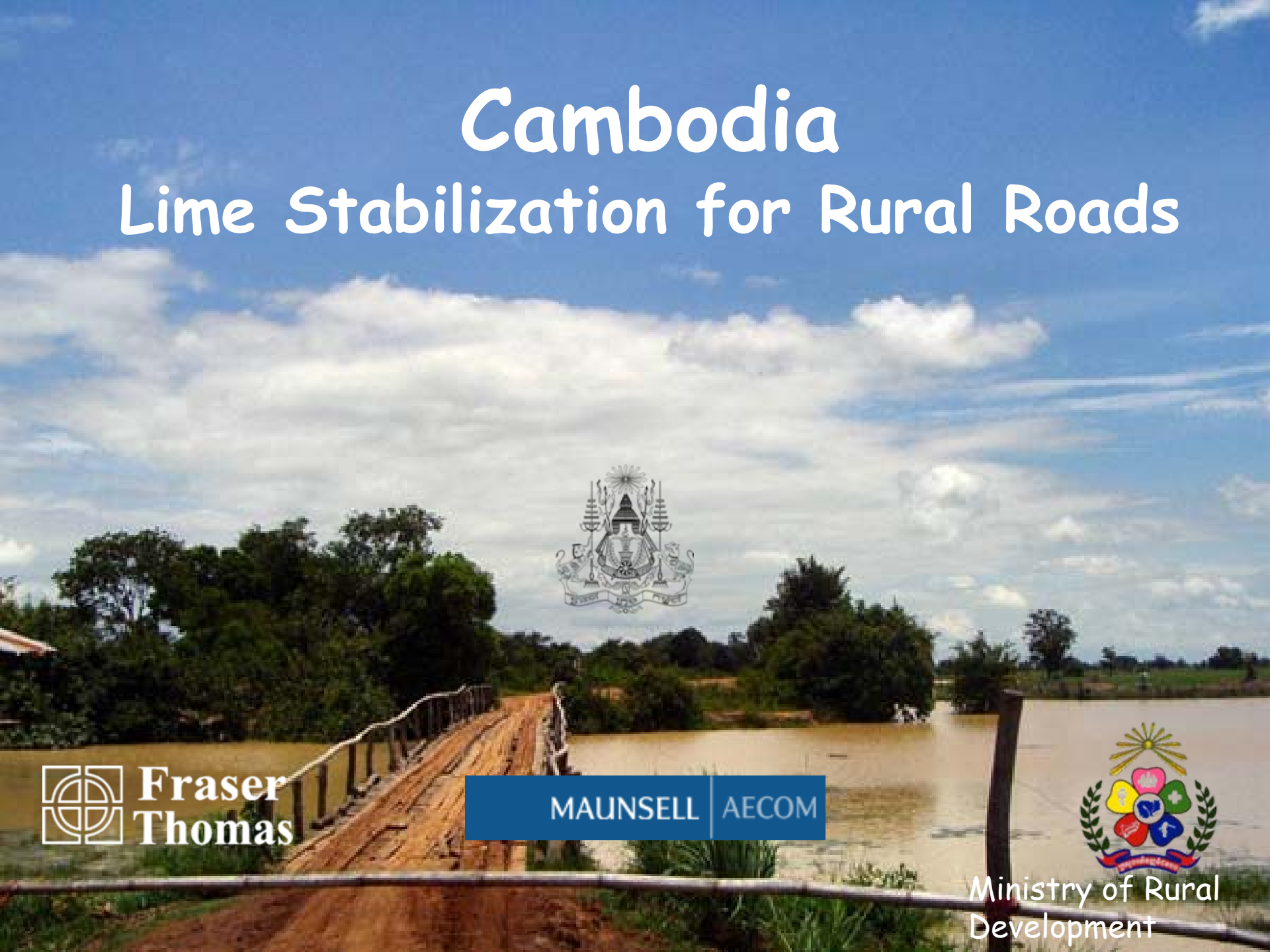
Cambodia

Lime Stabilization for Rural Roads



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Ministry of Rural Development

Common Road Conditions in Cambodia

Regular Sights

Cambodia's Rural Economy

- 81% of Cambodians live in rural areas
- Agriculture is the main source of income for 72% of Cambodia's households
- The rural road network is some 44,000km in extent. A vital link for most Cambodians.

