

# **Best Management Practices for Managing Water in Bioenergy Feedstock Production**

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# OBJECTIVES



- **Examine Current Water Status**
- **Discuss the BMP Concept**
- **Approach From a Life Cycle Analysis Viewpoint**
- **Focus on Bioenergy Feedstocks**
- **BMPs for Water Quality & Quantity**
- **Examine Several Case Studies**

# WELCOME TO PLANET "OCEAN"

- 70% of the Earth's surface is water
- 97.5% of the Earth's water is salt water
- 2.5% is fresh water
- 70% of fresh water is ice
- 29% of fresh water is in the soil or deep aquifers
- <1% of fresh water is accessible

• **WE LIVE**  
• **"ON THE EDGE"**



# WATER DECISIONS



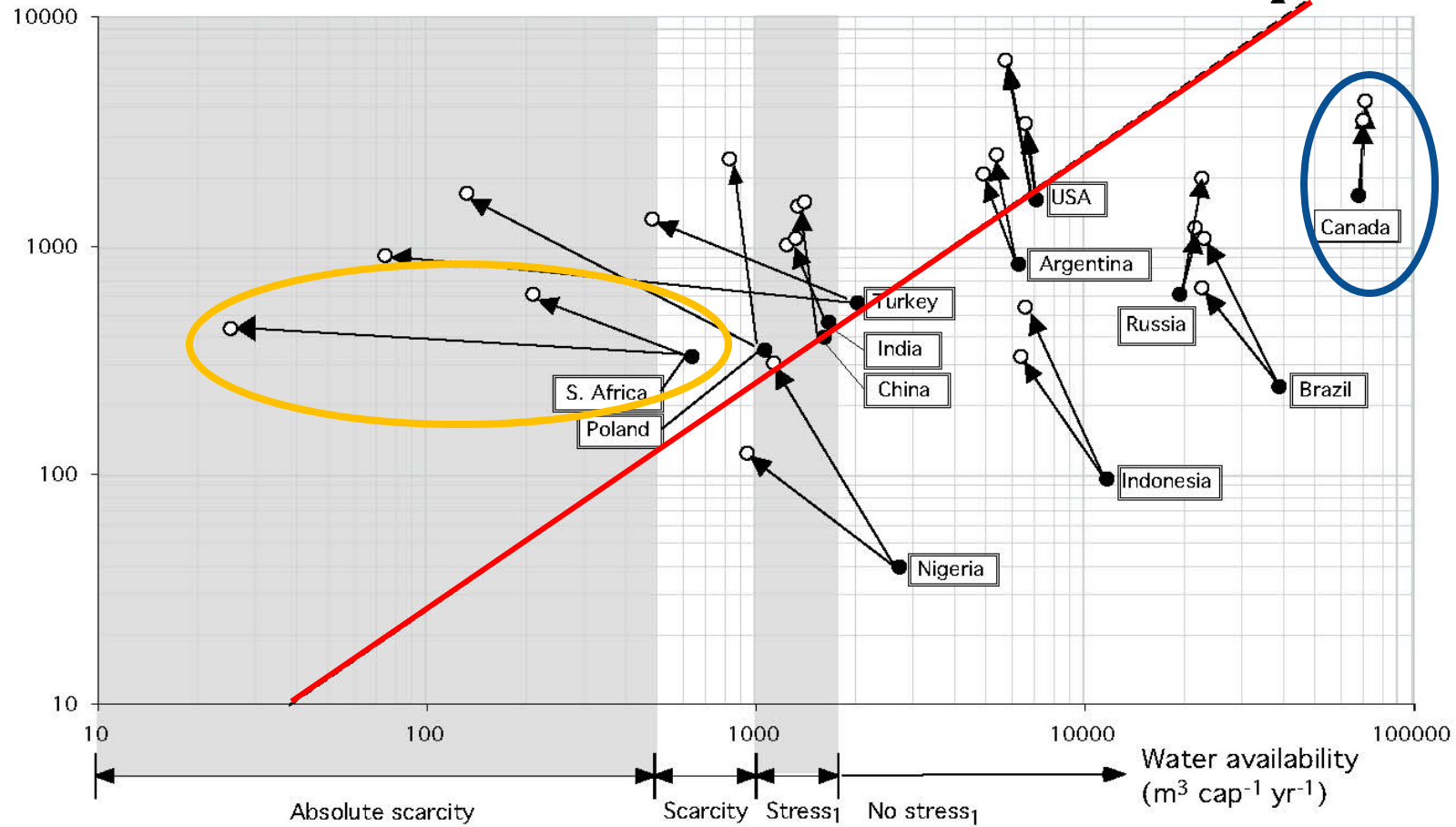
87%

ENERGY  
CROPS

FOOD  
CROPS

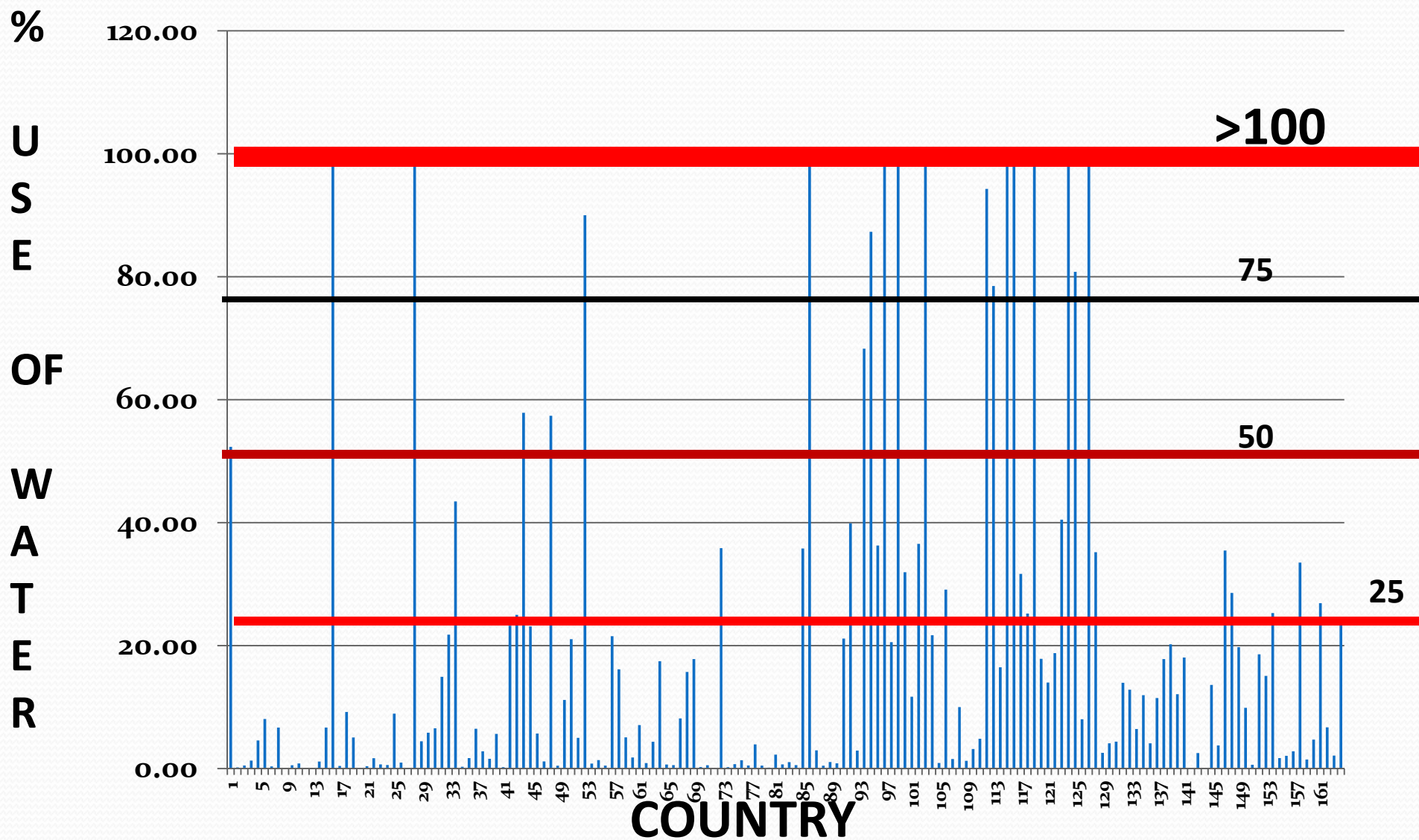


Water withdrawal  
( $\text{m}^3 \text{ cap}^{-1} \text{ yr}^{-1}$ )



