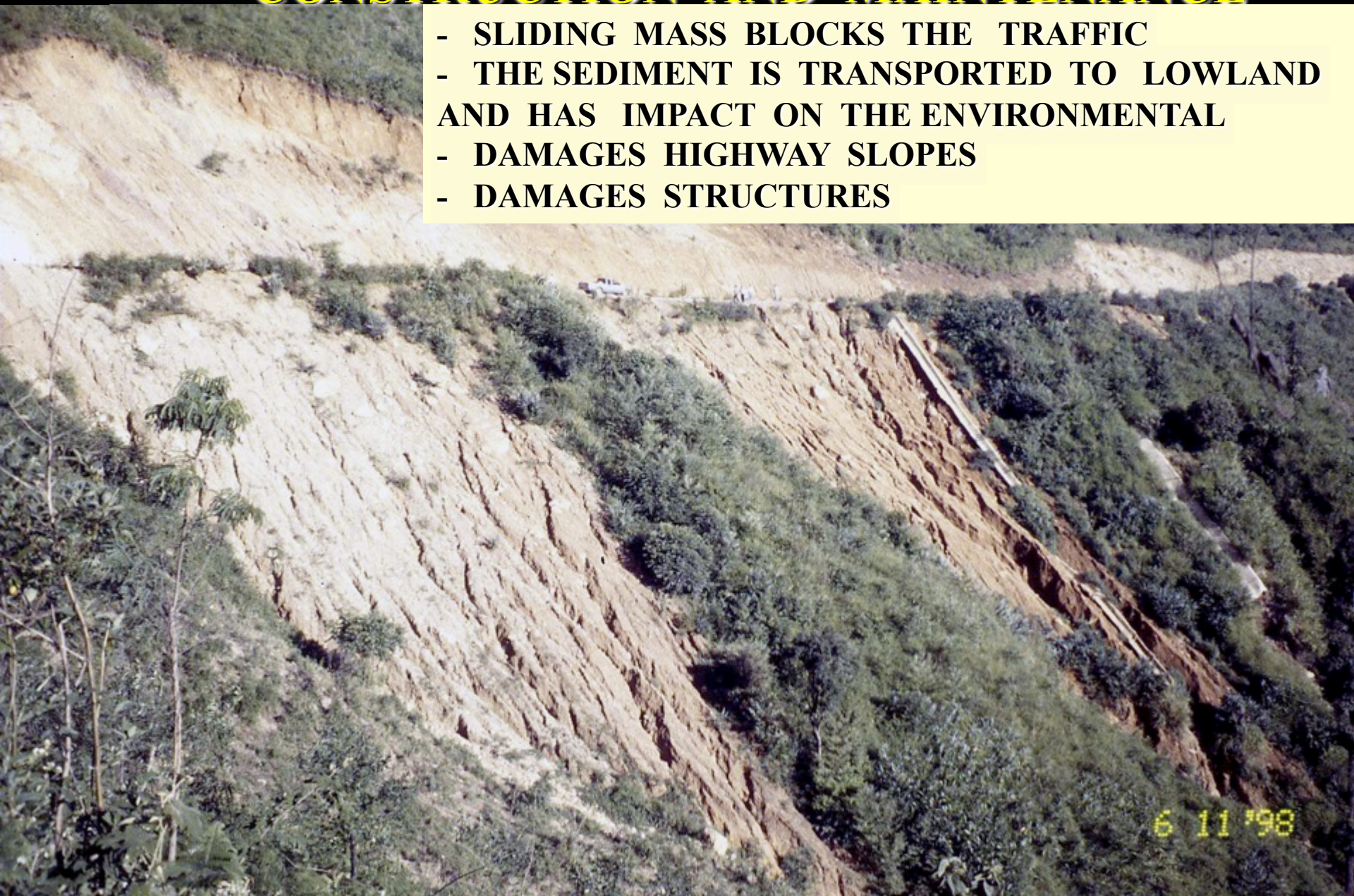
SUSTAINABLE VETIVER SYSTEM IN EROSION CONTROL AND STABILIZATION FOR HIGHWAYS SLOPE IN THAILAND (ICV-5 , 28/10/2011)

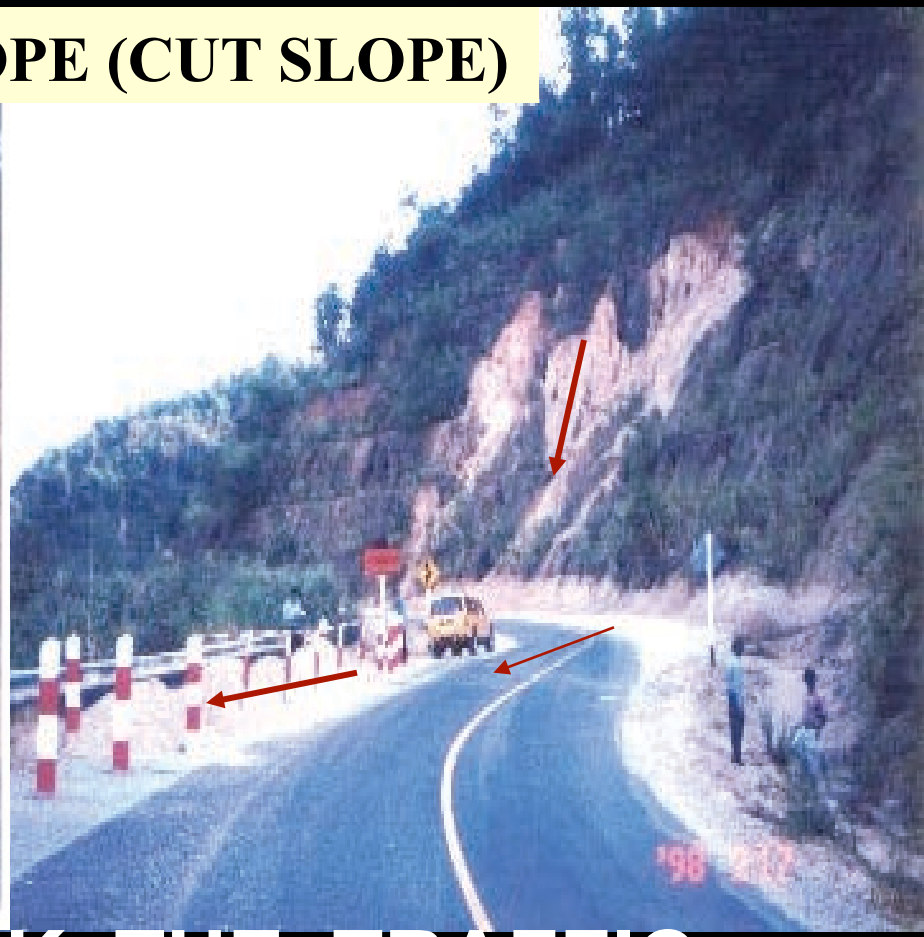
1.1) EROSION PROBLEMS IN HIGHWAY CONSTRUCTION AND MAINTENANCE

- SLIDING MASS BLOCKS THE TRAFFIC
- THE SEDIMENT IS TRANSPORTED TO LOWLAND AND HAS IMPACT ON THE ENVIRONMENTAL
- DAMAGES HIGHWAY SLOPES
- DAMAGES STRUCTURES



