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# 5

## Environmental Management

# The DOs & The DONTs



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COMMUNITY  
DRIVEN  
DEVELOPMENT



SOCIAL  
DEVELOPMENT  
THE WORLD BANK



PNPM  
MANGROVE



# The DOs & The DON'Ts Environmental Management

**General Considerations - Site Screening - Construction Site  
Management - Roads - Water Supply - Sanitation - Solid Waste  
Management - Markets - Rivers**

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# Preface

Environment is all about living and extinct things on earth. The surrounding environment condition is very much influencing our life pattern. A clean and well maintained environment will make us feel comfortable in doing a lot of activities. Conversely, a bad environment condition will cause a lot of problems, such as, disturbance of ecosystem <sup>1)</sup>, the lacking of or even the lost of natural resources, and moreover which is also important, it may influences our health.

Recently, we regularly have been faced with issues on activities where it potentially causes environment damages or disturbances, such as, illegal deforestation, forest burning, the coral usage for village road construction, improper domestic/factory waste disposal, and also without exception, dirty public places. If these activities were not immediately stopped, it may cause damages to our environment ecosystem. And if our ecosystem is damaged, our lives on earth will also fall to pieces. Therefore, it needs efforts, at least, to minimize the environment damages through the proper environmental management. These efforts can be the form of among others; forest rehabilitation, restriction to disposal waste into location that potentially may harm the environment, or also in the form of the delivery of awareness to the society of the danger that may threaten their viability.

This book is drafted to help to deliver the awareness especially to the public society on things that may potentially cause the environment disturbances and damages. This book is simply and clearly presented, by showing good and bad samples where generally may be seen in our surroundings.

It is expected that this book can be easily understood not only by the society who is not from environment engineering group, but also can be used by government staff, institutions who involved in environment preservation activities, civil engineers who regularly involved in construction and others whose activities related to environment.

Finally, the writer wishes that this book can be distributed and provided to anyone who demands; can also be used to complete the construction technique training material, environmental awareness, operational and maintenance activities, etc.

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1 Ecosystem can also be said as a unit arrangement completely and thoroughly between entire elements of life circle who interact.

# Gratitutation

Highest gratitude is awarded to some people who make this book into materialized: Scott Guggenheim who has the idea and financing this activity, Ekart Hartmann and Heinz Unger who carried the idea out, Vivi Rambe who has contributed ideas, and suggestion/input before and after this activity carried out, Octaviera Herawati who manages this activity (including in obtaining suggestion and input of the book contents, manages the printing and publishing, and translates it into Bahasa Indonesia) and Richard Gnagey who has provided his time for reviewing and giving valuable suggestion/input. Specifically to Victor Bottini and Sentot Satria who always gives their support towards this book. Also to colleagues who have made the illustration and layout, colleagues in administration section and whoever who has given his or her supports during the completion of this activity.

# Introduction

## Making Your Project Protect the Community Environment

### WHY SHOULD YOU USE THIS MANUAL?

- A community will not be aware of all possible environmental impacts.
- A project will have unforeseen and unexpected impacts, which could include economic loss and even death and injury.
- A project will have environmental impacts unless project concept, design and implementation stage consider all potential impacts and plan to handle them.
- A project may present an opportunity to fix a local environmental problem.
- It is worth to protect Our Environment – for Ourselves and Our children.

### HOW SHOULD YOU USE THIS MANUAL?

- Use the General Section – Environmental Aspects as a checklist for what not to do and not to buy.
- Use the Site Screening section to make sure the project does not have negative impact on environmentally or socially sensitive areas.
- Check the section on Construction Site Management for what to watch out for when implementing construction activities.
- Look at the different sector pages to see what environmental problems could arise from community infrastructure projects :
  - Imagine which hazards potentially came the most impact for the community.
  - Imagine which hazards are most likely to occur on the site.
  - Take measure to eliminate or minimize environmental damage.
  - Put environmental measures into design drawings and budgets.
  - Explain hazards and protective measures to the whole community.
- Learn from the sector pages how to prevent environmental impacts and problems, and see how to improve your project and the environment.
- Pay attention to the signs for good and bad samples provided on the top of each page; GOOD samples  BAD samples 



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**Good**

**Bad**

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# General Considerations





Is this timber illegal?

## USE ONLY LEGAL TIMBER FOR CONSTRUCTION

### WHY ?

- Illegal timber has been logged without a proper license.
- Illegal timber may have been logged in a protected area.
- Illegal timber is usually logged in an unsustainable manner – the forest may be lost forever.
- Use of illegal timber create a market that threatens protected species and ecosystems and harms Indonesia’s natural resources.
- If illegal timber could not be sold it wouldn’t be logged.

### HOW ?

- Always require the supplier to show a certificate for timber.

*Note:* This requirement applies to large housing projects only.

## Chainsaw



### NO CHAINSAWS SHOULD BE USED

#### WHY ?

- Chainsaws could be used to cut a lot of trees very quickly.
- Chainsaws could be abused (??).

#### HOW ?

- Only use handsaw for getting wood.
- Cut only as little wood as needed.
- When sitting infrastructure try to avoid cutting any trees, or as few as possible.



A roof covered with asbestos cement tiles

## DO NOT USE ANY MATERIALS THAT CONTAIN ASBESTOS

### WHY ?

- Asbestos is a health hazard to people that slowly reduces lung capacity and can cause cancer.
- Even materials that contain asbestos, such as asbestos cement roof tiles or asbestos cement panels, are a health hazard.
- The health hazard comes from handling and breathing dust from asbestos-containing materials, such as cutting or sawing them.
- Hazards are especially dangerous and unsuspected when asbestos materials are removed many years later.



Fishermen are catching fish using explosion

## DO NOT BUY OR USE ANY EXPLOSIVES, ESPECIALLY NOT FOR FISHING

### WHY ?

- Fishing with explosives is damages to the marine environment.
- Fishing with explosives is not sustainable.
- Fishing with explosives will reduce fish catch for many years or even for ever.
- Explosives are dangerous to handle and use.

### HOW ?

- Use traditional or conventional fishing nets or lines.

## Pesticides/Herbicides



**DO NOT BUY ANY PESTICIDES FOR THE PROJECT**

### WHY ?

- Runoff from field may contaminate surface water with pesticides.
- Seeping into ground may contaminate the groundwater.
- Over-application of pesticides poses a health risk to people, especially young children.
- Pesticides may pollute the ecosystem, i.e. plants, and beneficial insects, birds and mammals.

### HOW ?

- Use natural, traditional ways to fight pests.
- Consult with Agriculture Office about "Integrated Pest Management".



Coral rocks being used for village road construction

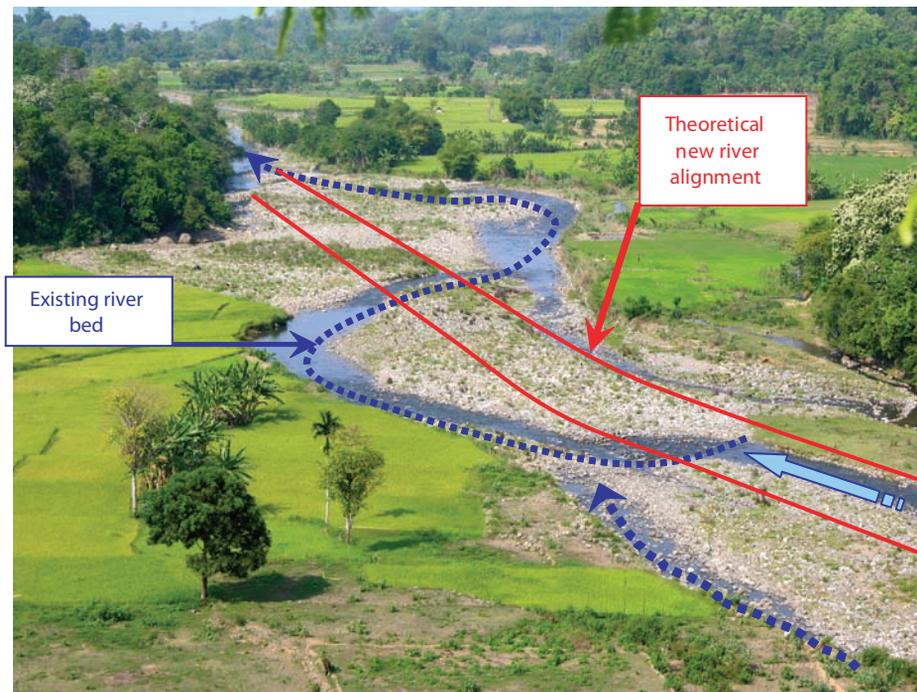
## DO NOT TAKE CORAL ROCKS (ALIVE OR DEAD) FROM THE SEA

### WHY ?

- Corals are a valuable marine resource.
- Corals grow very slowly, so damage is extremely difficult to recover from.
- Coral reefs protect the shoreline from wave action and storms.
- Coral reefs are the habitat of a great variety of fish and marine life.
- Coral reefs are important breeding areas for fish and shellfish, even deepwater fish.
- Coral reefs are a potential source of eco-tourism benefits.

#### Note:

- Alternative road building materials are usually available.
- May be excavated coral rock from land.



An illustration of what a river realignment might look like

## DO NOT REALIGN ANY RIVER

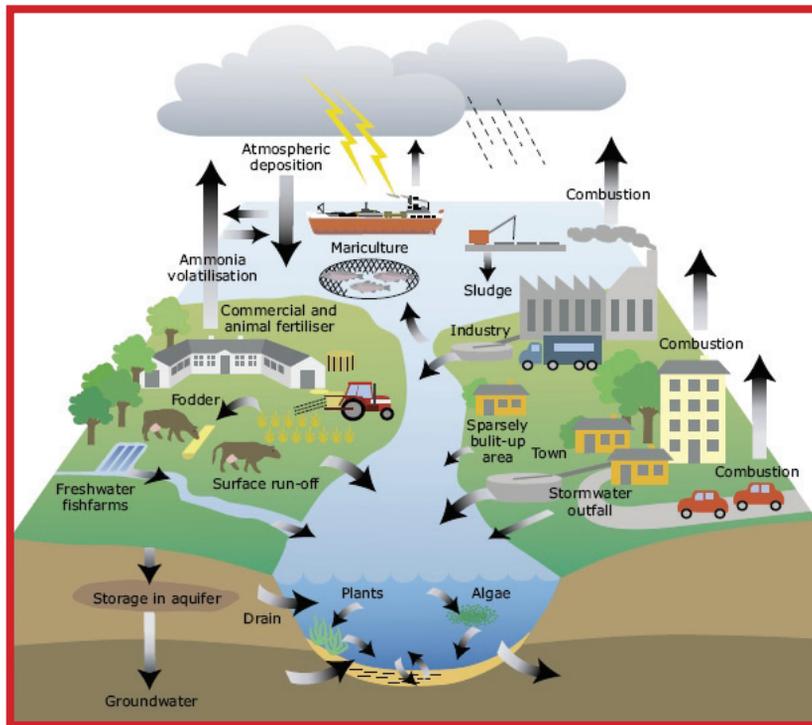
### WHY ?

- River alignment projects are complex.
- Realignment of a river can have numerous environmental impacts that are difficult to control and manage due to increased speed and uniformity of flow, loss of microhabitats, loss of fertile sediments, and effects if channeling.
- Bank and bed erosion and / or downstream flooding could be unforeseen results of river realignment works.



# Site Screening





Schematic diagram showing some potential sources of water pollution

## CONSIDER POTENTIAL WATER POLLUTION

### WHY ?

- River alignment projects are complex. Polluted surface and ground water are less valuable as economic resources.
- River alignment projects are complex. Polluted surface and ground water are unhealthy for consumption by human, plants and animals.

### HOW ?

- River alignment projects are complex .
  - o Prevent potential pollution from reaching ground or surface water, such as:
    - o Septic tank effluent that is not treated properly.
    - o Sediment from roads and slopes.
    - o Runoff from agricultural land that use fertilizer, pesticides or herbicides.
    - o Untreated wastewater from economic activities (dyeing, food processing, leather, industrial waste).