**Berndes 2002**

# WORLD WATER USE AS A PERCENT OF RENEWABLE



# PROLONGED DROUGHT



# WITHDRAWALS EXCEED SUPPLY





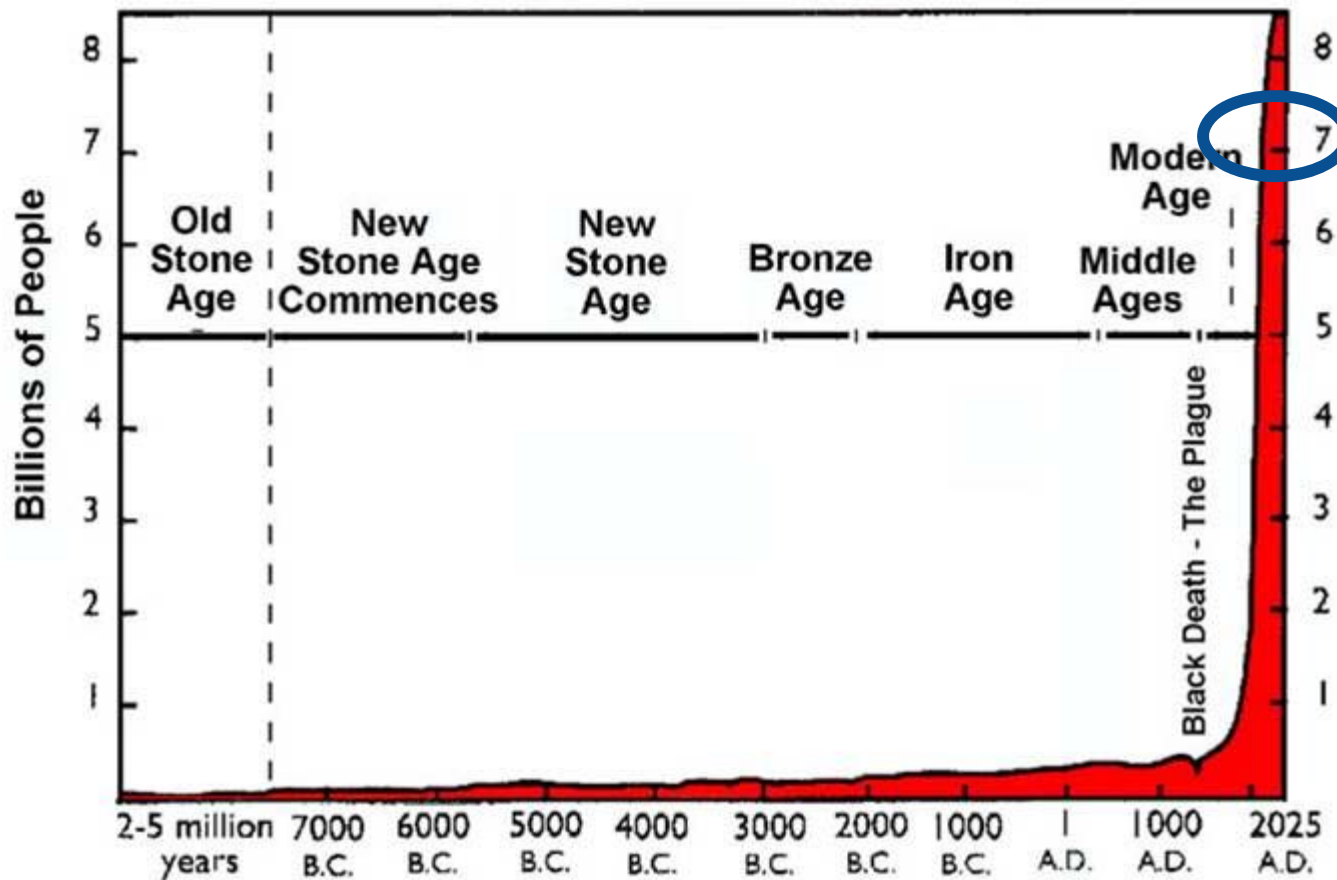
# ARAL SEA DISASTER



# POPULATION GROWTH



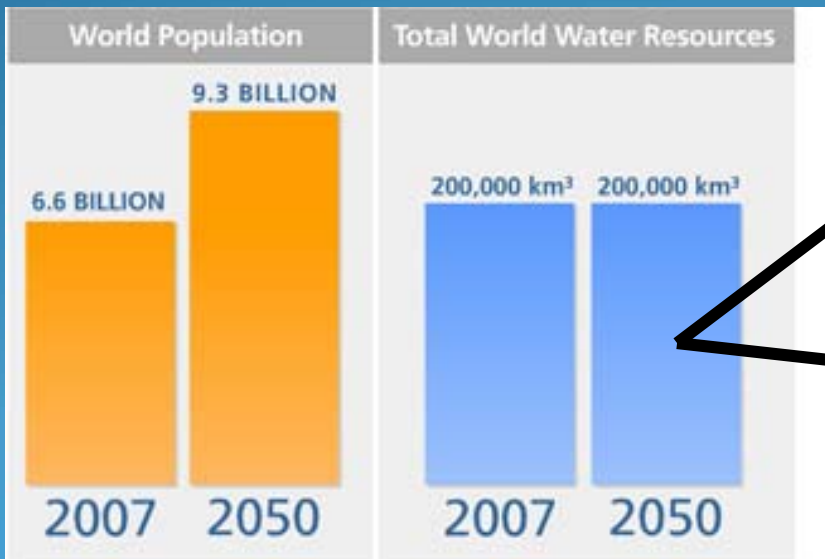
## World Population Growth Through History



From "World Population: Toward the Next Century," copyright 1994  
by the Population Reference Bureau

# CLIMATE CHANGE & WATER DISTRIBUTION

**DRIER DRYS & WETTER WETS**



# SUSTAINABILITY OF WATER SUPPLY

$S_w = \text{Water Quantity} + \text{Quality}$



# WATER DECISIONS



87%

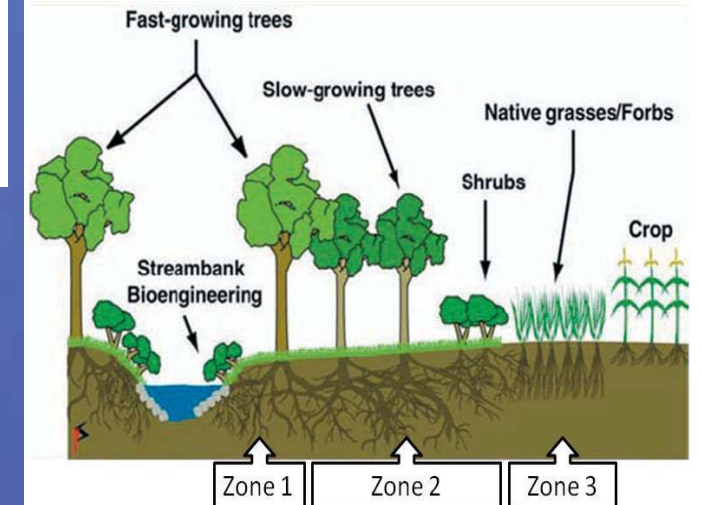
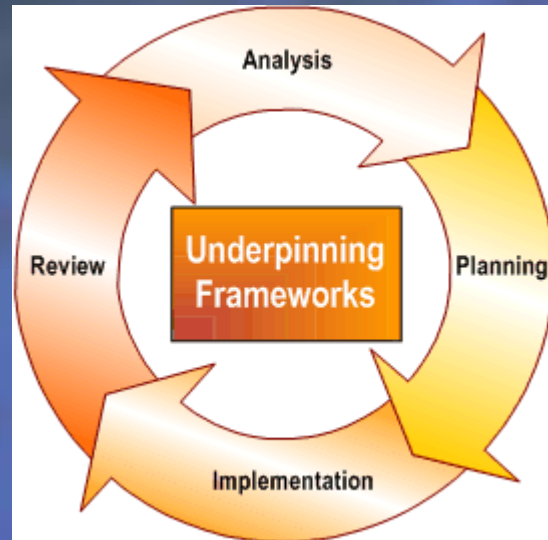
ENERGY  
CROPS

FOOD  
CROPS

??????????

??????????

# BEST MANAGEMENT PRACTICES



# BMP DEFINITIONS

- **Best Management Practices (BMPs) are effective, practical, structural or nonstructural methods which prevent or reduce the movement of sediment, nutrients, pesticides and other pollutants from the land to surface or ground water.**





# BMP DEFINITIONS

- **BMPs protect water quality from potential adverse effects of silvicultural or agricultural activities.**
- **BMPs are developed to achieve a balance between water quality protection and the production of woody and herbaceous crops within natural and economic limitations.**