1.1) EROSION PROBLEMS

1.1.1) EROSION ON BACK SLOPE (CUT SLOPE)



- SLIDING MASS BLOCK THE TRAFFIC
- SEDIMENTS FILL UP SIDE DITCH AND BLOCK WATER FLOW
- WATER FLOW ACROSS THE ROAD , ERODE AND

1.1) EROSION PROBLEMS

1.1.2 EROSION ON SIDESLOPE (FILL SLOPE)

STRONG EROSION (LACK OF ADEQUATE PREVENTIVE) INDUCED TO SHALLOW MASS MOVEMENT OF SOILS (SHALLOW-SEATED FAILURE)

1.1) EROSION PROBLEMS

1.1.3) EROSION AT THE END OF SURFACE DRAINAGE SYSTEMS

1.1) EROSION PROBLEMS

1. 1.4) STREAM BANK EROSION

EROSION AT THE TOE OF EMBANKMENT SLOPE ALONG THE STREAM CHANNEL WAY

1.2) BACKGROUND OF THE VETIVER GRASSING PROJECT OF THE HIGHWAYS DEPARTMENT, THAILAND

1.2) BACKGROUND OF THE VETIVER GRASSING PROJECT OF THE HIGHWAYS DEPARTMENT, THAILAND

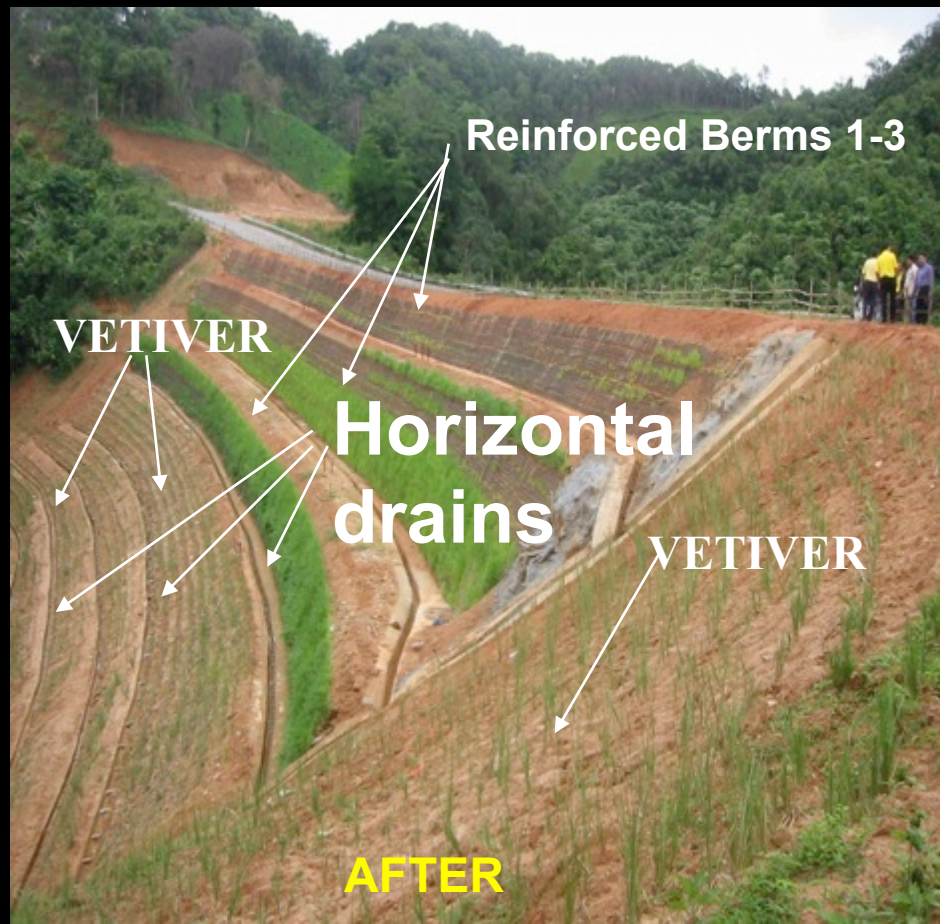
1.2.1 VETIVER SYSTEM FOR HIGHWAY CONSTRUCTION PROJECT.

1.2) BACKGROUND OF THE VETIVER GRASSING PROJECT OF THE HIGHWAYS DEPARTMENT, THAILAND

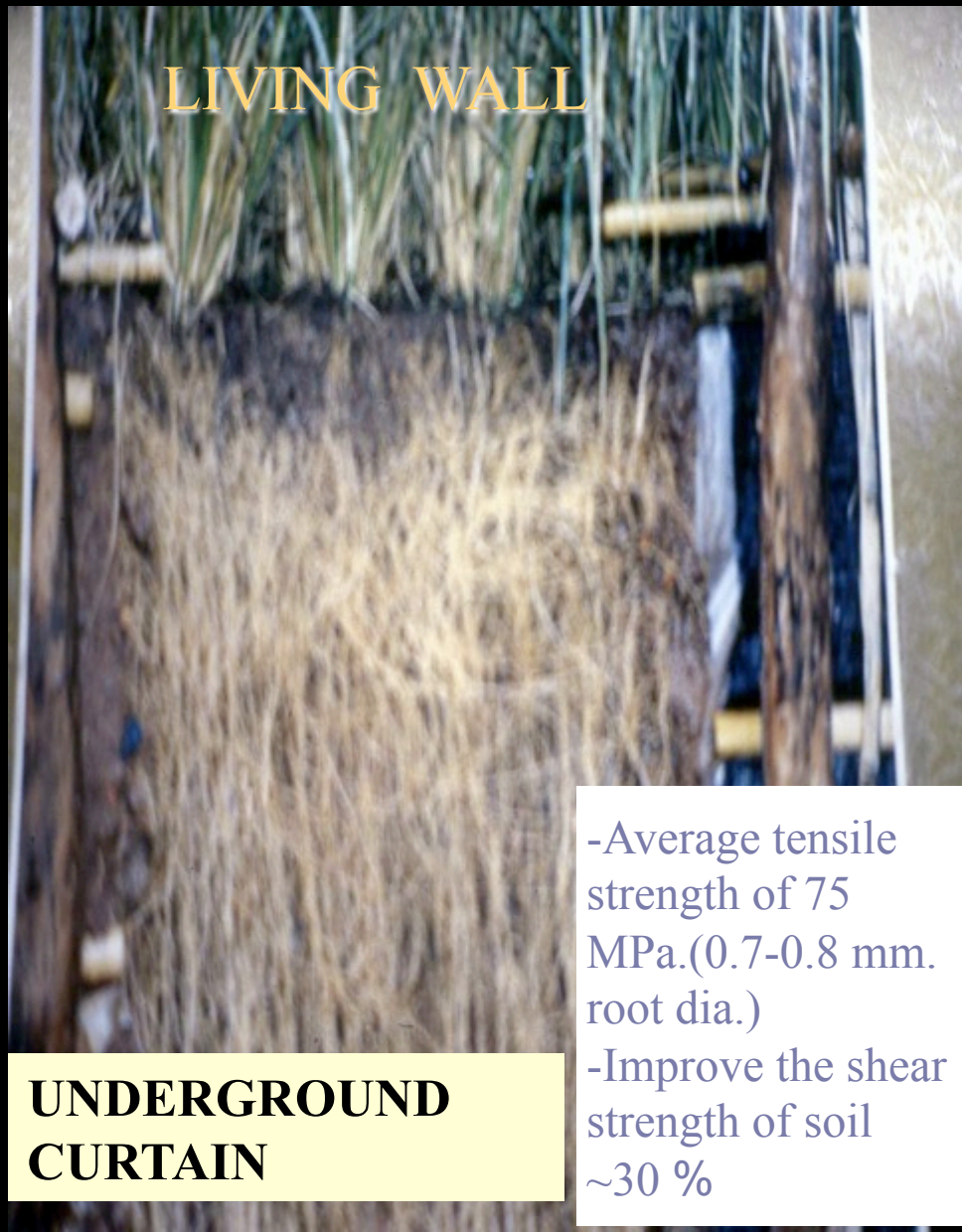
1.2.2 VETIVER SYSTEM FOR HIGHWAY MAINTENANCE