Severe gully erosion as a consequence of road construction in an zone of highly erodible soils

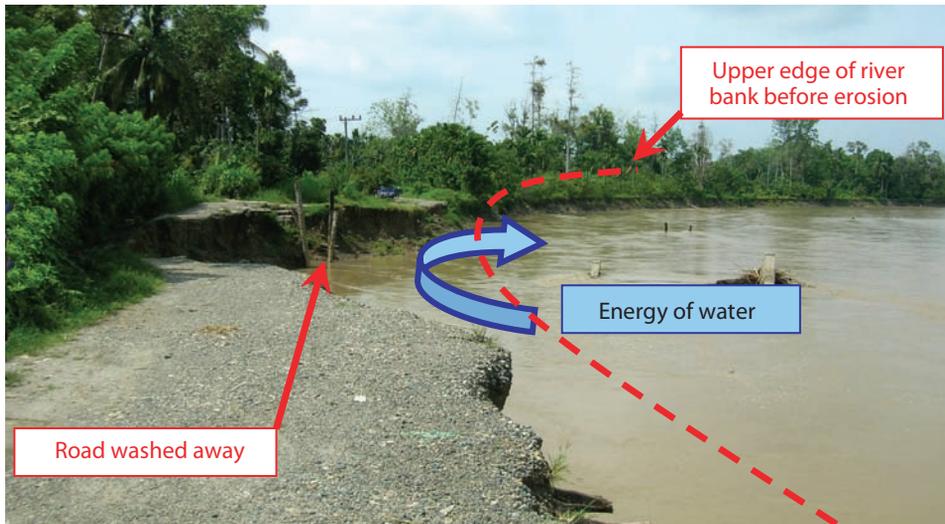
## AVOID BUILDING ROADS IN ERODIBLE SOILS

### WHY ?

- Many soils are easily eroded by rain splash and surface water.
- Removal of an existing vegetation cover worsen erosion problems.
- Steep slopes increase the speed of the flowing water and making erosion worse.
- Flows are channelled along roads on a grade, might cause gully erosion (as shown above).

### HOW ?

- Water interception, drainage and erosion control measures must be taken.
- Flows are intercepted before they reach steeper slope.
- Flowing water drains into ditches that drain water supply.
- Wayet can be channeled into culverts to softly cross roads as irrigation canals.
- Erosion control measures can be taken.



A section of a kabupaten road was completely washed away by erosion of the river bank

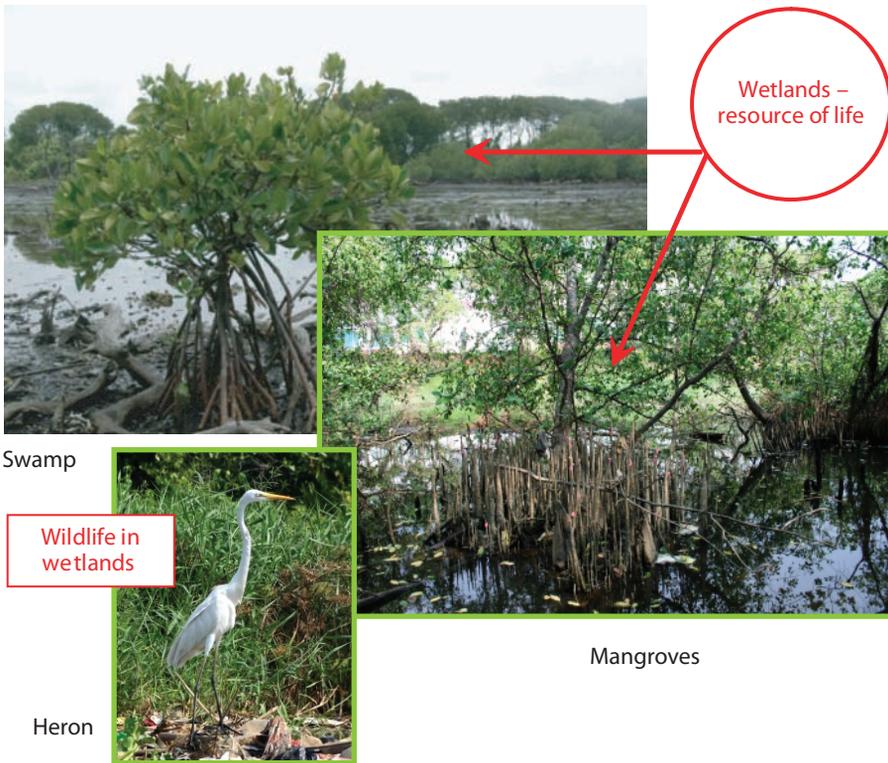
## BUILD ROADS OR STRUCTURES AWAY FROM RIVER BANKS

### WHY ?

- The outside bend of river banks is progressively eroded by the force of the flowing water especially from larger or fast flowing rivers.
- Stopping this erosive force requires significant protective structures.
- It is better to respect the natural forces and build away from the river, especially away from the outside bend of the river.

### HOW ?

- Choose a different road alignment away from the river banks.
- Do not locate any roads or structures too close to river banks.
- Check for evidence of bank erosion.

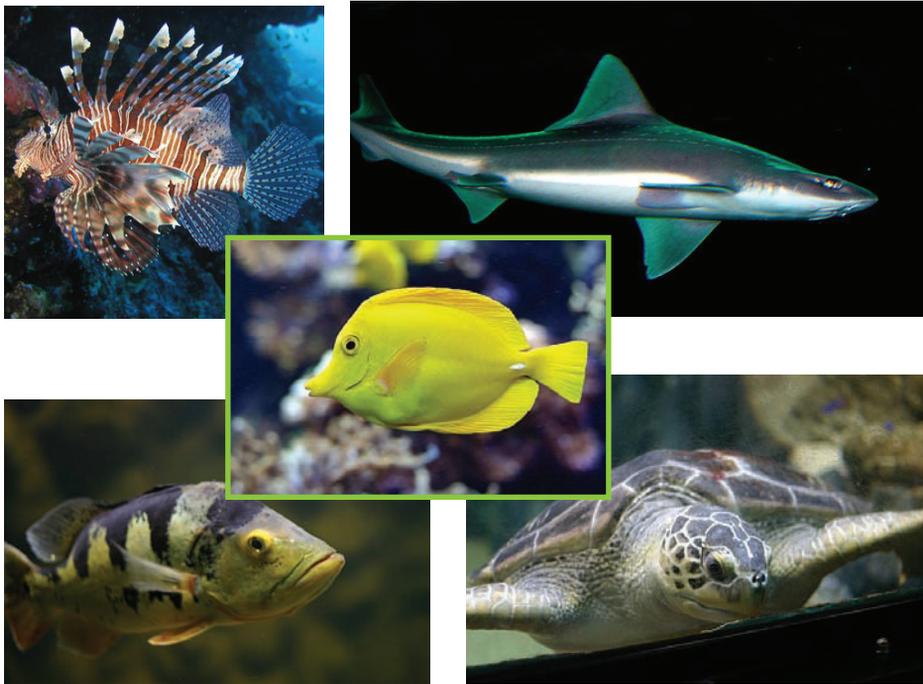


## PROTECT WETLANDS FROM INFRASTRUCTURE CONSTRUCTION

### WHY ?

- Wetlands serve as water reservoirs.
- Wetlands help recharge groundwater.
- Wetlands filter and clean water.
- Wetlands provide special habitat for wildlife.
- Marine wetlands are important breeding areas for fish and shellfish.
- Mangrove trees protect the shore.

Photos: [Jakartagreenmonster.com](http://Jakartagreenmonster.com)



Fish, turtles and other marine life can be affected by infrastructure in or near the sea

## PREVENT POLLUTION IN OR NEAR MARINE HABITATS

### WHY ?

- Infrastructure development in the ocean or near the ocean can adversely affect marine life.
- Fuel or oil spills from boat engines can pollute the sea and kill marine life.
- Near shore drainage polluted by septic tanks, or high in sediment, or effluent from economic activities can also affect marine life.
- The catch from fishing by the community may be reduced if ocean water quality is affected.



Indonesia has many special wildlife habitat areas

## PROTECT SPECIAL WILDLIFE HABITAT FROM INFRASTRUCTURE CONSTRUCTION

### WHY ?

- Wildlife habitat, such as in primary forest or in swamps, provides a haven for many special and algae endangered wildlife.
- Infrastructure development, especially roads, will disturb the wildlife.
- Roads will also provide access to other activities that may destroy the wildlife habitat.



Boundary of Protected Area (Note: The signboard needs re-painting)

## RESPECT PROTECTED AREAS

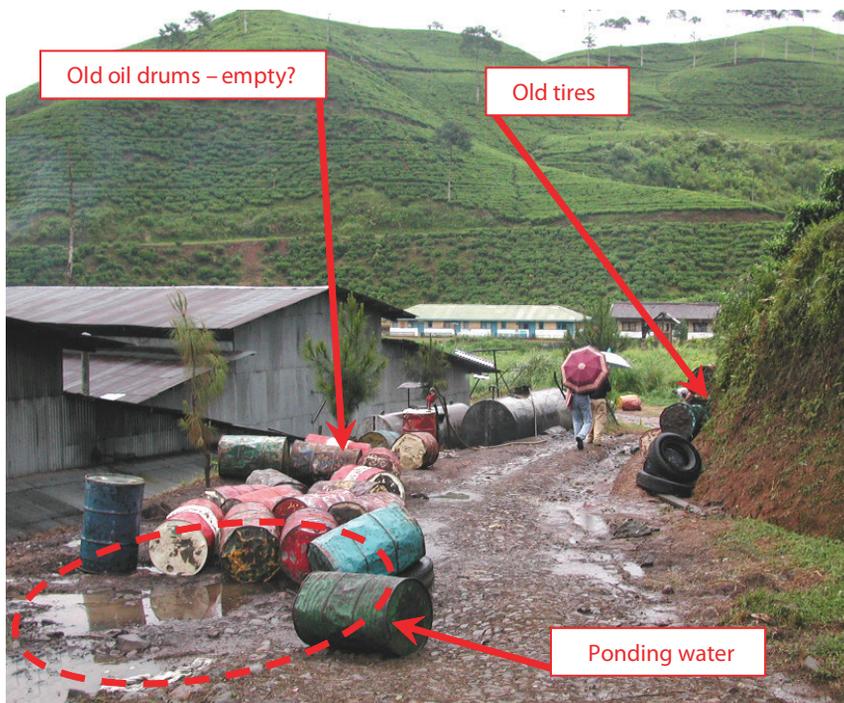
### WHY ?

- Protected areas are set up to give protection to unique or special habitats or ecosystems, including rare or endangered species.
- Protected areas can be a source of local revenue from visitors and eco-tourism businesses.
- The government has given legal protection to the area.



# Construction Site Management





A very poorly managed site with several hazards

## KEEP CONSTRUCTION SITES FREE OF HAZARDS

### WHY ?

- Poorly managed construction sites pose environmental risks.
- Waste materials, such as fuels, oil and grease, can contaminate the soil and the groundwater.
- Waste materials can also be a hazard for the people living in the vicinity, especially children.
- Unattended equipment and unsecured materials may be unsafe.
- Ponding water is always a health risk.

### HOW ?

- Remove the waste materials to more secure place and organize it neatly
- Make a sign on material which may contains hazard



## REDUCE AND CONTROL NOISE

### WHY ?

- Excessive noise can affect human health.
- Loud noise is a great nuisance.

### HOW ?

- Use proper equipment, such as mufflers on gensets and engines.
- Use noise-reducing insulation on buildings, such as for a diesel genset.
- Operate noise-generating facilities only during day-time hours.
- Do not locate noise-generating facilities close to sensitive areas such as:
  - o clinics or hospitals.
  - o schools.