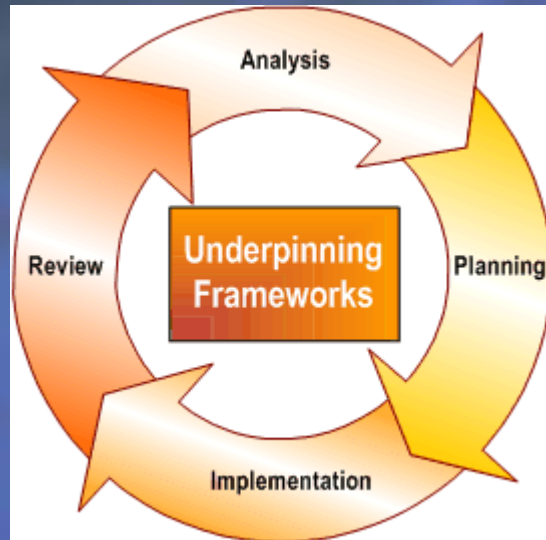
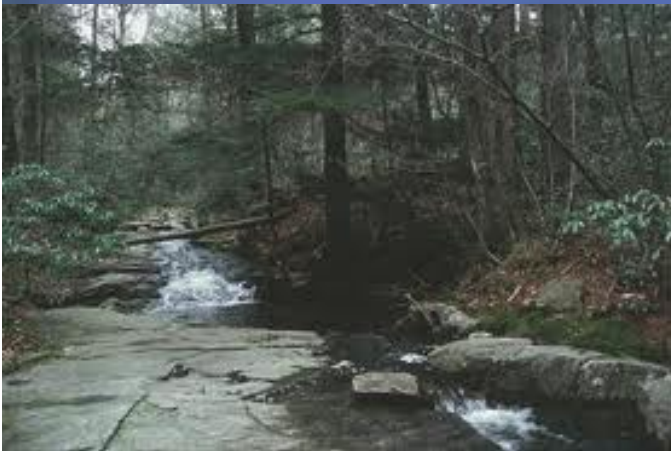


# BMP HISTORY

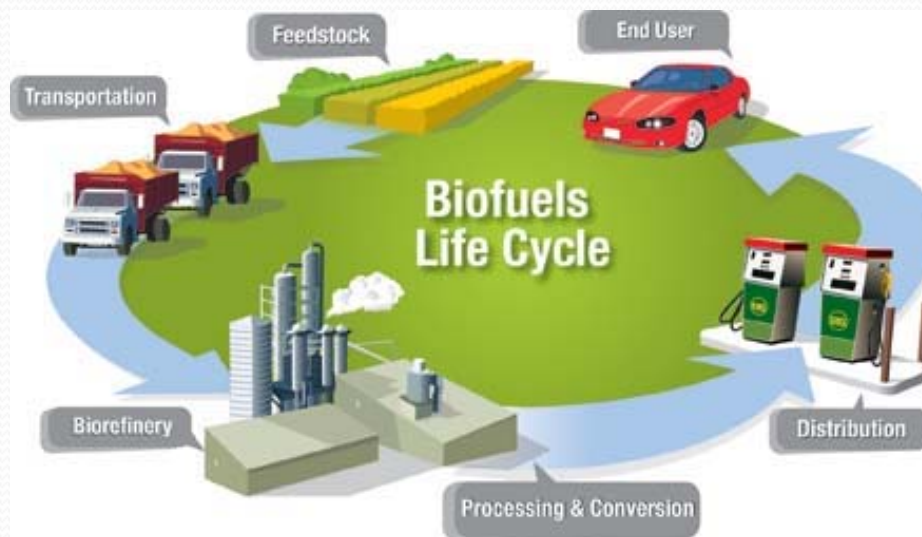
- Originally referred to auxiliary pollution controls in industrial wastewater, city sewage, and stormwater management.
- Mentioned in USA 1977 Clean Water Act
- Now Codified in International Codes of Forest Practices and Certification Standards



# BMP GOAL: PROTECT SOIL & WATER RESOURCES



# BIOENERGY LIFE CYCLE BMPs



- Planning
- **Crop establishment**
- Intermediate Treatments
- **Harvesting**
- **Transportation (Roads)**
- Processing & Generation
- Energy Dispersal
- Waste Handling
- Planning
- etc