1.2) BACKGROUND OF THE VETIVER GRASSING PROJECT OF THE HIGHWAYS DEPARTMENT, THAILAND

1.2.3 VETIVER SYSTEM FOR HIGHWAY MAINTENANCE IN REHABI LITATION OF COLLAPSED EMBANKMENT SLOPES



2) SLOPE EROSION CONTROL AND STABILIZATION MECHANISM BY VETIVER




VETIVER CONTRIBUTING TO EROSION CONTROL AND STABILITY OF SLOPE BY :
1) SLOW DOWN RUNOFF
2) ROOT REINFORCEMENT
3) EVAPOTRANSPIRATION
REDUCE RUNOFF ~ 70%
16 10 '01

3) APPLICATION OF THE VETIVER SYSTEM IN EROSION CONTROL AND STABILIZATION OF HIGHWAY SLOPES

3.1)THE PATTERN OF VETIVER GRASSING ON HIGHWAY SLOPE

3.1.1) ON SLOPES WHERE EROSION IS NOT SEVERE

June 2007

May, 2008

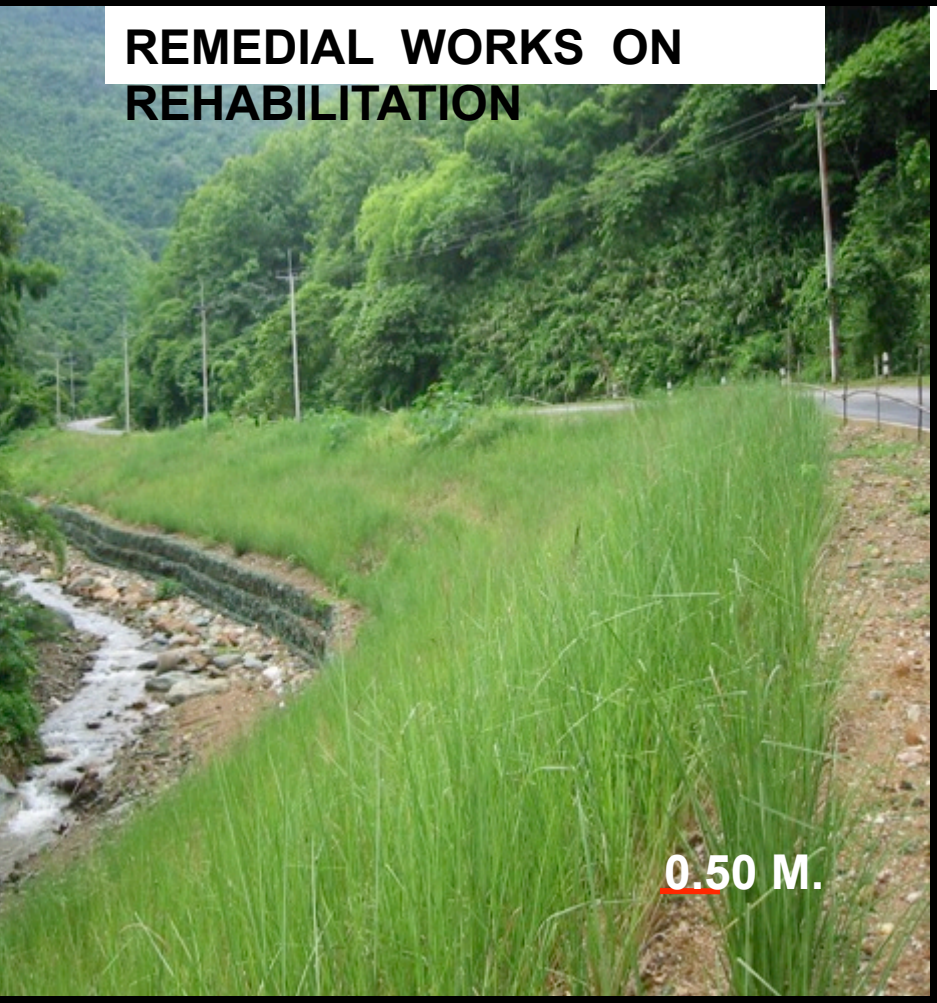
- PLANTING THE VETIVER IN LARGE SCALE AREA FOR GENERAL PREVENTIVE PURPOSE

-THE SPACING BETWEEN THE PLANTING ROWS CAN BE 1 METER APART AND 10 CMS. BETWEEN THE CLUMPS.