A simple way to control dust by water sprinkling

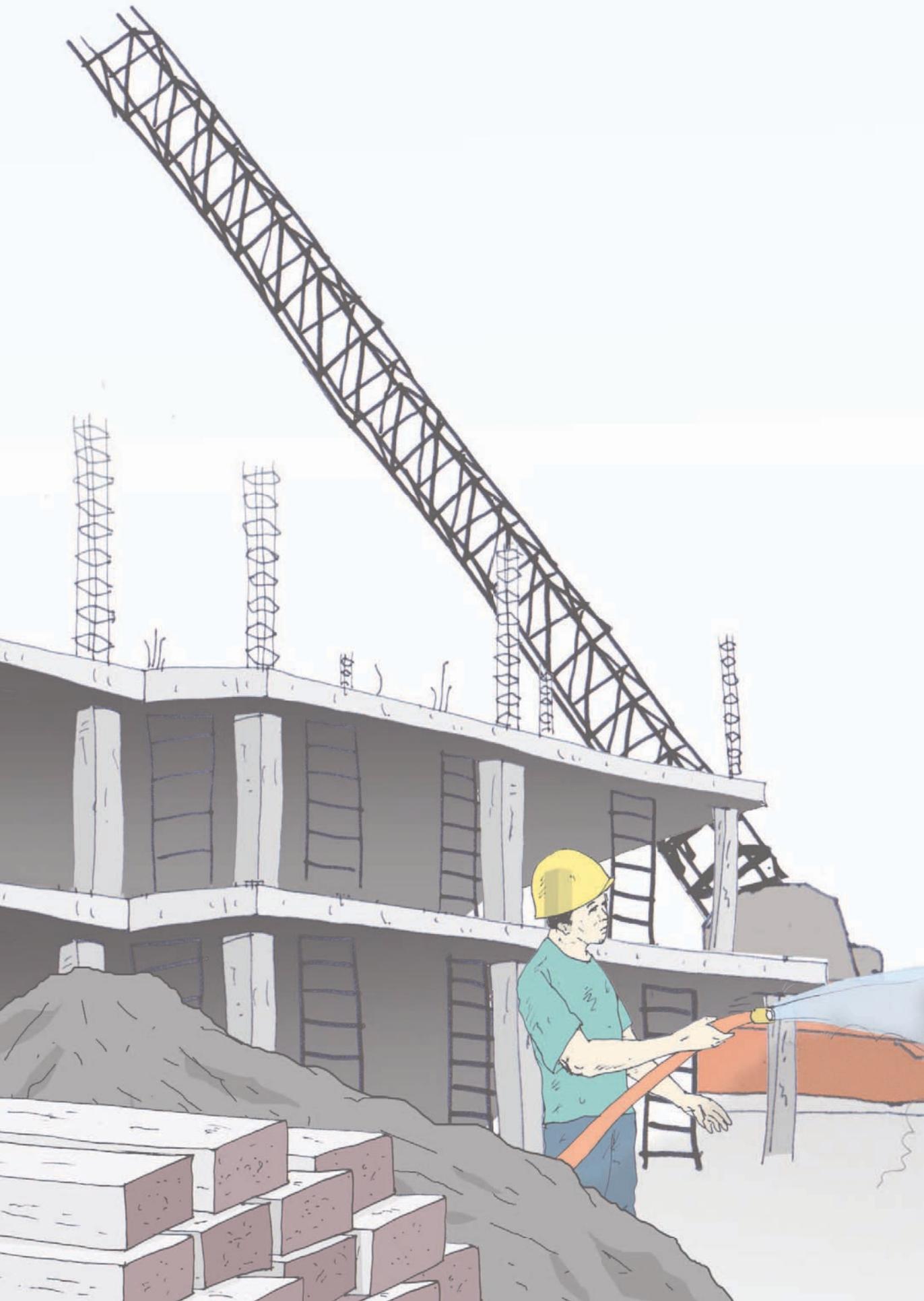
## MAKE EFFORTS TO CONTROL DUST DURING CONSTRUCTION

### WHY ?

- Dust is a potential health problem for some people, especially longer exposure to dust poses a health risk.
- Dust is a great nuisance to the entire community.
- Dust affects yards and gardens, and penetrates building and houses.

### HOW ?

- Use water sprinkling to control dust.
- Cover materials that produce dust.
- Avoid or at least limit activities that produce a lot of dust.
- If permanent roads through a housing area produce a lot of dust, use bitumen to seal the gravel surface and thereby control dust.



# Roads



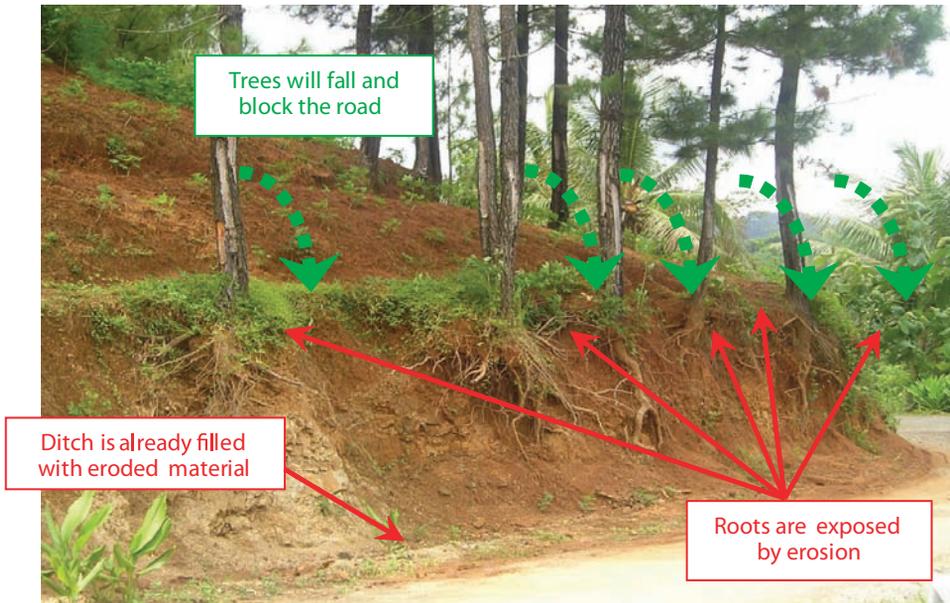


This road is already causing erosion problems

## AVOID BUILDING ROADS THROUGH PRIMARY FORESTS

### WHY ?

- New roads into primary forest can cause many problems, such as:
  - Open up the forest to illegal logging.
  - Give access to illegal mining.
  - Forest clearing for agriculture.
  - Erosion of soils.
  - Damage to the watershed.
  - Give access to illegal hunting.
  - Endanger rare species of animals.
  - Destroy special habitat and fragile ecosystems.



The erosion of this slope is in an advanced stage

## PROTECT SLOPES FROM EROSION

### WHY ?

- Steep, unprotected bare slopes are prone to erosion.
- Falling trees are a hazard for all road users.
- Eroded materials blocked the ditch on the up slope side causing drainage problems, potentially damaging the road surface.

### HOW ?

- Reduce side slopes.
- Terrace side slopes.
- Divert water from recharge side slopes.
- Add slope protection with vegetation or bioengineering measures.
- A low retaining wall could be built and the slope be cut back.



Fast-growing grass was planted on cut and embankment slopes of this road

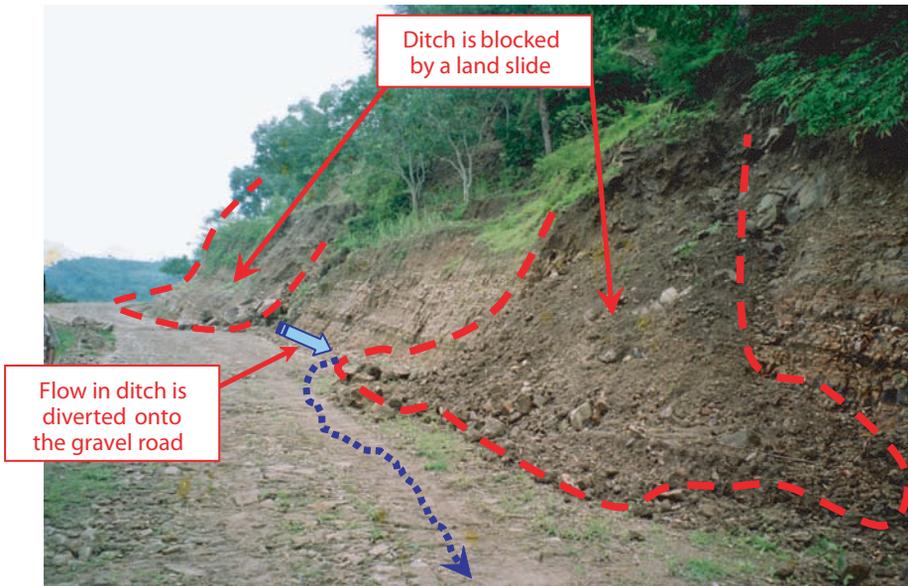
## REDUCE SLOPE EROSION

### WHY ?

- Over time or in heavy rainfalls slopes can be eroded easily.
- In some cases steep slopes can be washed out by progressive erosion.
- Ditches and roads can be quickly filled with sediment causing blockages.

### HOW ?

- Plant locally available, fast-growing grass on slopes prone to erosion.
- Some grasses grow quickly and have deep roots that help to stabilize the slope.
- The grass plants protect the soil from erosion by rain and runoff.
- Ask the community and / or local or regional experts which grass varieties are best suited for erosion prevention.
- Grass planted on the bare slope requires organic fertilizer and watering.



Landslides have blocked the ditch and may soon block the road

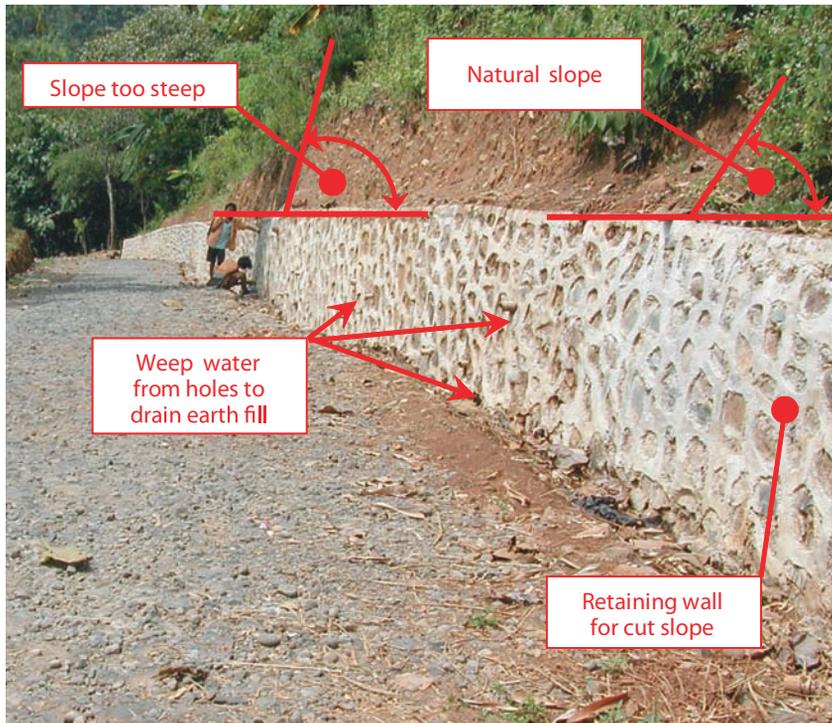
## PREVENT LANDSLIDES ON CUT SLOPES

### WHY ?

- Landslides can block ditches and water will flood the road during heavy rainfall events.
- Landslides occur when the slope is too steep in sandy soil.
- During the rainy season the risk of land slides is higher, because adding its weight to the forces causing instability.

### HOW ?

- Cut back the slopes in areas where land slides tend to happen frequently.
- Build a retaining wall at the lower part of the unstable slope.
- Build a crib at the toe of the slope, together with bioengineering plantings.
- Use bioengineering plantings on the steep slope in the long term.



Retaining wall for cut slope

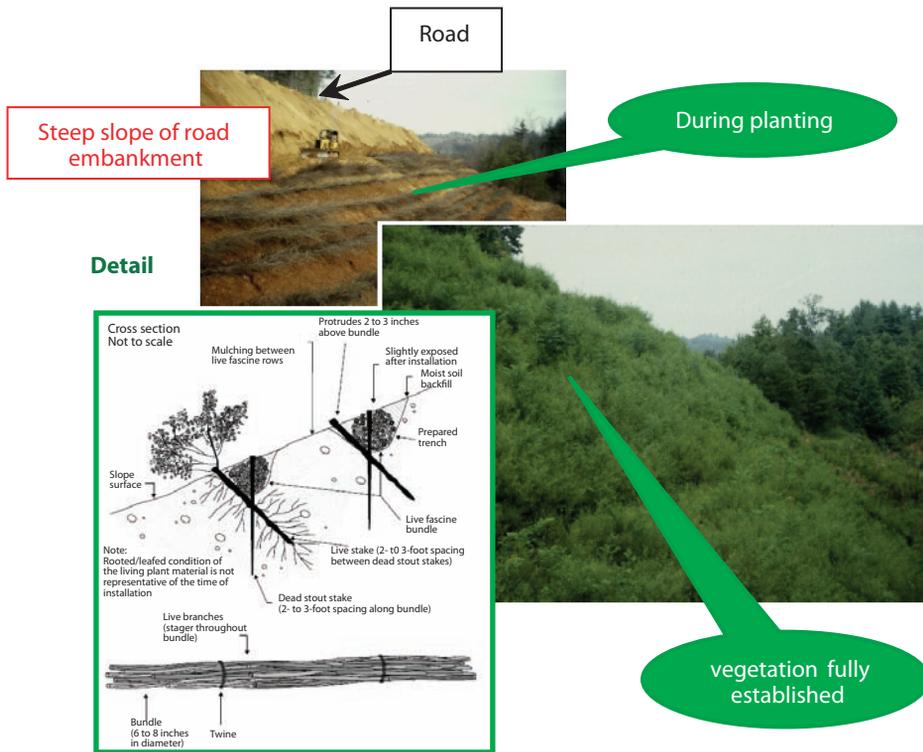
## USE RETAINING WALLS TO STOP LANDSLIDES

### WHY ?

- If the cut slope is too steep, build a retaining wall at the toe of the slope is cheaper than extensive earth works.

### HOW ?

- Weep holes should be filtered to keep soil behind the wall.
- The slope above the wall must be at the natural slope.
- Keep the weep holes clear to allow drainage from behind the wall.
- A solid foundation is essential for a well built retaining wall.