# BIOENERGY FEEDSTOCKS

## 1. AGRICULTURAL

Corn, Oats, Sorghum, Wheat Grains

Soybeans, Rice, Other Crops, etc

Alfalfa, Silage Corn, Silage Sorghum

Grasses

Cotton Lint



# BIOENERGY FEEDSTOCKS

## 2. WOOD

Logging Residues

Fuel Treatment Thinnings

Processing Residues

Urban Wood Wastes

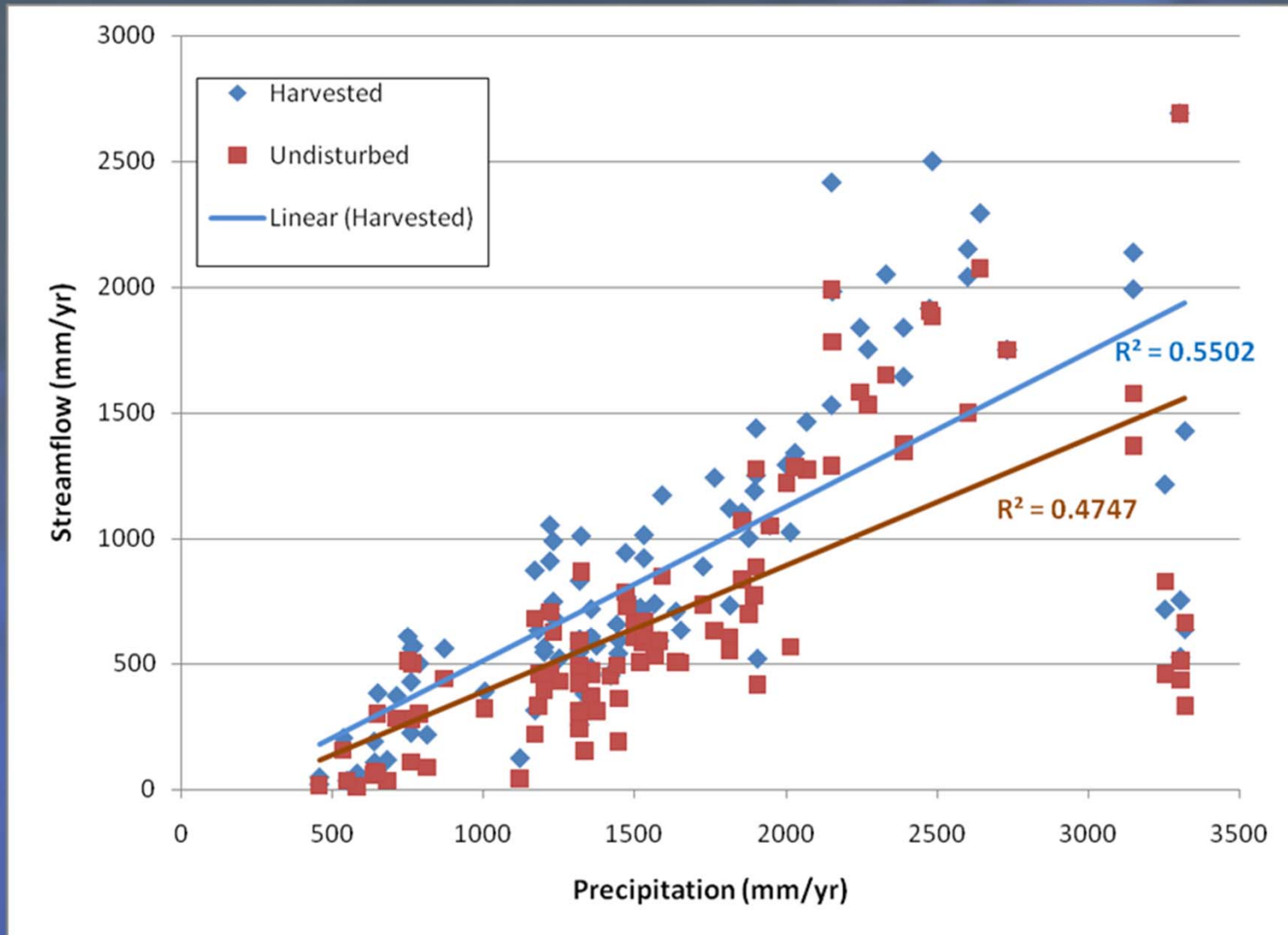


# BMPs FOR

- WATER QUALITY
- WATER QUANTITY

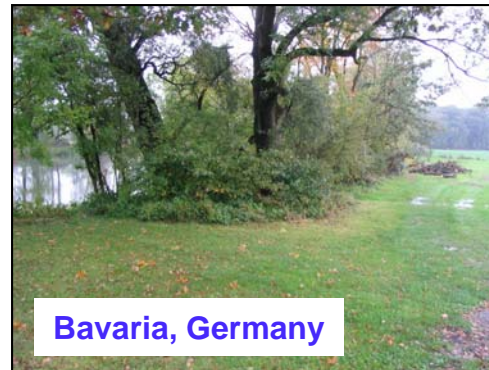


# STREAMFLOW RESPONSE TO FOREST HARVESTING





# BMP EXAMPLES



CSIRO.



