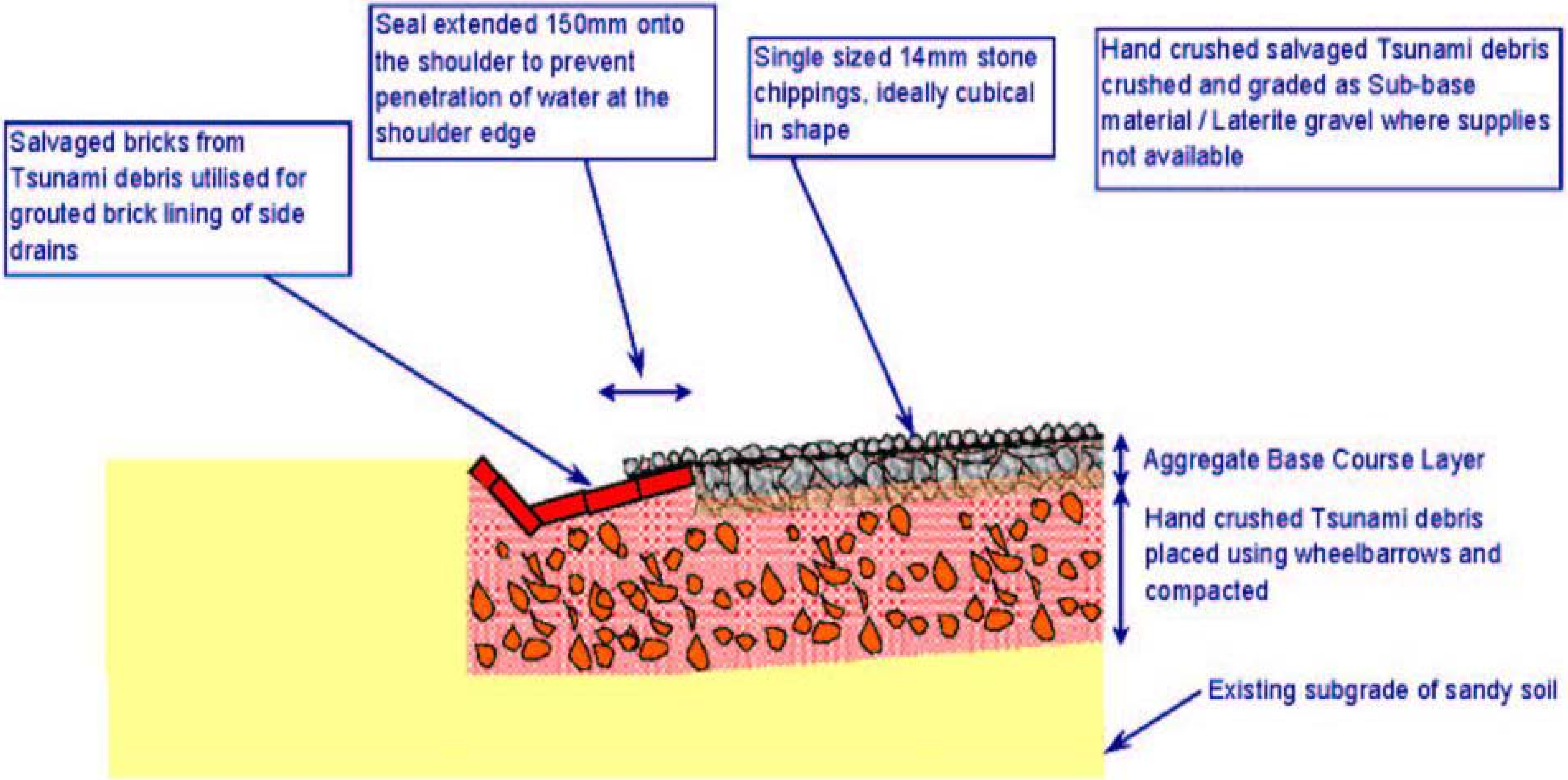
SEACAP Influence

- Studies and research.
- Countries with similar climate, traffic, materials and maintenance regimes.
- Results relevant to Sri Lanka.
- UNOPS/CAP designed similar trials.

Use of Tsunami Debris

- Used for sub-base layer.
- Crushed & blended with sand.
- High local labour input.
- Collected & transported using local tractors and trailers.
- Material - lab tested - compliance with specs.

Use of Tsunami Debris




BOMAG

Use of Tsunami Debris

- Trial road section excellent shape - two years.
- However:
  - ➢ Limited uptake;
  - ➢ Other programs wasted debris;
  - ➢ Need for:

    - definition of good practice;

    -practitioner training; and,

    - appropriate standards & specifications

4. **Standards and specifications that allow engineers to construct roads with available materials.**

Dr. Jasper Cook, OtB Engineering

Low Volume Rural Roads (LVRRs) for disaster recovery roads:

Standards and specifications:

- **road task** and
- **available resources**

- **Practical**
- **Useable**
- **Controllable**

Key Steps

1. Define road tasks.
2. Define geometric standards.
3. Identify available construction materials.
4. Identify suitable standard road designs.
5. Draft construction specifications

Define road task - **<u>classifying their functions:</u>**

- traffic type & volume, vehicle size
- key restraints of topography and climate.

Heavily loaded trucks over a short period ?

Pedestrian or two wheeled vehicle basic access?

Materials available in crisis recovery may have very variable non-standard behaviour characteristics.

Characterise in terms of their potential ability to perform defined engineering tasks within in a road.

Set of specifications to set out the parameters on how materials may be used in particular road tasks.

Application Framework

Environmentally Optimised Design (EOD): Available resources – budget, time and materials - most cost-effectively to counter the traffic, terrain, materials and sub-grade, etc.

Variable Longitudinal Design applies the principle of EOD along the whole road.

Spot Improvement involves the appropriate improvement of most critical obstacles to access.

Conclusions

General methodologies developed for the effective use of local materials in the design and construction of sustainable rural roads.

Principles may be adapted for crisis-road sector where rapidly achieving appropriate access routes using immediately available materials is often a high priority.

Thank you!

SEACAP

http:www.seacap-info.org

Global Transport Knowledge Partnership

http://www.gtkp.com