Schematic view of a bioengineering installation, and BEFORE and AFTER pictures

## STOP SLIDING AND ERODING SLOPES WITH BIOENGINEERING

### WHY ?

- Landslides on road cuts and embankments could cause a road to be partially or completely lost and communications would be cut off.
- Progressive erosion and slides could damage the roads and ditches.
- Bioengineering is a “natural” solution and the slope will be green in a short time as illustrated above.
- Bioengineering uses live plant materials to stabilize slopes with their roots; the plants also protect the slope against erosion.
- Different techniques are available for use, depending on the conditions.
- The local community and / or local or regional experts might know which plant varieties are best suited for this application.



Landslides happened on the downslope and upslope side of the road

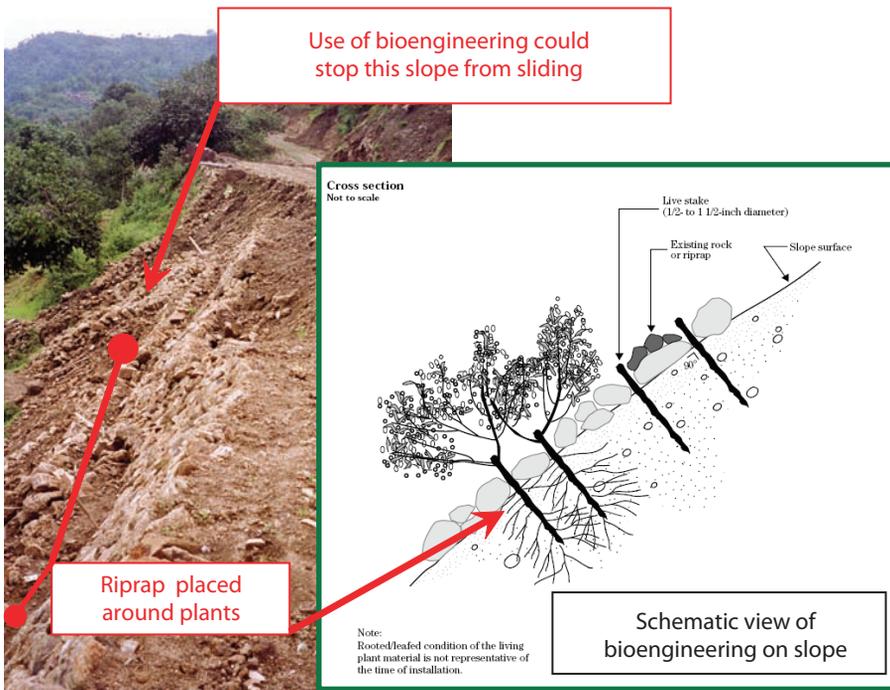
## PREVENT LANDSLIDES ON ROAD CUTS AND EMBANKMENTS

### WHY ?

- A landslide can block the ditches and drainage, potentially damaging the road through erosion or washouts.
- A landslide can block road drainage.
- A road may be completely lost when a major landslide happens.
- Communication and transport link can be cut.
- Restoration of the road would be very costly.

### HOW ?

- Cut back the slope to make it less steep (this is not always possible).
- Build a retaining wall at the toe of the unstable slope.
- Stabilize the toe of the slope with sand bags or similar measures.
- Use bioengineering measures to stabilize slope.
- Intercept drainage to prevent it from flowing into and over the slope.



This slope could be stabilized with bioengineering

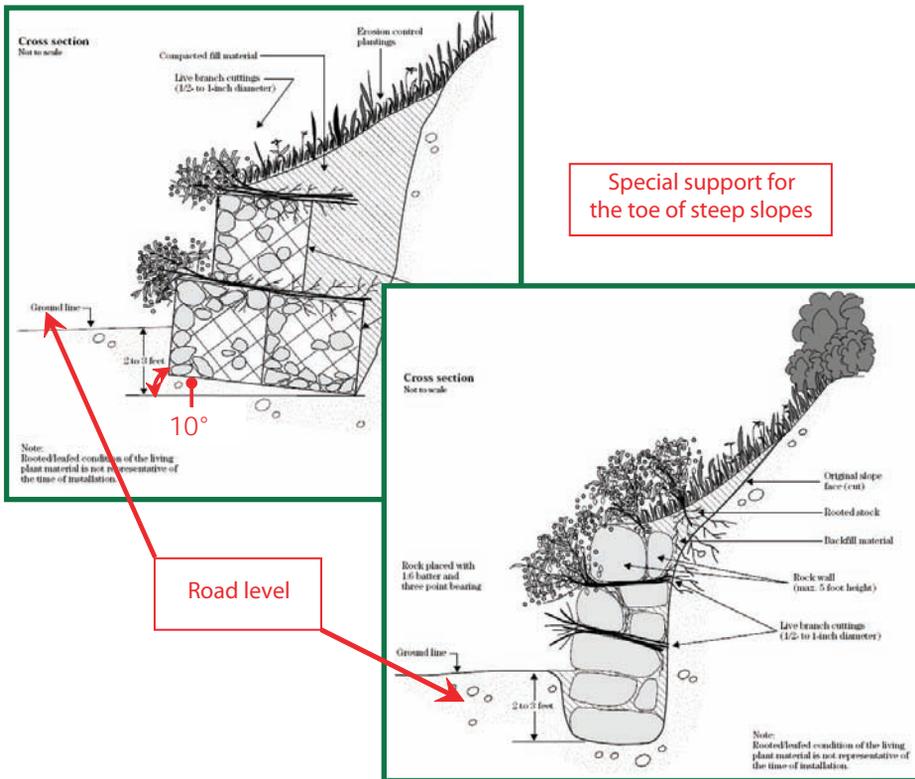
## STOP SLIDING AND ERODING SLOPES WITH BIOENGINEERING

### WHY?

- Landslides on road cuts and embankments could cause a road to be partially or completely lost and communication would be cut off.
- Progressive erosion and slides could damage the surrounding area.
- It's a "natural" solution and the slope will be green in a short time.

### HOW ?

- Bioengineering uses live plant materials to stabilize slopes with their roots; the plants also protect the slope against erosion.
- Quick-growing local tree cuttings are planted as shown above.
- Rocks (riprap) can be used in addition to protect the slope.
- Ask the community and / or local or regional experts which plant varieties are best suited for this application.



Two different methods of bioengineering support at the toe of steep slopes

## STOP SLIDING SLOPES WITH TOE SUPPORT AND BIOENGINEERING

### WHY ?

- Landslides on road cuts and embankments could cause a road to be partially or completely lost and communication would be cut off.
- The toe of a slope needs special support to prevent it from sliding.

### HOW ?

- Place large rocks or rock-filled gabions at the toe of unstable slopes.
- Use live plant materials (=bioengineering) to reinforce and stabilize the toe protection.
- Ask the community and / or local or regional experts which plant and grass varieties are best suited for this application.



Gabions are used to build a stable embankment slope

## USE GABIONS TO STABILIZE EMBANKMENT SLOPES

### WHY ?

- Embankment slopes, if too steep or in unstable soil material, may slide or may be eroded.
- Gabions are a fairly low cost method for stabilizing steep, potentially unstable or erodible slopes.
- Gabions use mostly local material and labour.

### HOW ?

- Use gabion baskets, place on slope and fill with locally available rocks.
- Build gabion "wall" in steps, but not too steep (for reasons of stability).
- Make sure that road drainage does not run down the slope.



A landslide totally blocked a road and almost buried a truck

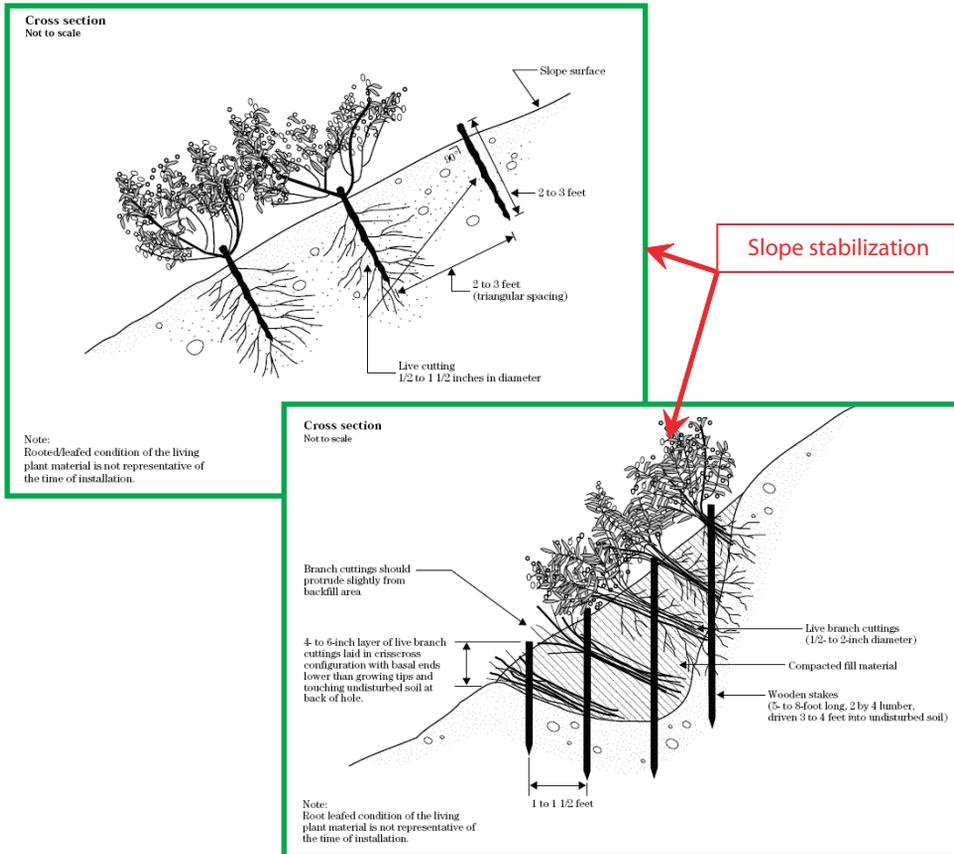
## NO ROAD CONSTRUCTION IN STEEP UNSTABLE SLOPES

### WHY ?

- Unstable slopes, when causing a landslide, are a hazard to traffic and people.
- Heavy rains usually set off landslides when the soils in the slope become saturated with water.
- Water runoff from further above can also cause landslides.
- Retaining walls or bioengineering cannot stop large landslides.

#### *Note:*

Before locating roads or other infrastructure, check for signs of instability, trees leaning down, traces of previous slides.



Schematic views of different bioengineering techniques

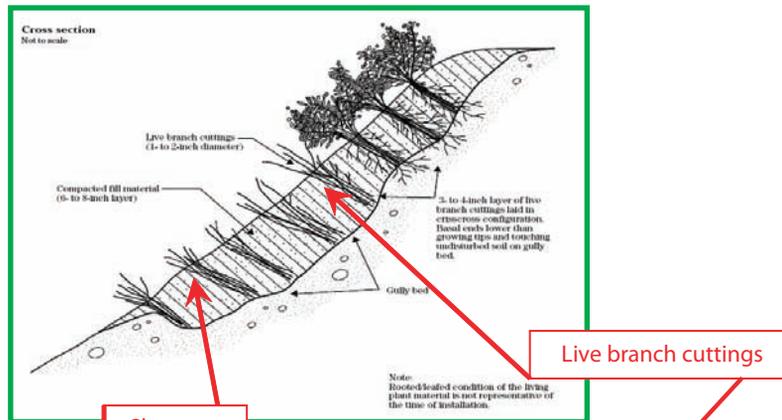
## STOP SLIDING AND ERODING SLOPES

### WHY ?

- Landslides on road cuts and embankments could cause a road to be partially or completely lost. Progressive erosion and slides could damage the road and ditches.

### HOW ?

- Use live plant materials to stabilize slopes with their roots; the plants also protect the slope against erosion.
- Different techniques are available for use, depending on the conditions.
- Ask the community and / or local or regional experts which plant varieties would be best suited for this application.