# TASMANIA SMZ

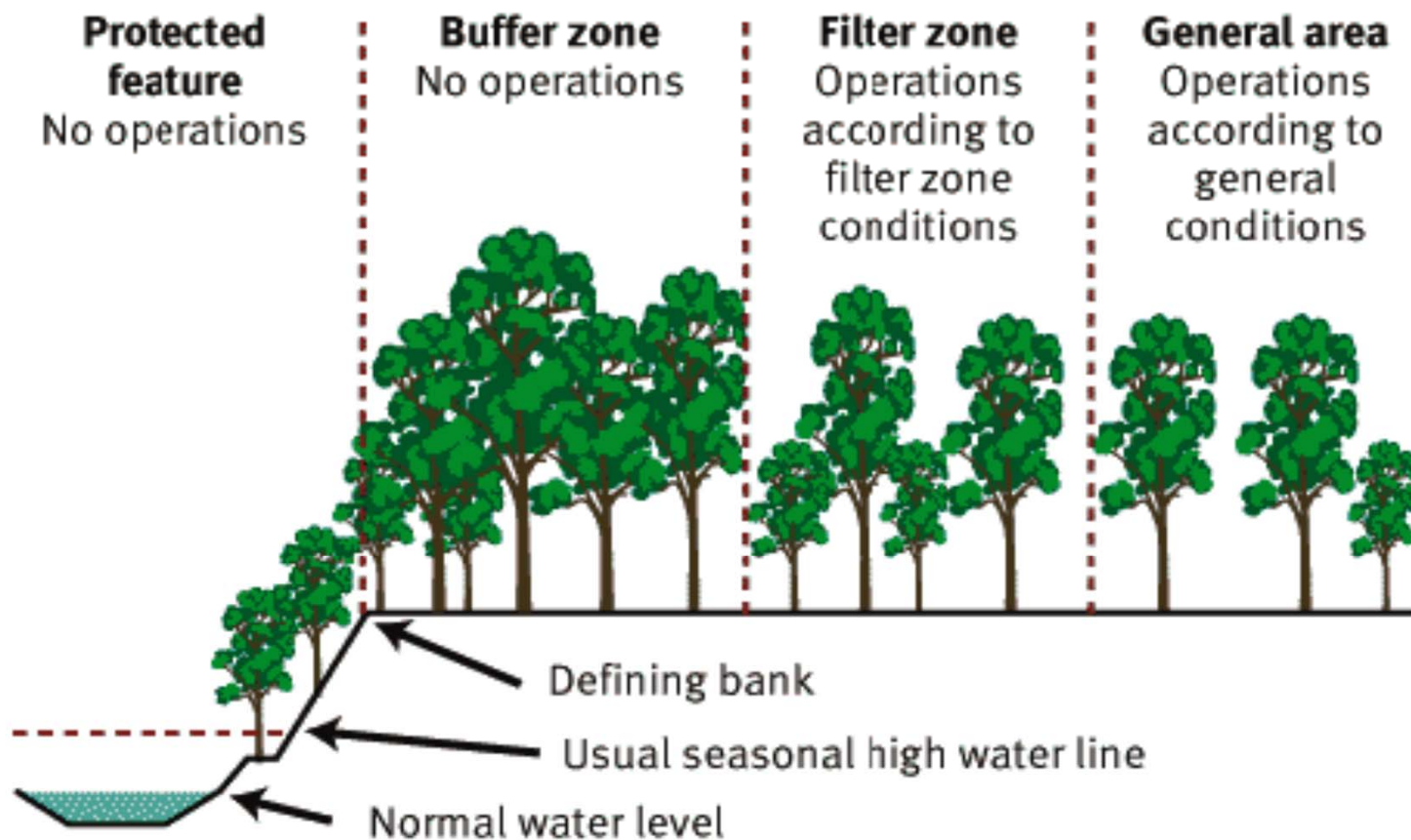


# AGRICULTURE SMZ

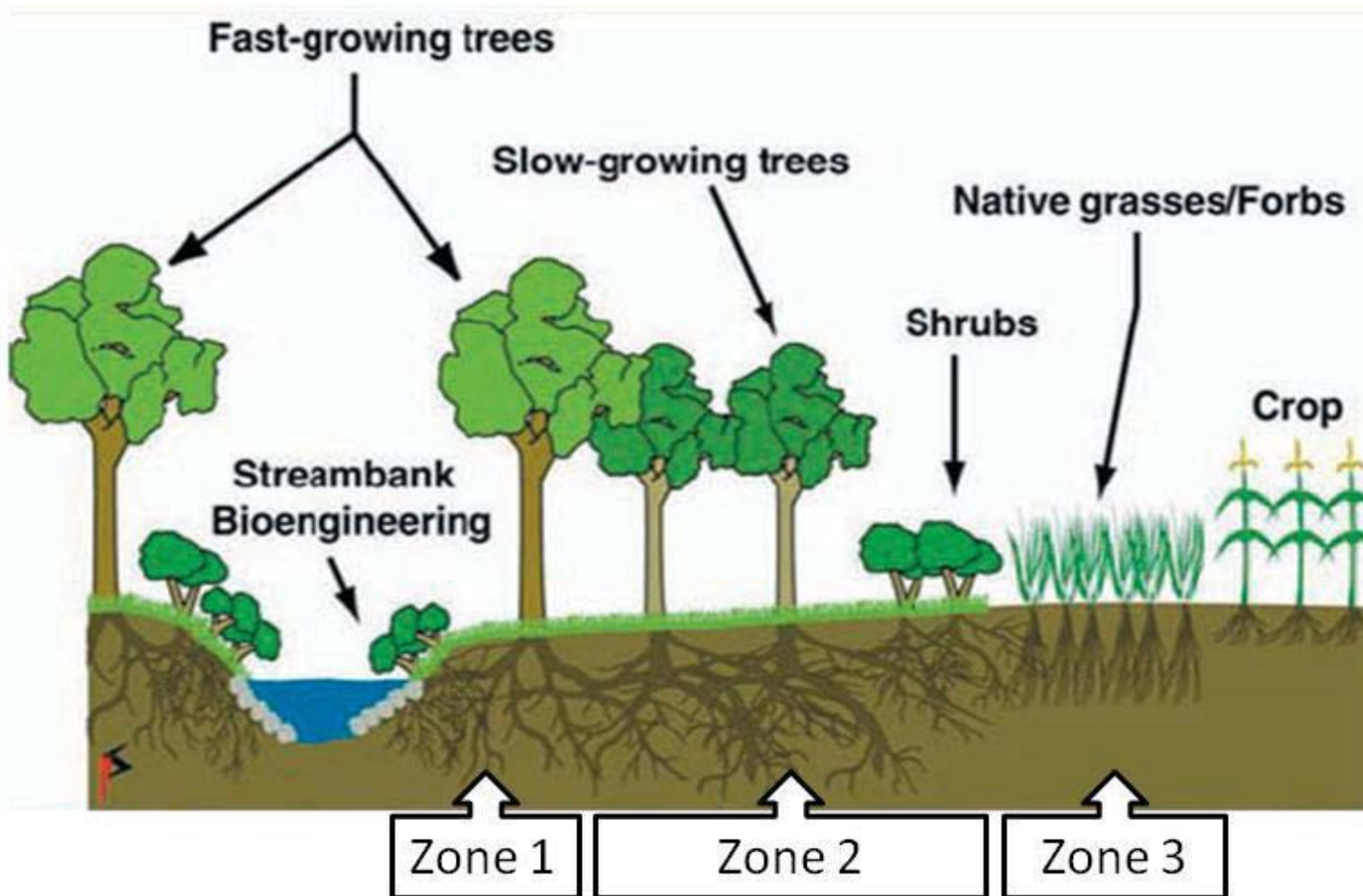


# QUEENSLAND SMZ DESIGN

## Stream protection system



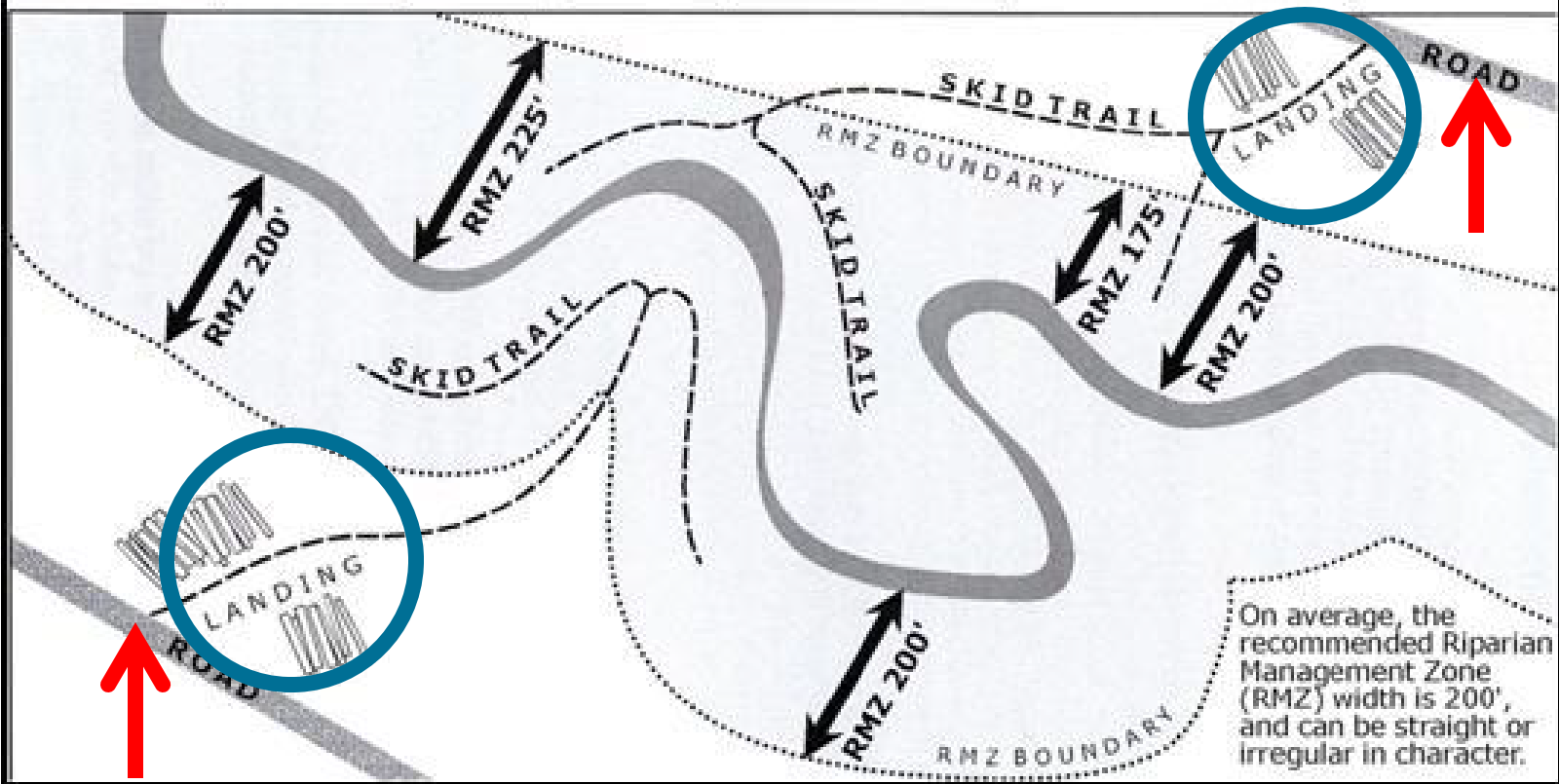
# AGROFORESTRY SMZ DESIGN



# PLANNING

## ROAD & LANDING LOCATIONS

Sample Location of Harvest Activity in Relation to RMZ Boundaries  
(Uneven-Age Management Adjacent to a Designated Trout Stream)