3) APPLICATION OF THE VETIVER SYSTEM IN EROSION CONTROL AND STABILIZATION OF HIGHWAY SLOPES

3.1.2) ON SLOPES WHERE EROSION IS SEVERE

REMEDIAL WORKS ON REHABILITATION



-STRONGLY ERODING SITES OR COLLAPSED SLOPES

THE SPACING BETWEEN THE PLANTING ROWS IS 0.5 METER APART AND 5 TO 10 CMS. BETWEEN THE

5) SUSTAINABLE VETIVER SYSTEM

5.1 OPTIMUM PLANTING TECHNIQUES

5.1.1 SUITABLE VETIVER TILLERS

NURSERY VETIVER SLIPS IN POLY-BAGGED FOR 45-60 DAYS TO PRODUCE ACTIVE TILLERS

DIRECT TO SUNLIGHT

(APRIL , 2003)

JUNE, 2003

5) SUSTAINABLE VETIVER SYSTEM

5.1 OPTIMUM PLANTING TECHNIQUES

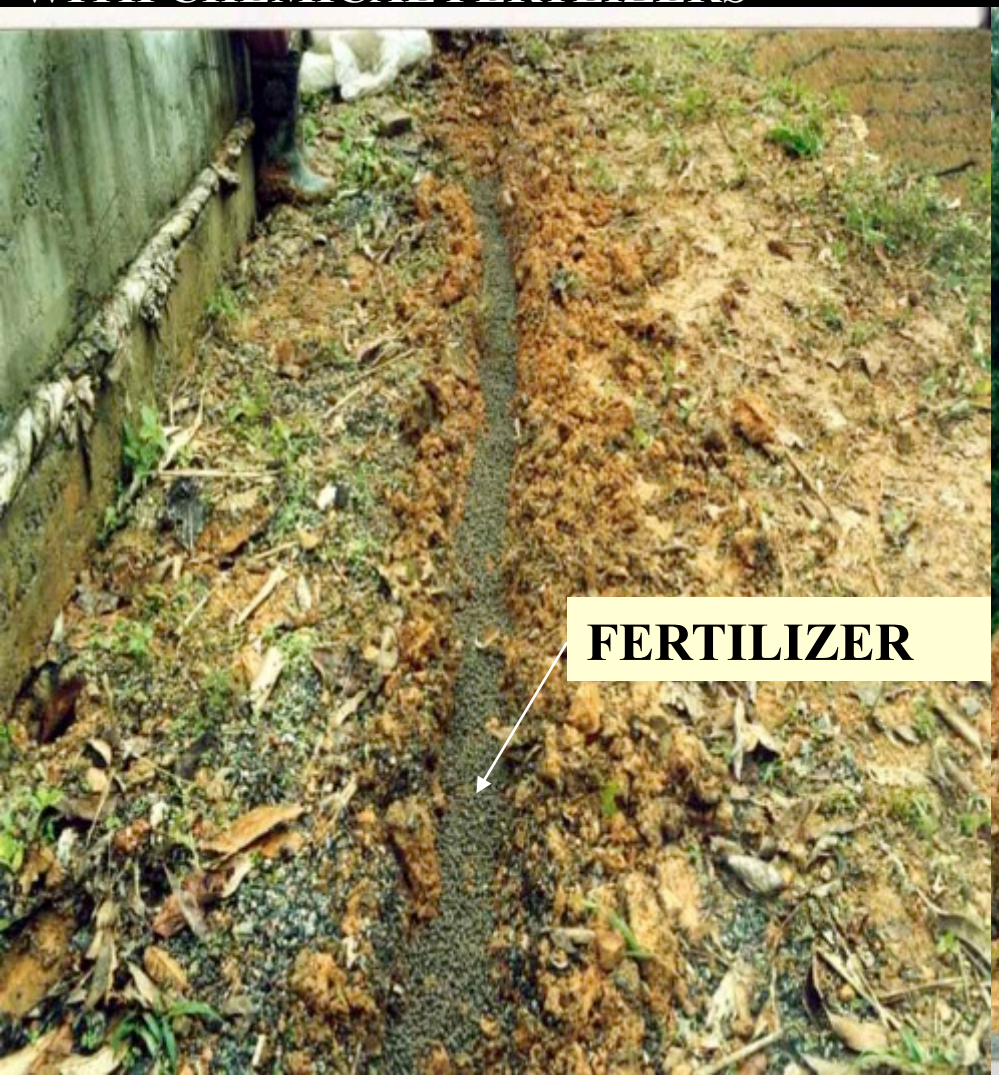
5.1.1 SUITABLE VETIVER TILLERS

ACTIVE TILLERS AT AGE OF 45-60 DAYS MUST BE PLANTED

5) SUSTAINABLE VETIVER SYSTEM

5.1 OPTIMUM PLANTING TECHNIQUES

5.1.2 SOIL FERTILITY IMPROVEMENT: FERTILIZE THE SOIL WITH BASAL APPLICATION OF CHICKEN MANURE OR FARMYARD MANURE MIXED WITH CHEMICAL FERTLIZERS