On very steep slopes it is better to cut “steps” into the slope before planting

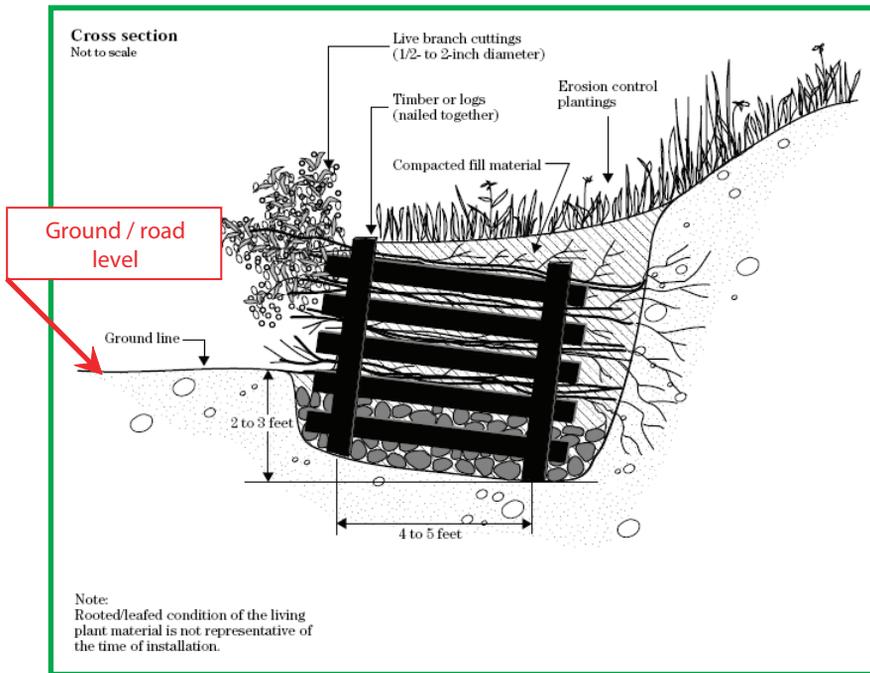
## STOP SLIDING AND ERODING SLOPES WITH BIOENGINEERING

### WHY ?

- Landslides on road cuts and embankments could cause a road to be partially or completely lost.
- Transport and communication would be cut off.
- Progressive erosion and slides could damage the surrounding area.
- It’s a “natural” solution and the slope will be green in a short time.

### HOW ?

- Bioengineering uses live plant materials to stabilize slopes with their roots; the plants also protect the slope against erosion.
- Quick-growing local tree cuttings are planted as shown above.
- As shown above, small “steps” like terraces, may be cut on very steep slopes before planting the cuttings.



Use of crib structure in combination with bioengineering plantings

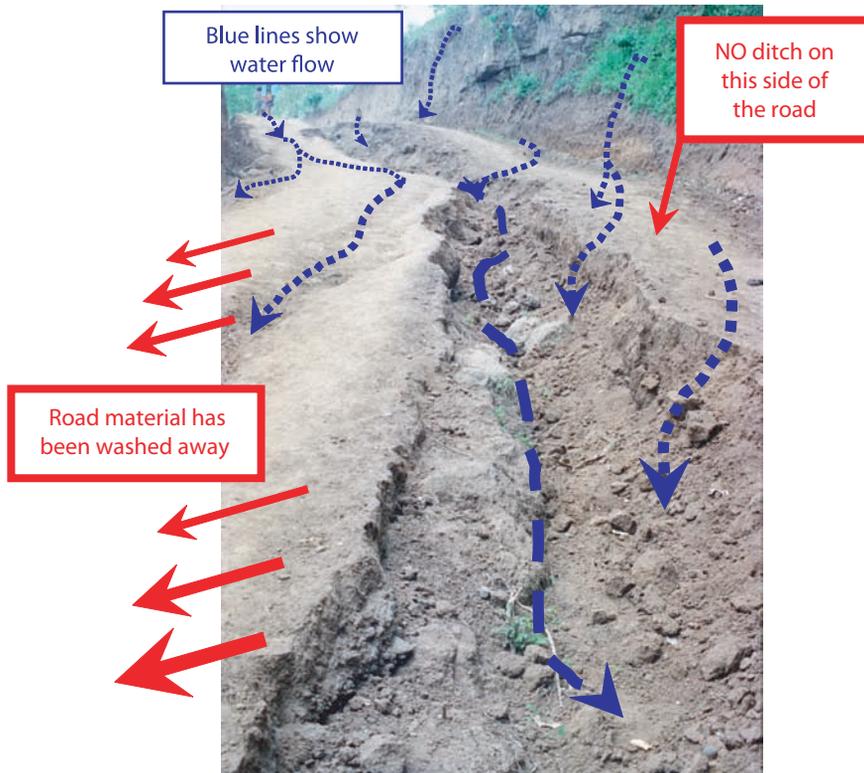
## USE CRIBS TO STOP SLIDING SLOPES

### WHY ?

- The toe of an unstable slope is the most critical spot.
- Stabilizing the toe will help to stop a slope from sliding.
- A timber crib gives extra structural support to the toe of the slope.
- If the toe cannot slide, the slope will remain stable.

### HOW ?

- Use a timber crib structure reinforced by plantings to stabilize the toe of an unstable slope.
- Set the timber crib in a stone or rock base, then fill with soil and plant live cuttings of branches.



Water that was not managed has eroded its own ditch and thereby damaged the entire road

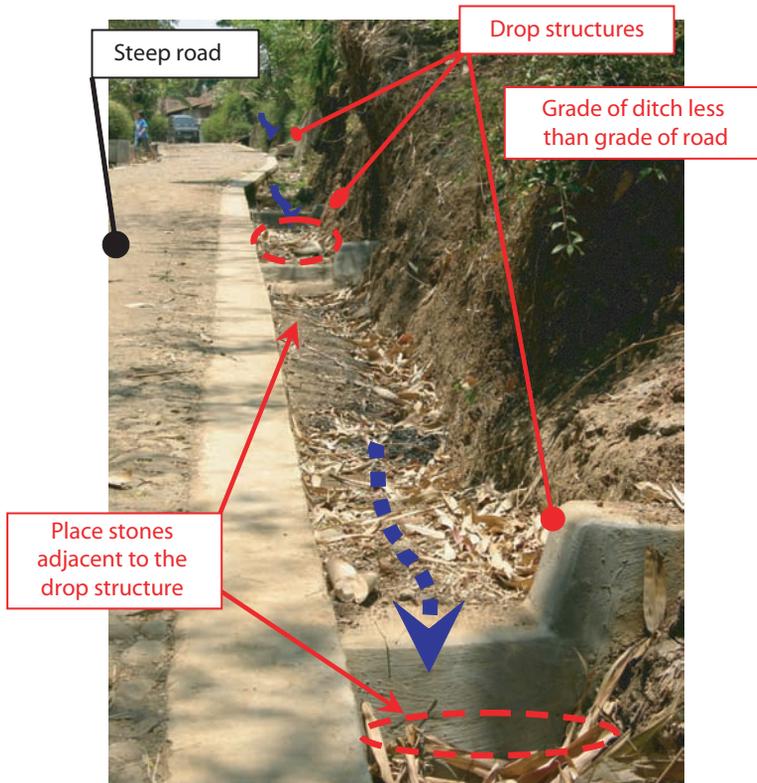
## STOP DITCH (AND ROAD) EROSION

### WHY ?

- Water must be drained to and down through the side ditches.
- Water flowing over a gravel road surface can cause severe gully erosion, especially on steeper road grades.
- Such erosion washout could also happen when ditches are too small or completely blocked.

### HOW ?

- Adequate ditches should have been built when the road was constructed.
- Rebuild the road section in such a situation.
- Make sure there are ditches and cross drainage to remove water from road.
- Fill gullies slightly higher than road (after compaction).



Concrete drop structures were built to halt ditch erosion

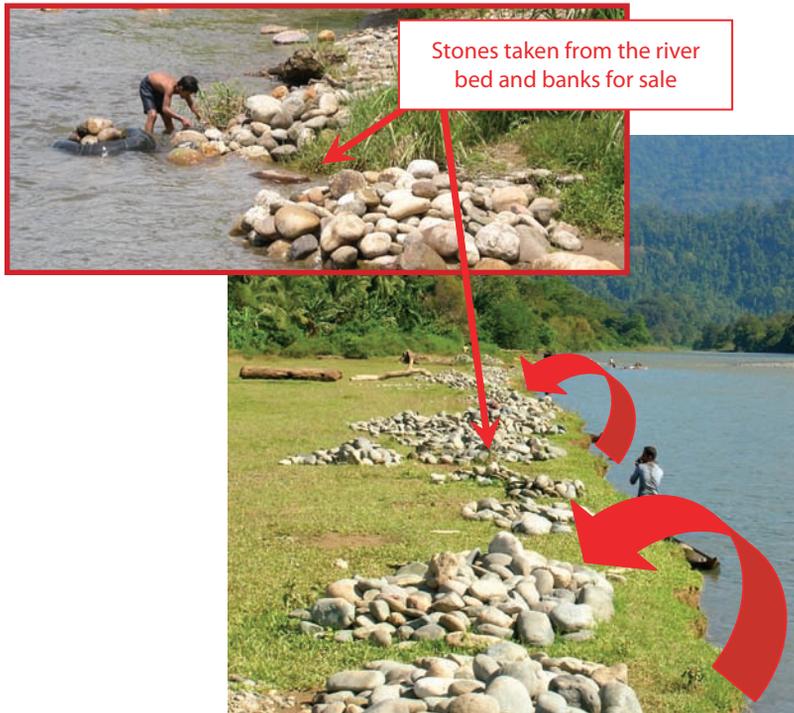
## PROTECT DITCHES FROM EROSION

### HOW ?

- Build drop structures on regular intervals.
- The velocity of the flowing water is reduced and it cannot erode the ditch.
- Distance between drop structures depends on the grade of the road.
- The steeper the grade the more drop structures must be built.
- If there is too much flow in the ditch, install a culvert to “downslope” side.
- Loose rocks adjacent to the drop structure help to dissipate the erosive force of the flowing water.
- Drop structures work for earth and for lined ditches but if grade of earth ditch is too steep it must be lined.

#### Note:

Due to the lower flow velocity, there may be more sedimentation → clean the ditch periodically.



River rocks to be sold for use in road construction

## DO NOT DIG SAND, GRAVEL OR ROCKS FROM RIVERS FOR ROAD CONSTRUCTION

### WHY ?

- Extraction of sand, gravel and stones from the river bed and banks can seriously affect the flow pattern of the river.
- The river may erode other sections of its bed and banks and thereby cause serious problems elsewhere.
- The river may scour around bridge piers and abutments and endanger their stability.
- The river may even change its course and bed, potentially causing serious problems to human infrastructure or productive areas.

#### Note:

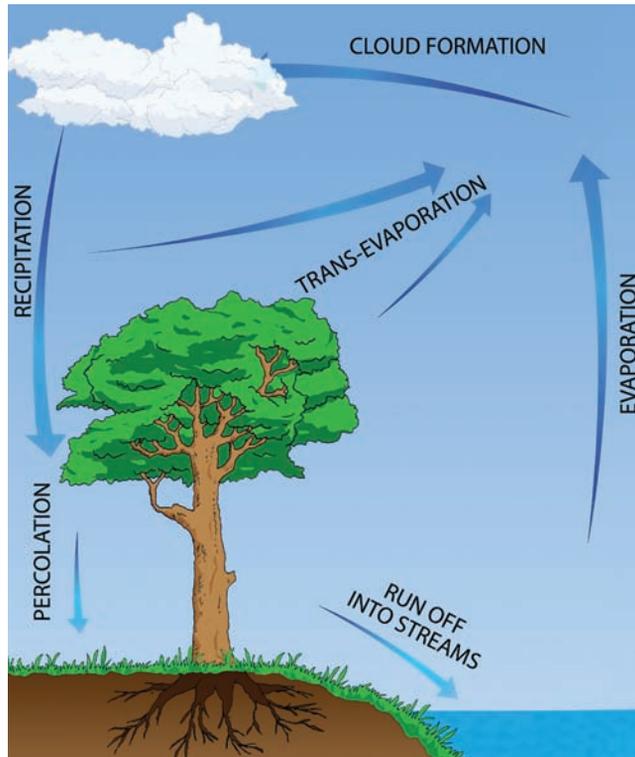
Sand and gravel extraction from old, dry river beds is not a problem if permission from land owner(s) has been obtained.



# Water Supply



## Hydrologic cycle



A simple schematic of the hydrologic cycle showing the central importance of trees

### ALWAYS PRACTICE GOOD WATERSHED MANAGEMENT

#### WHY ?

- A well-managed watershed will provide a good supply of water.
- Intact forests are the best cover for a watershed because forests:
  - Store water (together with the soil).
  - Release water slowly during the dry season.
  - Help to prevent or reduce floods.
  - Decrease erosion and sedimentation when there is ground cover.
- Good water supply is equally important for
  - Drinking and clean water supply for communities.
  - Irrigation use.
  - Hydro power and mini hydro power generation.
  - Use by economic activities and industry.



Water is our  
natural treasure

Pristine forest watersheds “produce” good water supply

## PROTECT AND MANAGE FORESTED WATERSHEDS

### WHY ?

- Forested watersheds supply water for human use.
- Healthy watersheds also provide water for irrigation use.
- Mountainous and hilly watersheds also provide water for hydro power, including mini hydro system that generate electricity for rural communities.
- Healthy watersheds will also provide enough water during the dry season.
- Upper watersheds often recharge groundwater resources.