**RMZ = SMZ**

# HARVESTING BMP GUIDES



# **EXAMPLES OF BMP USE**

**Naraglen Farm Tasmania**

**Butik Tarik Malaysia**

**South Island New Zealand**



# Naraglen Farm

**NORTHWEST  
TASMANIA  
AUSTRALIA  
SOUTH OF  
BURNIE**



**NEARY ET AL. 2010**

**Pet River Water Supply Dam**

# **NARAGLEN BMPs**

**USE OF EXISTING ROADS**

**WIDE-TRACKED FELLER BUNCHERS**

**NO MACHINERY WITHIN 10 m OF  
WATERWAYS**

**SLASH LEFT IN PLACE**

**HARVEST DURING DRY WEATHER**

**PRE-PLANNED LANDINGS**

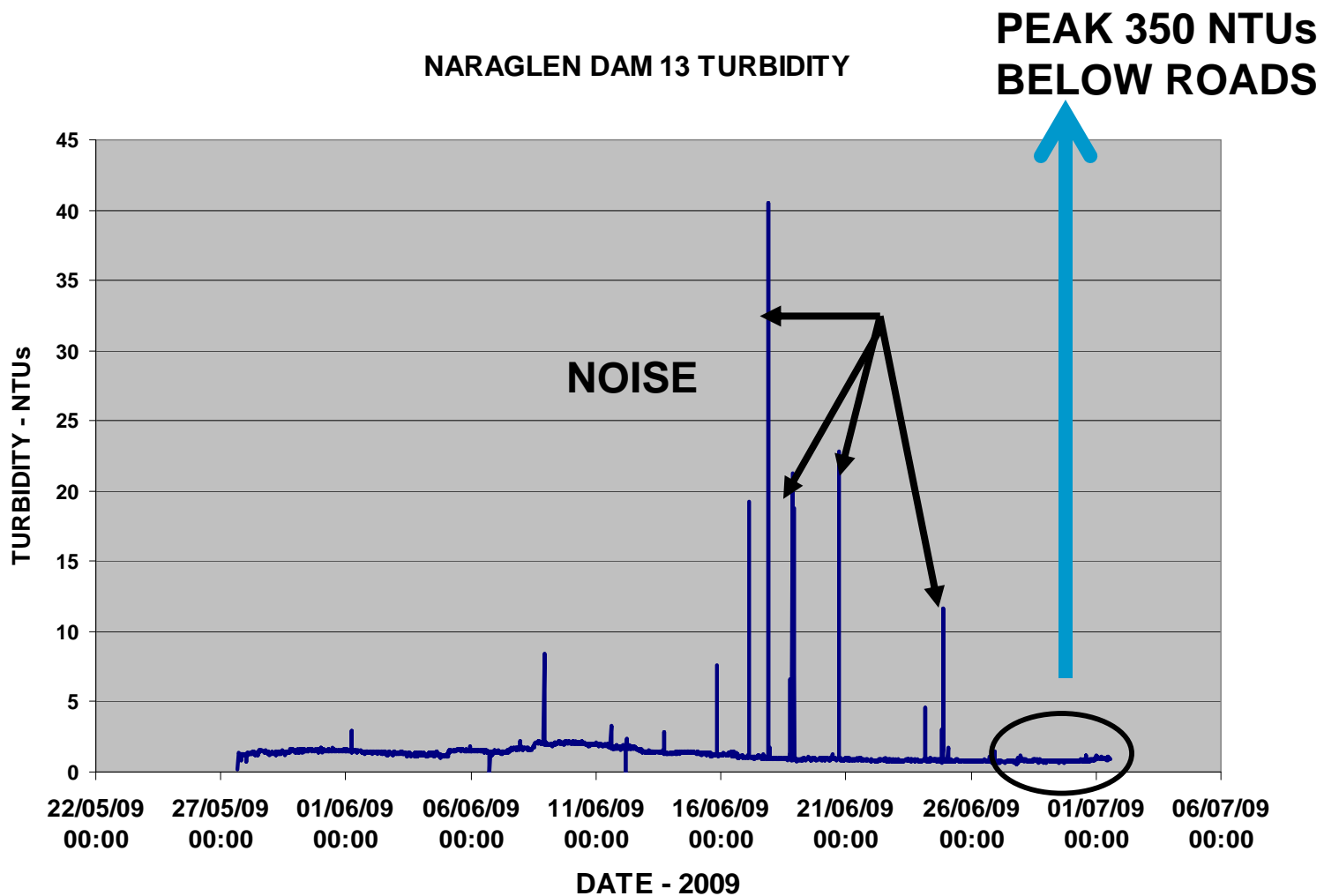
**SERIES OF FARM STOCK PONDS**

**SMZ FENCING**

# NARAGLEN FARM COVER – AFTER HARVEST



# NARAGLEN DAM 13 TURBIDITY



# BUTIK TARIK MALAYSIA



**GOMI ET AL. 2006**



# **BUTIK TARIK BMPs**

**NO HARVESTING (C1)**

**20 m SMZ, NO SMZ HARVEST (C2)**

**20 m SMZ, HIGH ROAD DENSITY  
(C2T)**

**SMZ PARTIAL HARVEST (C3)**

**SKIDDER & LOG TRUCK  
EXTRACTION**