5) SUSTAINABLE VETIVER SYSTEM

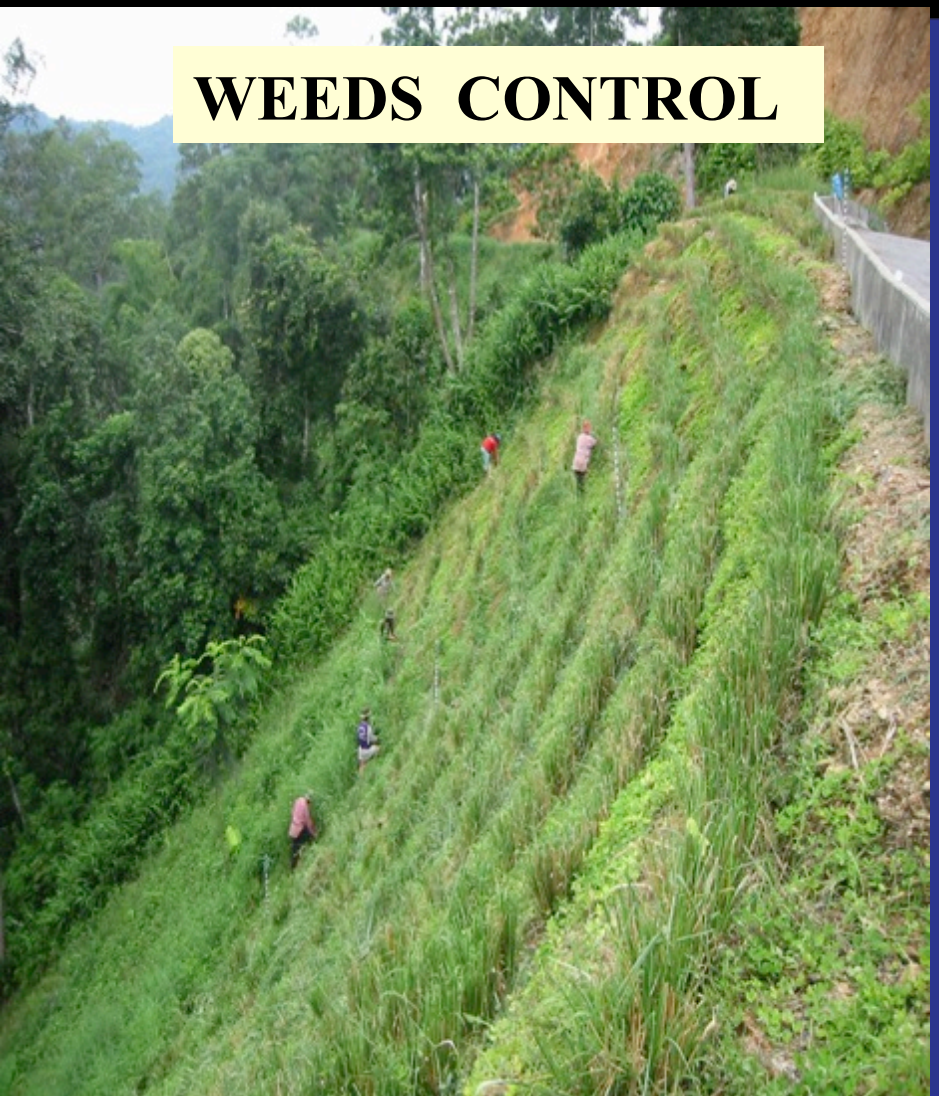
5.1 OPTIMUM PLANTING TECHNIQUES

5.1.3 PLANTING DURING SUITABLE PERIOD (AT LEAST 2 MONTHS FOR VETIVER GROWING IN RAINY SEASON)

ACTIVE TILLERS AT AGE 45-60 DAYS (IN POLY-BAG)