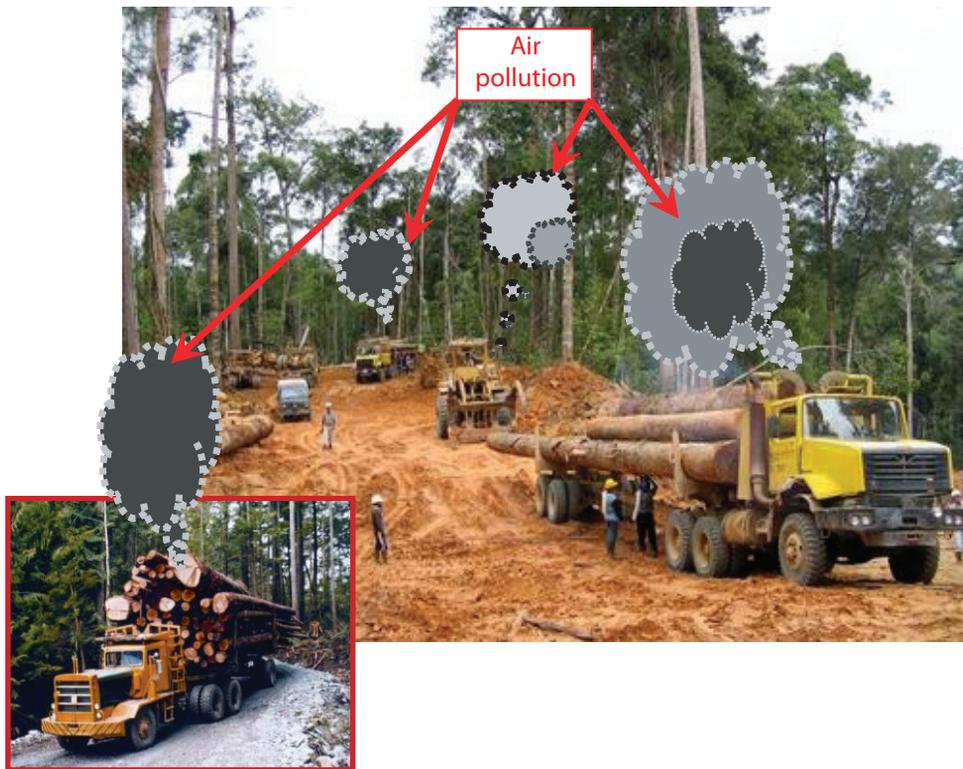


Forest clearing for hillside planting of crops

## DO NOT ALLOW OUTSIDERS CLEAR LARGE FOREST AREAS IN HILLY AND MOUNTAIN WATERSHEDS

### WHY ?

- The trees in the forest together with the soil hold back runoff and store it for slow release into springs and streams.
- Forests help to recharge the groundwater.
- Without tree and vegetation cover, the soils will be easily eroded.
- Erosion of the slopes will cause sedimentation in streams and creeks downstream.
- Sedimentation will decrease water quality and could cause flooding.
- The fertility of soils in logged-off areas is usually limited.



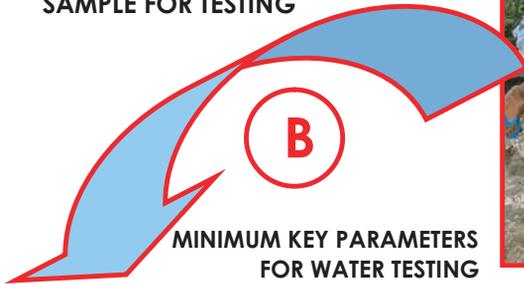
Massive unsustainable logging in primary forest  
Note the major earth movements in the larger picture

## PROTECT PRIMARY FORESTS IN WATERSHEDS

### WHY ?

- Forest trees, together with the soil, act like a sponge → a water reservoir.
- An intact forest cover will assure a reliable water supply, even during the dry season.
- Forests protect the watershed from erosion and the downstream rivers from sedimentation.
- Primary forests are a valuable natural resource, yielding many non-forest products.

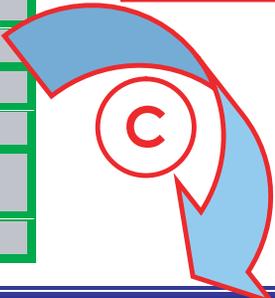
**BEFORE USING A NEW WATER SOURCE TAKE A SAMPLE FOR TESTING**



**MINIMUM KEY PARAMETERS FOR WATER TESTING**

TESTING DONE BY COMMUNITY / FACILITATOR	
PARAMETER	REMARKS
TASTE	salty, bad, other
ODOUR	foul, rotten, other
COLOUR	visual test
TURBIDITY	visual test (or <1.0 NTU by lab) – proxy for TSS test
TEMPERATURE	using thermometer

Have the water tested – it's for **YOUR HEALTH**



**Notes:**

If high turbidity then sandfilter should be used

Nitrates may indicate other pollution such as bacteria, animal waste or fertilizer

Also test for bacteria at regular intervals, say 6 months

TESTING TO BE DONE BY DEPKES KABUBATEN LABORATORY	
PARAMETER	REMARKS
TOTAL COLIFORM	<10 MPN (or use H2S strip as indicator)
pH	between 6.5 and 8.5
ARSENIC	<0.01mh/L (only in groundwater in some region)
NITRATE	<10 mg/L in groundwater – health risk for babies



This water source is protected against entry by animals and unauthorized persons

## PROTECT WATER SOURCES FROM POLLUTION AND CONTAMINATION

### HOW ?

- The fence around this spring capture shows how the valuable water source can be protected from potential pollution and contamination.
- Make sure that the gate is locked and only authorized persons get the key.
- The stability of the fence has to be checked periodically.

#### *Note:*

The capture basin should be covered to prevent dead leaves and fruit from falling into it.



A good example of sharing a water source between a number of users

## SHARE A SCARCE WATER SOURCE BETWEEN DIFFERENT USERS

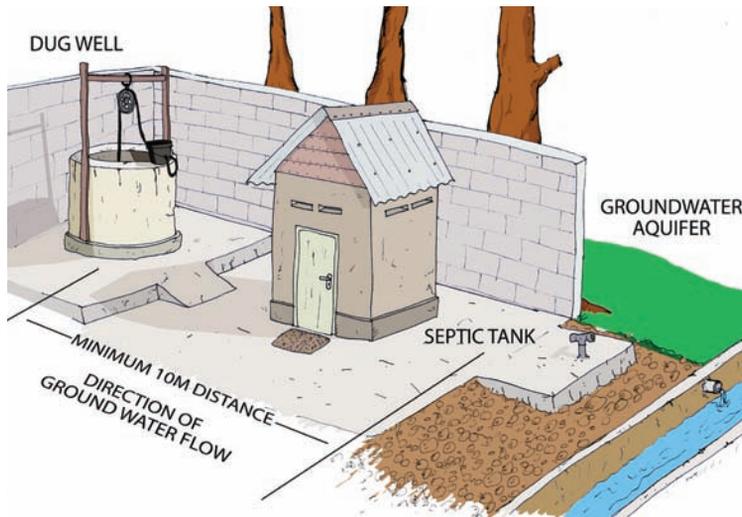
### WHY ?

- Water supply is a basic human right and water is a public resource.
- Especially in water-scarce areas water must be shared equitably between different users.
- Prior users of a source must be respected and their rights preserved.

### HOW ?

- Negotiate an agreement between the different users to share the common source equitably.
- Seasonal use, such as for irrigation, must be considered.
- If necessary, use an independent outside mediator to reach agreement.
- All parties sign the agreement and stick to it.

## Distance between well and septic tank



This schematic section shows the right way to site a dug well in relation to septic tank

### LOCATE DUG WELL A SAFE DISTANCE FROM SEPTIC TANK

#### WHY ?

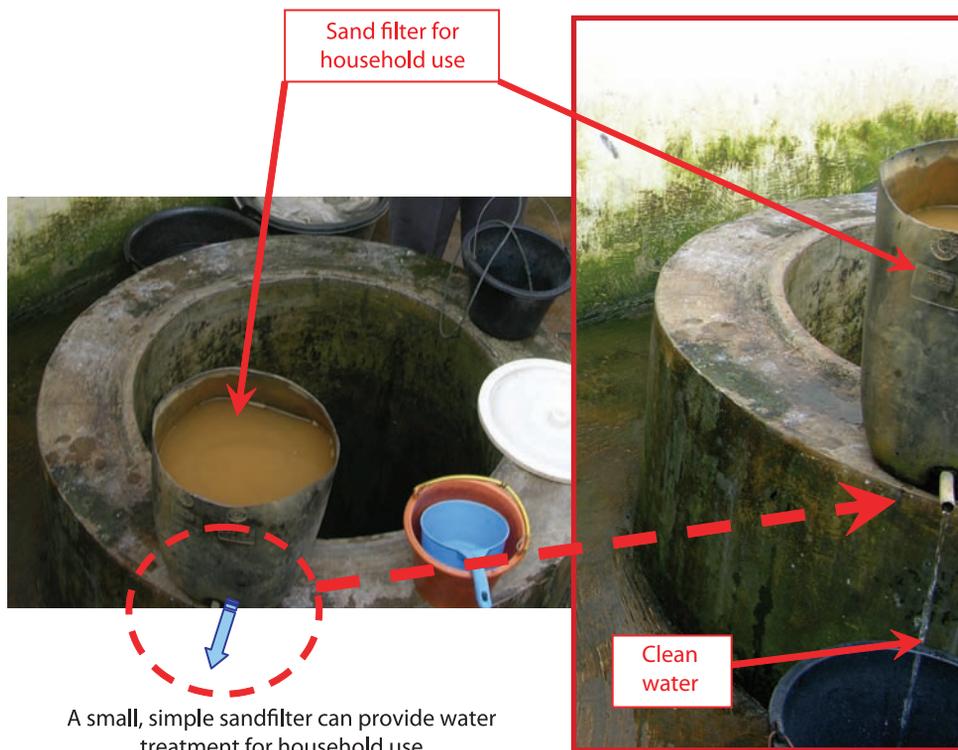
- The minimum distance must be 10 meters, but more is better.
- Partially treated effluent from septic tank can easily pollute the groundwater in the dug well – even after many years.
- Septic tank may leak and raw wastewater may slowly pollute the groundwater.
- Surface water pollution from around the septic tank may percolate into the groundwater.

#### HOW ?

- Respect minimum distance of 10 meters.
- Check the likely direction of groundwater flow and locate septic tank **DOWNSTREAM** from dug well.

#### *Note:*

The direction of groundwater flow can be determined from the overall slope of the ground surface, or if near a river, from the flow direction of the watercourse.



## USE HOUSEHOLD LEVEL WATER TREATMENT WHERE NEEDED

### WHY ?

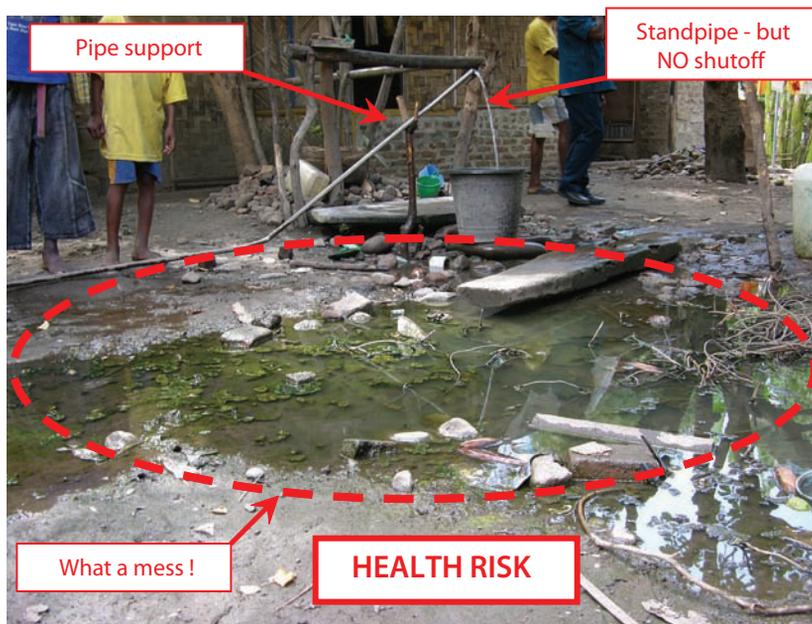
- The public water supply is not always clean enough and free from (bacteriological) contamination.

### HOW ?

- Small and simple household level treatment is available such as:
  - o Sand filters (as shown above).
  - o Ceramic filters.
  - o Solar disinfection reduces bacteria significantly.
  - o Carbon filters remove colour, such as from peat water.
  - o Boiling of water is the traditional household level treatment but it uses more energy.