THE NEED FOR STABILIZATION

Demonstration Road

Demonstration Road

Typical Road 12 Months After Repair

Typical Provincial/Rural Road

STABILIZATION: KEY ATTRIBUTES

- An option for enhanced base construction
- Allows local low-grade soils to be used in road pavement layers

STABILIZATION: KEY ATTRIBUTES (2)

- Longer lasting pavements
- Use of local materials
- Cost-effective rural roads
- Cost-effective maintenance
- Lasting benefit to local rural economies

WHAT STABILIZATION ACHIEVES

THROUGH TREATMENT OF ROAD BASE

- Corrects a known deficiency
- Enhances performance as a pavement
- Increases bearing capacity
- Reduces susceptibility to water damage

LIME-SOIL SYSTEM

- Calcium in lime reacts with clay minerals, coating the surfaces of clay particles
- This changes the way that clay platelets align, causing rapid increase in soil strength and gradual curing, or secondary cementing, over time

SOIL MODIFICATION

- Strength (CBR) or (UCS) is increased
- PI reduced
- Water content reduced
- Soil more friable, better pulverization
- Impermeability increased
- Optimum water content reduced

SUITABLE TYPES OF LIME

THE TERM "LIME" IS USED LOOSELY FOR AGRICULTURAL LIME, QUICKLIME AND HYDRATED LIME. THE LAST TWO ARE USED FOR STABILIZATION:

- Quicklime (calcium oxide) CaO, formed when limestone is heated to 1315^{0}C
- Hydrated lime or slaked lime (calcium hydroxide) $Ca(OH)_2$ formed when water is added to quicklime

SECTOR CAPACITY

STABILIZATION IS NEW FOR CAMBODIA:

- No technical understanding of the process
- Limited related management skills
- No purpose built equipment
- No lime supplies organised
- Enthusiasm, but a need to train/build capacity

The Local Resources for Local Roads Project

This NZAID funded project sought to:

- Demonstrate stabilization works
- Train counterpart staff
- Train contactor personnel
- Help develop capacity for further training in stabilization

METHODS

- Use of hydrated lime (rather than quick lime as preferred in NZ) because it is easier and safer to handle)

- In-situ stabilization

OUTLINE OF PROCESS:

USES HYDRATED LIME WHICH IS EASIER TO HANDLE

COMPRISES A TEN-STEP PROCESS:

1. Pavement construction & compaction
2. Spreading the Lime and/or Cement
3. Scarifying the pavement
4. Applying water to achieve OMC
5. Mixing with purpose built unit/rotary hoe
6. Compaction behind mixer –using full dynamic capacity

7. Back-cutting of edges, trimming to profile
8. Final compaction and finishing – preferably with pneumatic tired roller or heavy three point roller
9. Flushing surface for good mosaic
10. Moist curing and continued smoothing with light compaction for 4 to 7 days

COMPARATIVE COSTS

PER SQ.M

Pavement	Comment	Unsealed US$	Sealed US$
DBST	Standard	-	5.50
Laterite	400 mm Base	3.35	8.85
Stabilized	3% Lime	3.80	9.30
"	4% Lime	4.29	9.79
"	3% + 1% Cement	4.16	9.66
T3/S3	200/+250 sub-base	8.82	14.32

WHOLE OF LIFE SERVICE COSTS

PER SQ M

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Pavement	Unsealed US$	Sealed US$
Laterite (untreated)	17.90	17.40
Stabilized 3% Lime	6.80	15.82
Stabilized 3% + 1%	7.16	16.18
Stabilized 4% Lime	7.29	16.31
T2/S3 Aggregate	27.62	22.09

TRAVEL TIMES
FROM "FLOATING" VEHICLE SURVEY

Mode	Rough	Good	Reduction
Bicycle	18m 48s	6m 43s	62.35%
Koyun	19m 00s	4m 43s	75.0%
Motorbike	6m 12s	1m 35s	74.5%
Pick-up	12m 19s	1m 30s	70.8%

Finished Road in Same Locality

SUMMARY

KEY OUTCOMES OF THE PROJECT

1. Local laterite soils reactive
2. Lime sources available
3. Contractors have skills
4. Machinery has been adapted
5. Stabilization methods work
6. Poorer local soils can be used
7. Lower-cost, strong pavements

The On-going Challenge

- Stabilization contributes to sustainable upkeep of the rural road network in Cambodia
- Regular maintenance, though more affordable for stabilized roads, remains essential
- Adequate provision of funding and skilled personnel vital for sustainability

Demonstration Road Completed