**PLANNED LANDINGS**

# BUTIK TARIK MALAYSIA

CATCHMENT	BMP DESIGN	SEDIMENT YIELD INCREASE
C1	NO HARVEST	0
C2	20 m SMZ, LOW ROAD DENSITY	0
C2T	20 m SMZ, HIGH ROAD DENSITY	6X
C3	SMZ PARTIAL HARVEST	5X





# **SOUTHLAND NEW ZEALAND**

**THOMPSON ET AL. 2009**





# **NEW ZEALAND BMPs**

**NO SMZ, GROUND-BASED  
HARVESTING EQUIPMENT**

**SMZs WITH SOME HARVESTING,  
SKYLINE YARDING SYSTEMS**

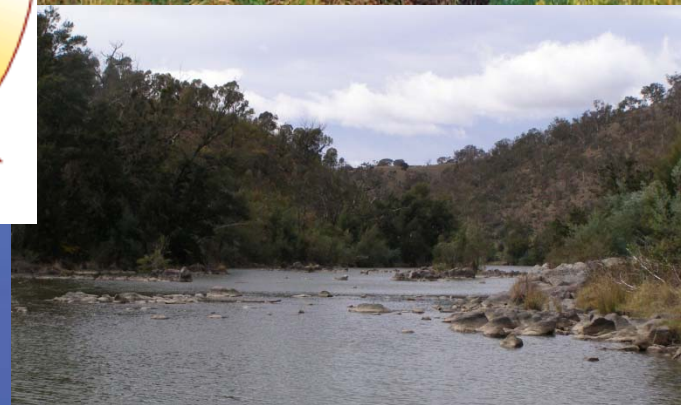
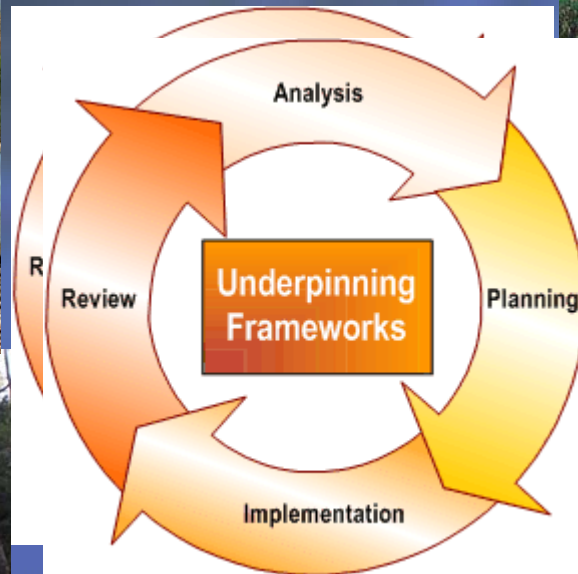
**10 m SMZ, NO HARVEST IN THE  
SMZ, SKYLINE YARDING**

# SOUTHLAND NEW ZEALAND

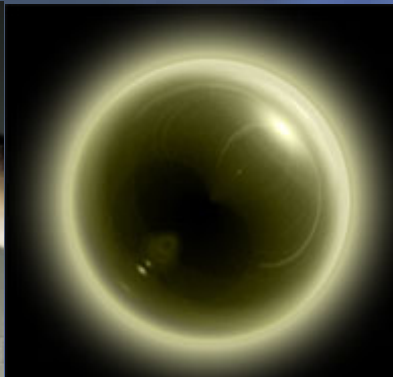
CATCHMENT	BMP DESIGN	NO <sub>3</sub> -N
		mg L <sup>-1</sup>
	CONTROL	0.31
	10m SMZ, HARVEST IN SMZ	14.32
	10m SMZ, NO HARVEST IN SMZ	0.40



# BMP GOAL: PROTECT SOIL & WATER RESOURCES



# BMPs & WATER: "THE CRYSTAL BALL"



**YOUR  
CHOICE!  
BMPs WORK!**