#### Notes:

1. Bio-sand filters are better, they need a specially built container.
2. Solar disinfection needs only clear water bottles left in the sun for a day.



There is clean water supply in the yard BUT a big mess because there is NO shutoff faucet and NO drainage

## ALWAYS PROVIDE GOOD DRAINAGE AT PUBLIC AND YARD TAPS

### WHY ?

- An open or missing faucet can spill a lot of water in a day.
- Valuable water that other users may need is wasted.
- If there is no proper drain for the wastewater it will create a muddy mess around the tap or in the yard.
- Standing water will become a mosquito breeding ground.
- Standing water is a big inconvenience for all users.

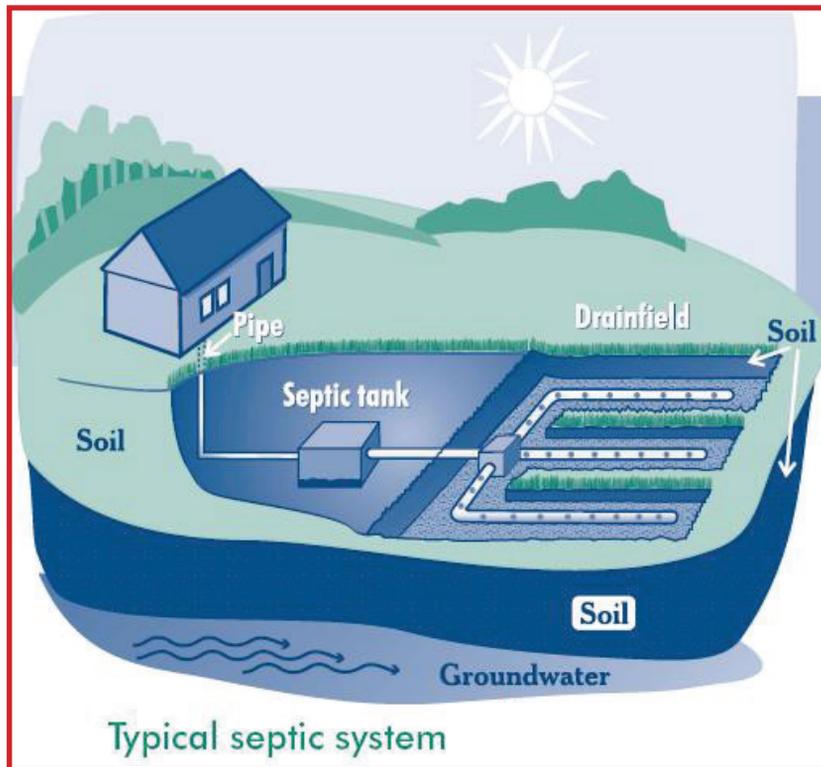
### HOW ?

- Make sure there is a WORKING faucet installed and that it is turned off when water is not needed.
- Build a concrete pad with a curb around the tap to contain and collect wastewater and drain away to a ditch, garden, field or soak away pit.

*Note:* Wastewater can be recycled and used for nearby garden or field.

# Sanitation



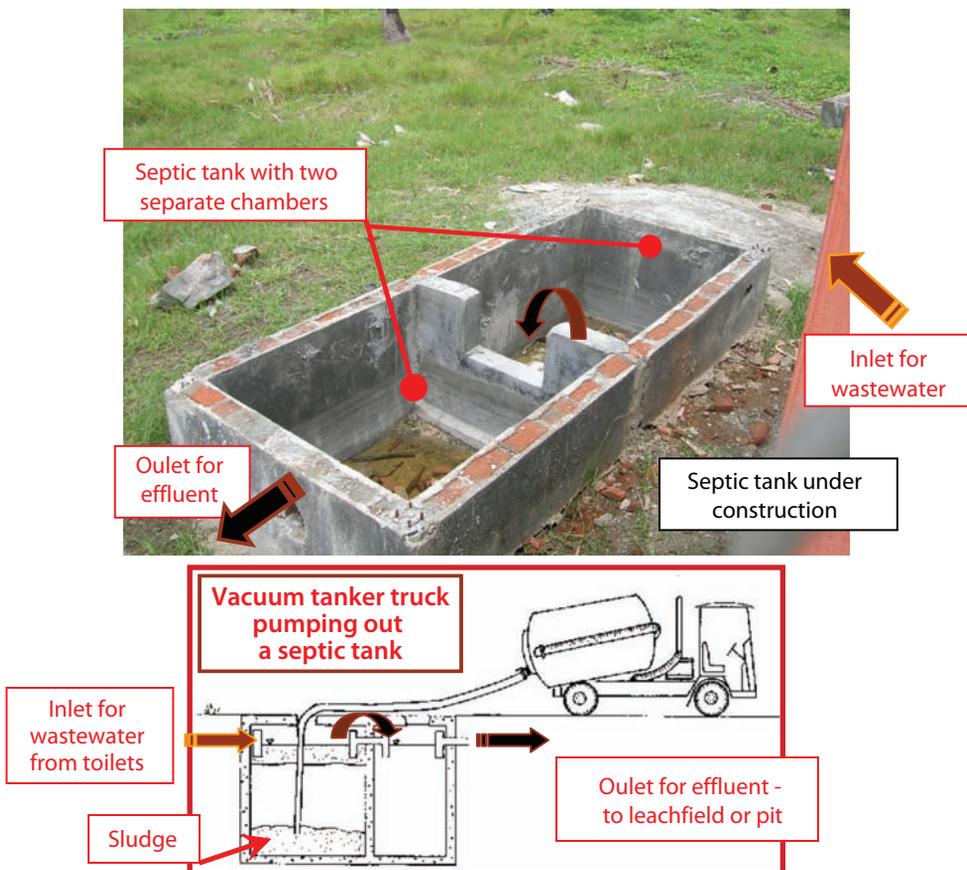


Schematic diagram of a complete septic tank system

## BUILD A COMPLETE SEPTIC TANK SYSTEM AND MAKE SURE ALL PARTS OF THE SYSTEM ARE WORKING PROPERLY

### WHY & HOW ?

- Untreated wastewater can spread infection and disease --> HEALTH RISK.
- Septic tank effluent can pollute the groundwater or surface water.
- Effluent from the septic tank is only partially treated and must be piped to a leachfield (drainfield), a vegetated leachfield or at least to a soak away pit.
- Finally, the septic tank must be inspected periodically and the accumulated sludge must be emptied every few years.



Desludging has to be done when sludge level has built up more than halfway in the first chamber

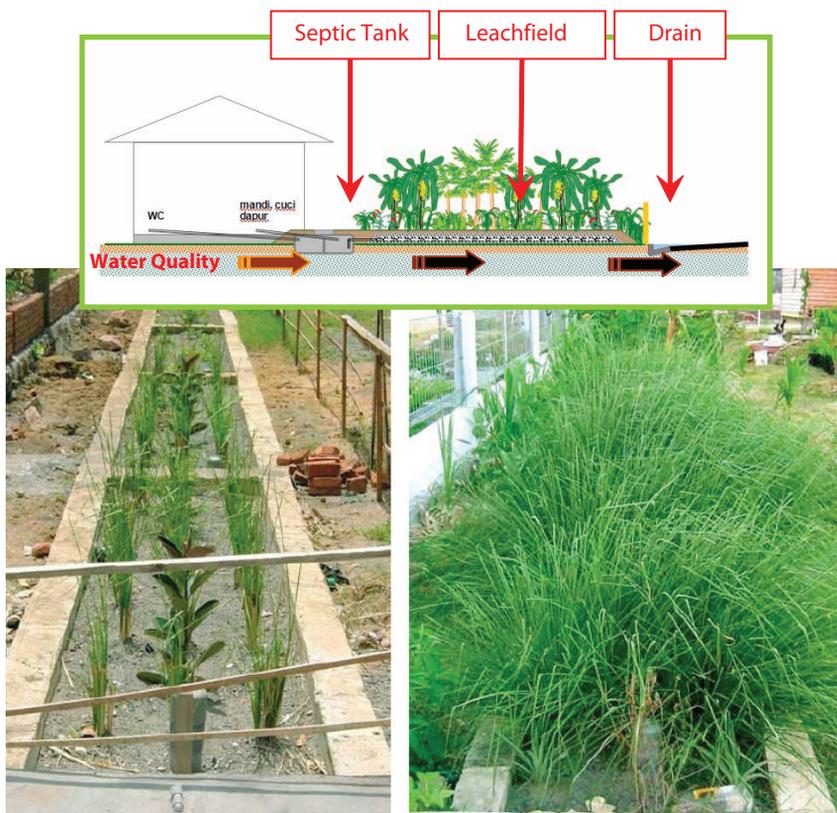
## USE SEPTIC TANKS FOR WASTEWATER TREATMENT DISPOSE OF EFFLUENT PROPERLY PUMP OUT SEPTIC SLUDGE PERIODICALLY

### WHY ?

- Untreated wastewater can spread infection and disease → **HEALTH RISK.**
- Partially treated effluent is still a threat to health and environment and pipe effluent to a leachfield or pit - **NOT** to an open drain or surface water body.

### HOW ?

- A septic tank with two chambers will generally clean wastewater better.
- Septic tanks must be inspected regularly through the access manhole.
- Sludge settles in septic tank and must be pumped out by a vacuum tanker periodically → the sludge must be disposed at a designated dump site.



Example of septic tank effluent treatment by vegetated leachfield

## TREAT SEPTIC TANK EFFLUENT BEFORE FINAL DISPOSAL

### WHY ?

- Partially treated effluent from septic tanks is still a threat to health and the environment.
- Septic tank effluent will pollute groundwater or surface water, especially if piped to an open drain.

### HOW ?

- Pipe the septic tank effluent to:
  - o An underground leachfield.
  - o A vegetated leachfield (as shown above).
  - o A pit (for soaking away).
  - o Do not discharge septic tank effluent to an open drain or other surface water.



A neat looking, clean and well equipped toilet

## KEEP TOILETS CLEAN

### WHY ?

- Hygiene is much improved if toilets are regularly cleaned.
- The community likes to use a clean & attractive toilet.
- If a toilet is found clean, the next user is more likely to keep it clean.

#### Notes:

1. A properly working water supply is essential for keeping toilets clean.
2. Cleanliness is assured if clean up after themselves and / or if a paid attendant has been assigned to cleaning the toilets.

# Solid Waste Management





A suitable container for waste collection  
Waste disposal at a designated dump site must also be arranged

### COLLECT GARBAGE → Do not litter

#### WHY ?

- Scattered garbage attracts insects (flies , mosquitos), vermin and stray animals --> **HEALTH RISK.**
- Garbage, if not properly disposed, smells bad and is big nuisance.
- Roads, public areas and the natural environment are NOT dumping areas.

#### HOW ?

- A well built & conveniently located waste container gives the community the opportunity for proper waste disposal.
- Educate the community how and where to dispose their garbage.
- Also educate the community about the damage to the environment caused by uncontrolled waste disposal.
- Arrange for or organize a pick-up a service to remove garbage when the container is full.
- Alternatively, designate a dumping area for the garbage that has been collected.



Waste separation at the household level allows recycling and also saves valuable resources

## SEPARATE WASTE AT SOURCE FOR RECYCLING

### WHY AND HOW ?

- Waste, not separated and collected, will be an environmental problem.
- Recyclable waste is a resource and potential source of income.
- Collect the waste in separate containers → WET & DRY for recycling.
- Train and assign people to be responsible for waste collection & disposal
  - WET waste (organic) for composting,
  - DRY waste (paper, glass & metal) for recycling,
  - OTHER waste for disposal.
- Recycling has economic potential.