5.1) OPTIMUM PLANTING TECHNIQUES

5.1.4) MAINTENANCE OF WEED AND FERTILIZATION ARE NECESSARY FOR 1-2 YEARS AFTER PLANTING

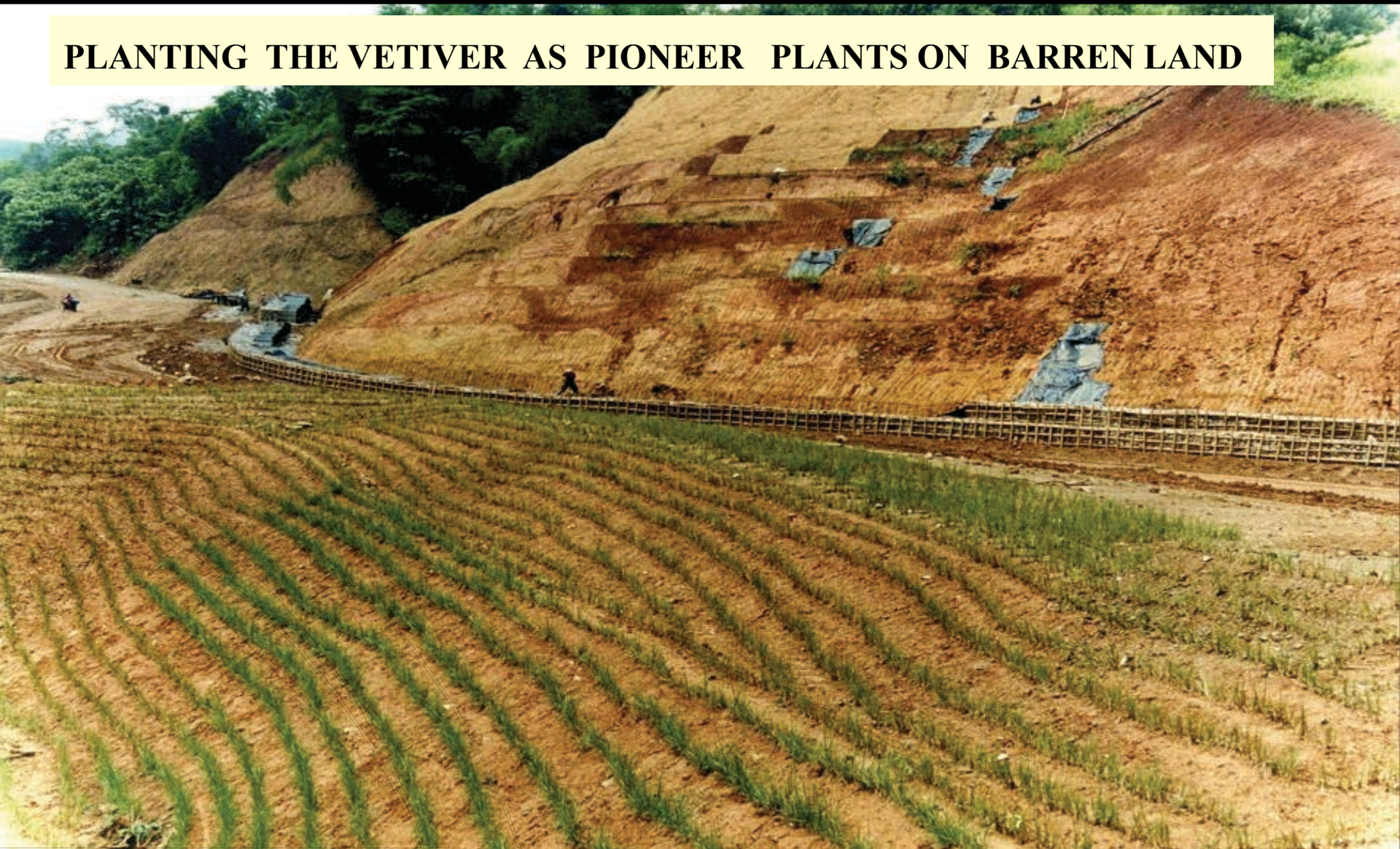


5) SUSTAINABLE VETIVER SYSTEM

5.1 OPTIMUM PLANTING TECHNIQUES

5.1.5 THE EFFECT OF LAND SURFACE

PLANTING THE VETIVER AS PIONEER PLANTS ON BARREN LAND



5) SUSTAINABLE VETIVER SYSTEM

5.1 OPTIMUM PLANTING TECHNIQUES

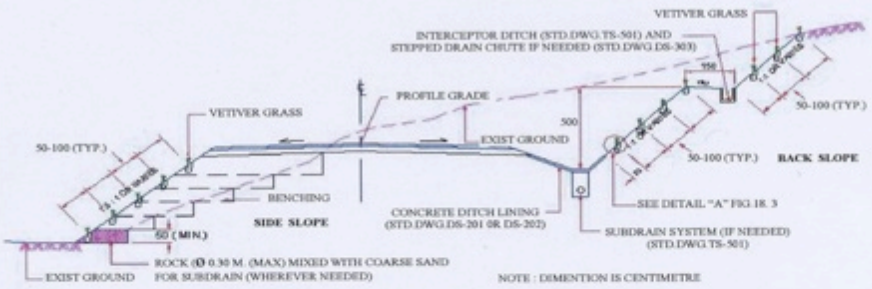
5.1.6) EFFECT OF SLOPE INCLINATION ON THE GROWTH DEVELOPMENT


VETIVER SLIPS CAN DEVELOPS A COMPLETELY DENSE HEDGEROW
THAT TO BE EFFECTIVE FUNCTION ABLE AFTER 3-4 MONTHS

5) SUSTAINABLE VETIVER SYSTEM

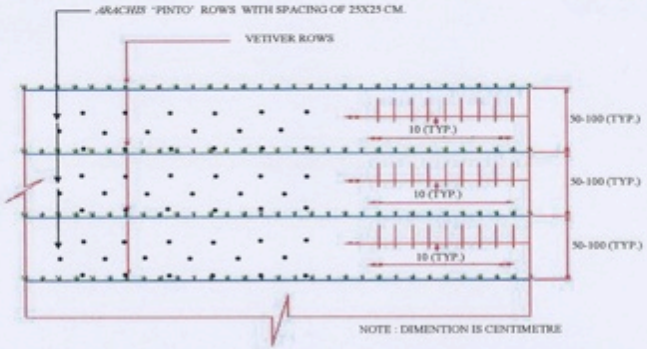
5.2 DRAWING: VETIVER GRASS PLANTING FOR HIGHWAYS SLOPE PROTECTION, SP- 205 / 2 (2006)

Fig.18 Standard Drawing "Vetiver grass planting for highways slope protection" (2006)



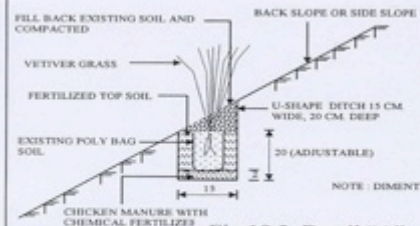
- Spacing of vetiver grass rows varies from 50-100 cm. and in clump 10 cm. which depend on severe erosion problems on soils.
- Drainage system i.e. interceptor ditch, drain chute, subdrains are also necessary.

Fig.18.1 Cross-section : Vetiver grassing on back slope and side slope



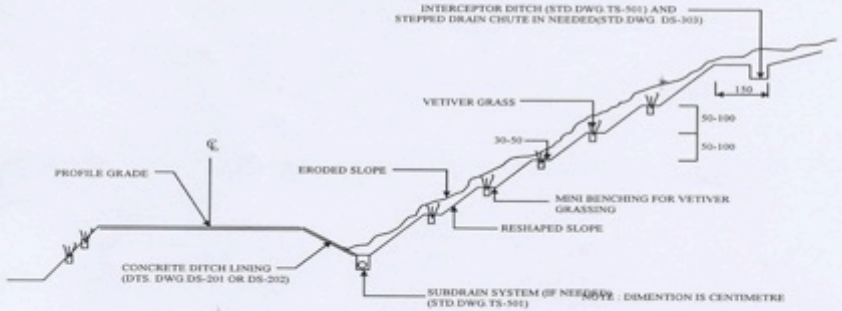
- For not serious cases, planting in rows is 1.00 m. apart and in clump 10 cm spacing.
- For serious cases, planting in rows is 50 cm. apart and in clump 10 cm spacing.
- For minimal maintenance of weeds and fertilization, *Arachis* 'Pinto' is planted between the rows of vetiver.

Fig. 18.2 Plan : Vetiver grassing on back slope and side slope



- Digging the existing soil U-shape ditch 15x20 cm.
- Basal with chicken manure (600 g.) /farmyard manure (2 kg.) + fertilizer 15-15-15(60 g.) pe linear meter.
- Planting time should be the beginning of rainy season or in rainy season.

Fig.18.3 Detail "A"



- Reshape the eroded back slope
- Make mini benching 30-50 cm. wide, 50-100 cm. height
- Plant the vetiver grass on the bench
- Together with drainage systems

Fig. 18.4 Cross-section : Vetiver grassing on existing eroded back slope

Fig. 18.5 Vetiver grassing on high erosible area and side ditch.

DRAWING BASED ON TECHNOLOGY IMPROVEMENTS : VETIVER GRASS PLANTING FOR HIGHWAYS SLOPE PROTECTION, SP- 205 / 2 (2006)

1) THE SPECIFICATION OF VETIVER TILLER

2) GROUND PREPARATION AND HOLE DIGGING

3) SOIL FERTILITY IMPROVEMENT

4) PATTERN OF VETIVER GRASSING

5) SUITABLE PERIOD FOR PLANTING

6) PLANT CARING

7) MAINTENANCE AFTER PLANTING

8) MINIMAL MAINTENANCE (THE VETIVER IN COMBINATION WITH *ARACHIS 'PINTOI'*)

9) VETIVER GRASSING ON DEEP CUT AND HIGH FILL SLOPES

5) SUSTAINABLE VETIVER SYSTEM

5.3 UNIT RATES OF VETIVER GRASSING FOR HIGHWAY SLOPE PROTECTION

A)	GROUND PREPARATION COST	0.10 BAHT/ TILLER
B)	MATERIALS COSTS	1.10 BAHT/ TILLER

- MATERIALS FOR MULTIPLICATION IN PLASTIC BAGS
- COST OF VETIVER TILLER
- MATERIALS FOR BASAL APPLICATION
- MATERIAL FOR MAINTENANCE

C)	LABOUR COSTS	1.50 BAHT/ TILLER

- LABOUR COST OF NURSERY FOR 60 DAYS
- LABOUR COST FOR PLANTING AT THE TARGET AREA

D)	TRANSPORTATION COSTS	0.55 BAHT/ TILLER

- IN CASE OF BARE ROOT SLIPS
- IN CASE OF TILLER IN PLASTIC BAG
- FROM NURSERY TO TARGET AREA

E)	MAINTENANCE COST AFTER PLANTING	0.50 BAHT/ TILLER
F)	MISCELLANEOUS COST	0.25 BAHT/ TILLER
	TOTAL COST	4.00 BAHT/TILLER

5) SUSTAINABLE VETIVER SYSTEM

5. 4MIXED PLANTING WITH SUITABLE PLANT(*Arachis pintoi*

***Arachis pintoi* :LEGUMINOSAE (CREEPING FORAGE PEANUT)**

-1) VERY DENSE MAT-FORMING PERENNIAL (HIGH EFFICENCY ON BLOCKING OR CONTROLING WEEDS)