**You must separate your garbage !**

**Solid waste separation makes my job easier and I can make some additional income**



Waste separation at the household level allows recycling and also saves valuable resources

## SEPARATE WASTE AT SOURCE FOR RECYCLING

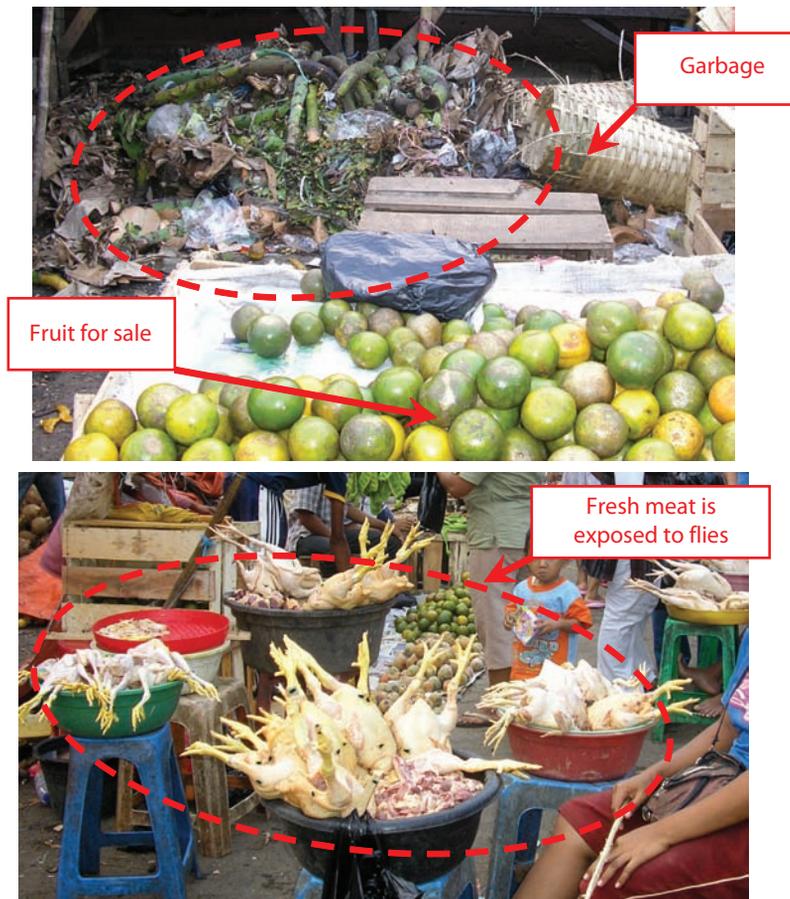
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  - OTHER waste for disposal.



# Markets





Fresh food close to garbage and meat exposed to flies --> a serious lack of hygiene

## KEEP MARKETS VERY CLEAN

### WHY ?

- Fresh food, especially raw meat, must not be exposed to flies and dirt.
- Infection can easily be spread by flies.
- Uncollected garbage attracts vermin and stray animals that could carry diseases.
- Garbage at a market is unsightly and unattractive – a big nuisance.



An example of lots of flies and poor hygiene at a market

## CONTROL FLIES AND OTHER VECTORS, ESPECIALLY AT MARKETS

### WHY ?

- Flies are vectors that carry diseases, such as diarrhea.
- Flies are an indicator of poor hygiene.
- Flies are a nuisance, especially at markets.

### HOW ?

- Cover food, especially fresh food like meat.
- Remove or cover fly breeding spots like vegetable garbage piles, and animal and human waste.
- Educate traders and the community about effective vector control.



The lack of good drainage is not only a health risk but also a real nuisance to traders and customers

## RECYCLE MARKET WASTE THROUGH COMPOSTING

### WHY ?

- A lot of vegetable waste is generated at markets.
- Organic (vegetable) waste is a valuable resource.
- Composting can turn organic waste into a good soil conditioner with valuable nutrients, such as for gardens.
- Composting is a simple process that needs only air, moisture and periodic turning over.
- The sale of high quality compost can generate income → economic activities.
- The volume of garbage to be dumped can be reduced a lot.



A very clean toilet block – maybe because a user fee is being charged?

## KEEP MARKETS VERY CLEAN

### WHY ?

- Ponding water breeds mosquitoes that could carry malaria or dengue fever.
- Ponding water may be polluted from the market products.
- Ponding water may also contain untreated wastewater.
- Ponding water is a great nuisance and inconvenience for all market users.
- Ponding water gives the market a poor image → people may not come back.

### HOW ?

- Pave the market place.
- Build covered drains along the lanes.
- Slope floor for drainage.
- Drainage channels must lead to safe discharge.

Note:

Provision of drains may not be enough in the above example, it may be necessary to pave the market aisles.



Composting of organic waste can be done easily in Indonesia

## KEEP MARKET TOILETS VERY CLEAN

### WHY ?

- Cleanliness is especially important at public markets because many people meet and a lot of food is being handled.
- Toilets are very important at markets so that there is NO open defecation.
- Market toilets must have a functioning water supply so that people can wash their hands before handling food.

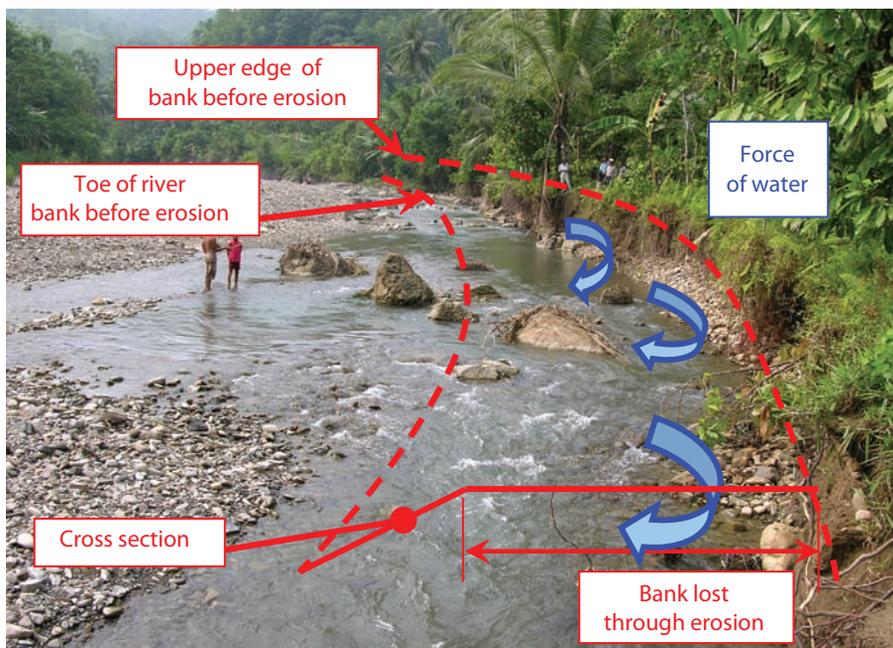
### HOW ?

- A user fee should be charged for the toilets to employ an attendant who can keep the toilets clean all the time.



# Rivers





Erosion of bank of a small river – note the outside bend of the river

## DO NOT BUILD CLOSE TO RIVER BANKS

### WHY ?

- Even smaller rivers have great erosive force and can wash out their banks – always on the outside bend of the bank.
- River bank protection measures are difficult and costly and often are not effective in any case.
- It is better to respect the force of the river and build infrastructure away from the river banks, especially the outside bend.



Bamboo staves and slats can also be used for bank protection on small streams or irrigation channels

## PROTECT STREAM BANKS FROM EROSION

### WHY ?

- Earth banks of streams are easily eroded by the erosive force of flowing water.
- Erosion is worse in the outside bends of rivers.
- Bank erosion also increases during flood events.
- Valuable agricultural land or even infrastructure can be lost to stream bank erosion.

### HOW ?

- On smaller streams and on earth irrigation channels natural materials such as locally available bamboo staves and slats can be used for bank protection with lower costs.



Two good examples of gabions used for river bank protection

## ALWAYS PROTECT STREAM AND RIVER BANKS FROM EROSION

### WHY ?

- Unprotected earth banks will easily be eroded by flowing water (or sometimes by wave action if along a beach).
- Banks are more likely eroded in the outside bends of rivers and during high flows.
- Valuable agricultural land and infrastructure could be lost due to erosion.

### HOW ?

- Use gabion wire baskets.
- Gabions are very flexible, and they can be stacked in several layers.
- Gabions use mostly local material and can be built by local labor.
- Gabions can be further strengthened by planting vegetation in them.
- Gabion must extend below the base of water flow.



A partially collapsed gabion wall along a steep river bank

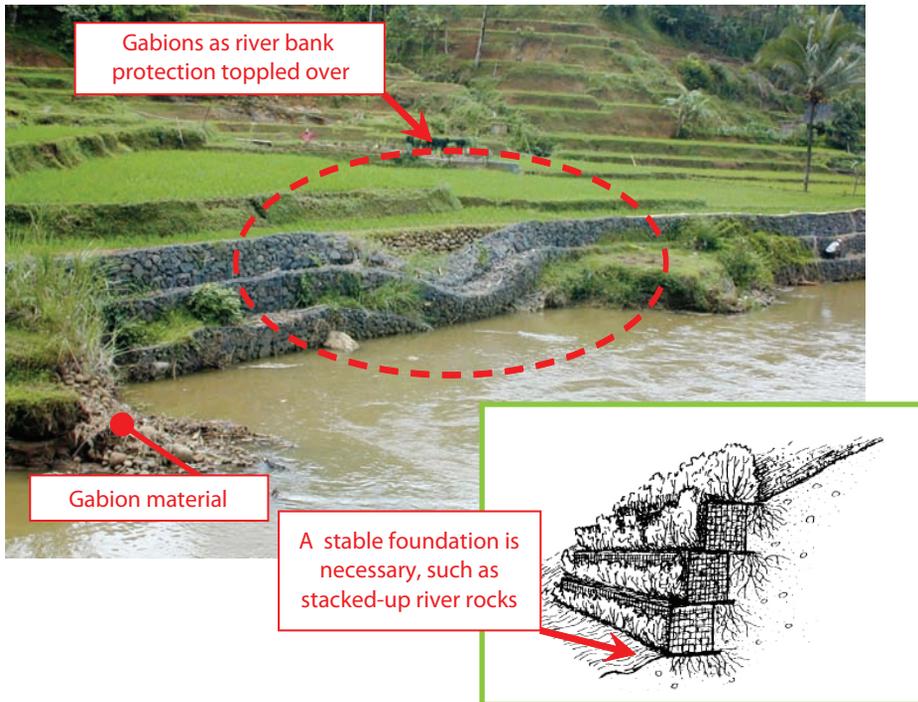
## MAKE SURE THAT RIVER BANKS ARE STABLE

### WHY ?

- River bank slopes must also be protected against erosion by flowing water.

### HOW ?

- Build a gabion wall BUT make sure that:
  - It is built on a good foundation that will not be washed out or scoured by river.
  - It is not too steep because it could topple over if force of soil material behind the gabion wall is too strong.



A partially collapsed gabion wall along a steep river bank

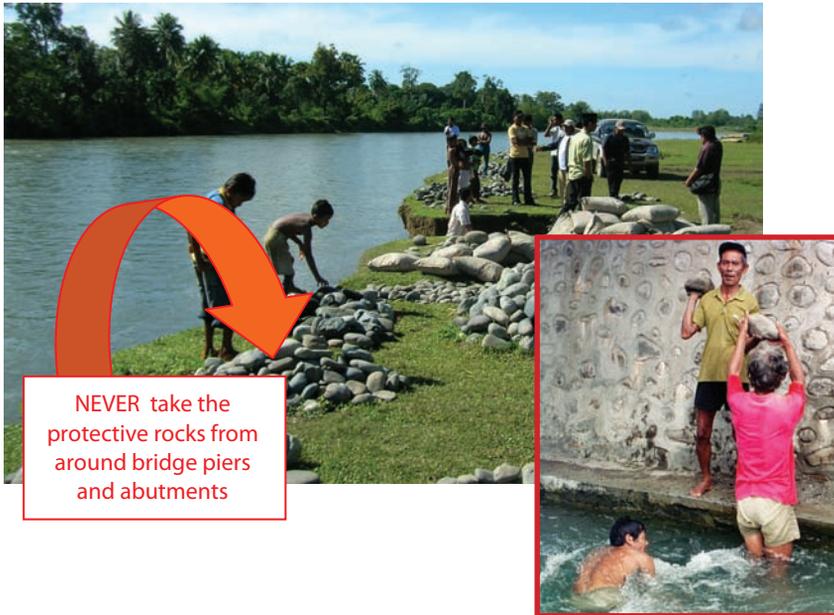
## PROTECT RIVER BANKS AGAINST EROSION

### WHY ?

- River bank slopes must be protected against erosion by the force of flowing water.
- Especially the outside bends of rivers are subject to bank erosion.
- Erosion is worse during high water and flood flows in the river.
- If left unprotected, bank erosion can progress inland and agricultural land or infrastructure may be lost.

### HOW ?

- Build a gabion wall BUT make sure that:
  - It is built on a good foundation below the base of water flow that will not be washed out or scoured by the river.
  - The wall is not too steep because it could topple over if the force of soil material behind the gabion wall is too strong.



River rocks to be sold for use in road construction

## DO NOT EXTRACT SAND, GRAVEL OR ROCKS FROM RIVERS THE SEA

### WHY ?

- Extraction of sand, gravel and stones from the river bed and banks can seriously affect the flow pattern of the river.
- The river may erode other sections of its bed banks and thereby cause serious problems elsewhere.
- The river may scour around bridge piers and abutments and endanger their stability.
- The river may even change its course and bed, potentially causing serious problems to human infrastructure or productive areas.

#### Note:

Sand and gravel extraction from old, dry river beds is not a problem if the necessary permission from the land owner(s) has been obtained.





**Program Nasional Pemberdayaan Masyarakat - Mandiri Pedesaan  
(PNPM Mandiri Perdesaan)**

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