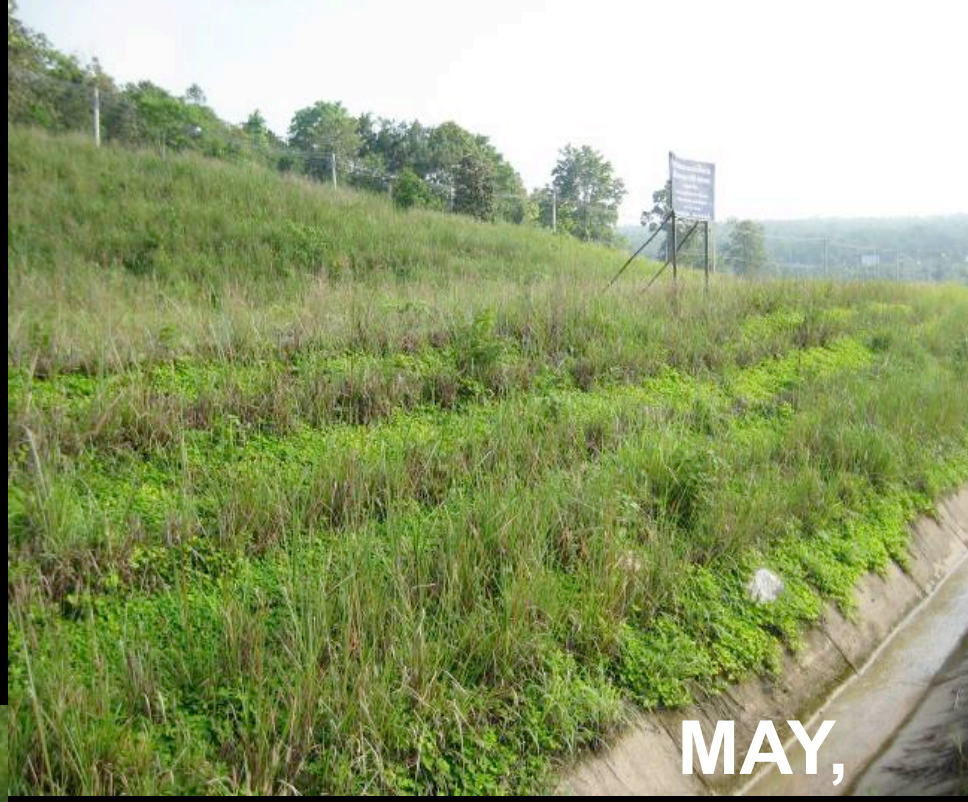
-- 2) BIOLOGICAL NITROGEN FIXATION (TO FERTILE SOIL)

‘ PINTOI ‘ IS A CREEPER THAT GROWS CLOSELY TO THE GROUND SURFACE AND SHADE TOLERANT CAN GROW WITH TALL GRASS AS VETIVER


COVERING 40 - 60 % OF AREA WITHIN 5 MONTHS

COVERING 80 - 90 % OF AREA WITHIN 8 - 12 MONTHS

THE EFFICIENCY OF *ARACHIS ' PINTOI '* TO CONTROL WEEDS ON ROUTE NO. 107 (Km. 10.150 – Km. 10.450)



MAY, 2008

1 YEAR AFTER PLANTING

2 YEARS AFTER PLANTING (MAY,

6) EFFICIENCY OF EROSION CONTROL AND STABILIZATION OF HIGHWAY SLOPES

6.1 PROTECT THE SOIL AGAINT EROSION AND SHALLOW-SEATED FAILURE

BEFORE STABILIZED BY VETIVER

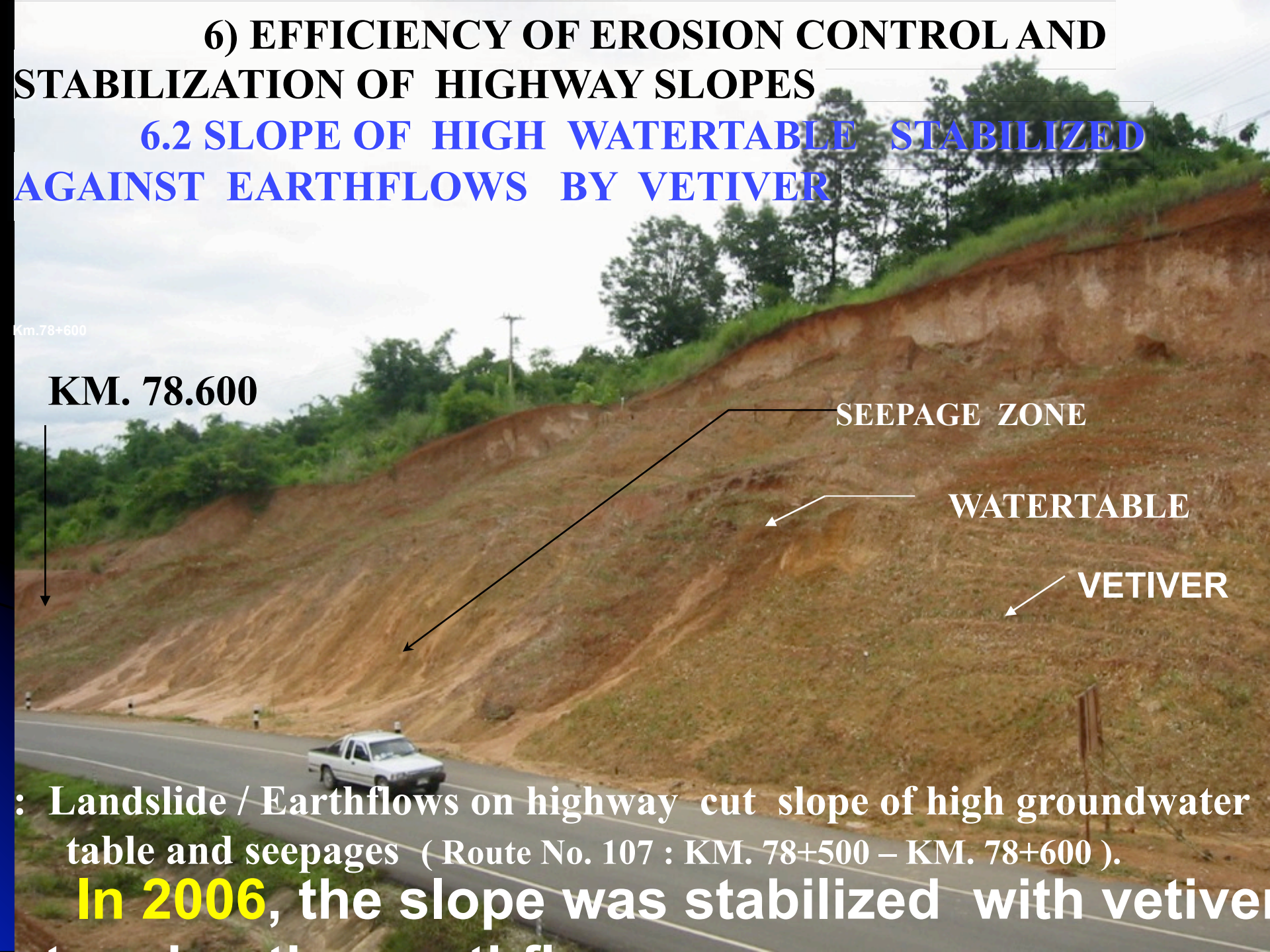
AFTER STABILIZED BY VETIVER FOR 2 YEARS

6) EFFICIENCY OF EROSION CONTROL AND STABILIZATION OF HIGHWAY SLOPES

6.2 SLOPE OF HIGH WATERTABLE STABILIZED AGAINST EARTHFLOWS BY VETIVER

6) EFFICIENCY OF EROSION CONTROL AND STABILIZATION OF HIGHWAY SLOPES

6.2 SLOPE OF HIGH WATERTABLE STABILIZED AGAINST EARTHFLOWS BY VETIVER

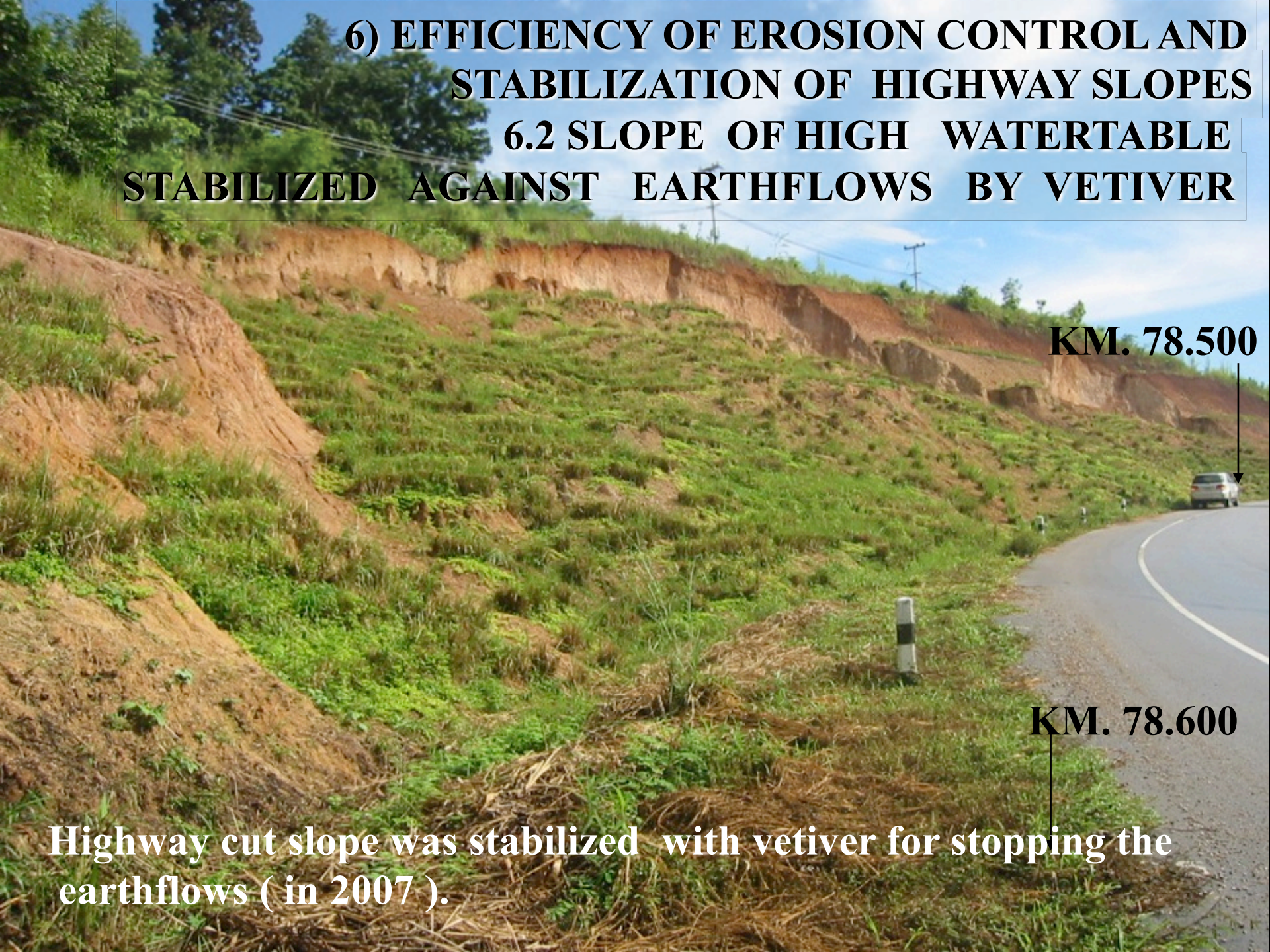


: Landslide / Earthflows on highway cut slope of high groundwater table and seepages (Route No. 107 : KM. 78+500 – KM. 78+600).

In 2006, the slope was stabilized with vetiver

6) EFFICIENCY OF EROSION CONTROL AND STABILIZATION OF HIGHWAY SLOPES

6.2 SLOPE OF HIGH WATERTABLE STABILIZED AGAINST EARTHFLOWS BY VETIVER



Highway cut slope was stabilized with vetiver for stopping the earthflows (in 2007).


6) EFFICIENCY OF EROSION CONTROL AND STABILIZATION OF HIGHWAY SLOPES
6.2 SLOPE OF HIGH WATERTABLE STABILIZED AGAINST EARTHFLOWS
KM. 78.500
STABLE DRY SLOPE
Vetiver stopped the flowage of earthflows in 2008 .


NON-PLANTING VETIVER ARE
VETIVER PLANTING AREA
07/09/2011

7) CONCLUSIONS

7.1 OPTIMUM PLANTING TECHNIQUS

7 2 PLANTING THE VETIVER AS PIONEER PLANT ON BARREN LAND.

7.3 ARACHIS ‘ PINTO ‘ HAS EFFICIENCY TO CONTROL WEEDS.

7) CONCLUSIONS

7.4 VETIVER STABILIZED THE SOIL SLOPES NOT ONLY ROOT REINFORCEMENT BUT BY GETTING SOIL TO DRY BY EVAPOTRANSPIRATION .

7.5 VS IS AN EFFECTIVE MEASURES FOR EROSION CONTROL AND STABILIZATION AGAINST EROSION, SHALLOW-SEATED FAILURE AND EARTHFLOWS (SLOW MOVEMENT OF SATURATED SOILS).


7.6) VS IS MULTI- TECHNOLOGY
VETIVER
VETIVER
MSE WALL
VETIVER
VETIVER SYSTEM WAS APPLIED WITH MSE WALL ON
HIGHWAY CONSTRUCTION PROJECT ROUTE NO. 11
08/09/2011


THANK YOU