Coping with water scarcity

Crop and Environmental Sciences Division
International Rice Research Institute
Los Baños, Philippines

Reducing nonproductive outflows

Reduce seepage, percolation, evaporation

1 Land preparation

2 Crop establishment

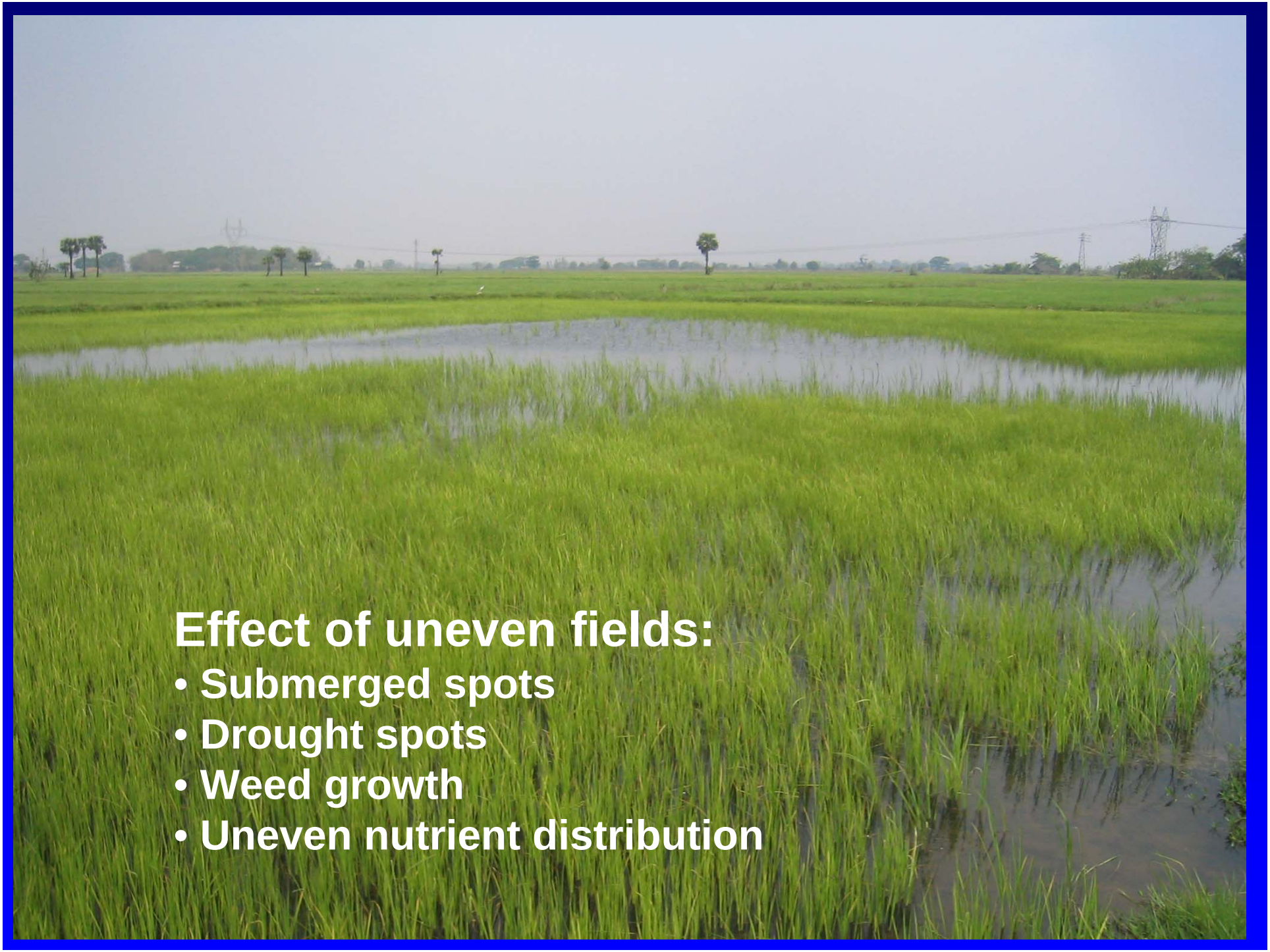
3 Crop growth period

1. Land preparation (get basics right)

- Field channels for irrigation and drainage
- Land leveling
- Crack plowing
- Soil compaction
- Good puddling
- Good bund establishment

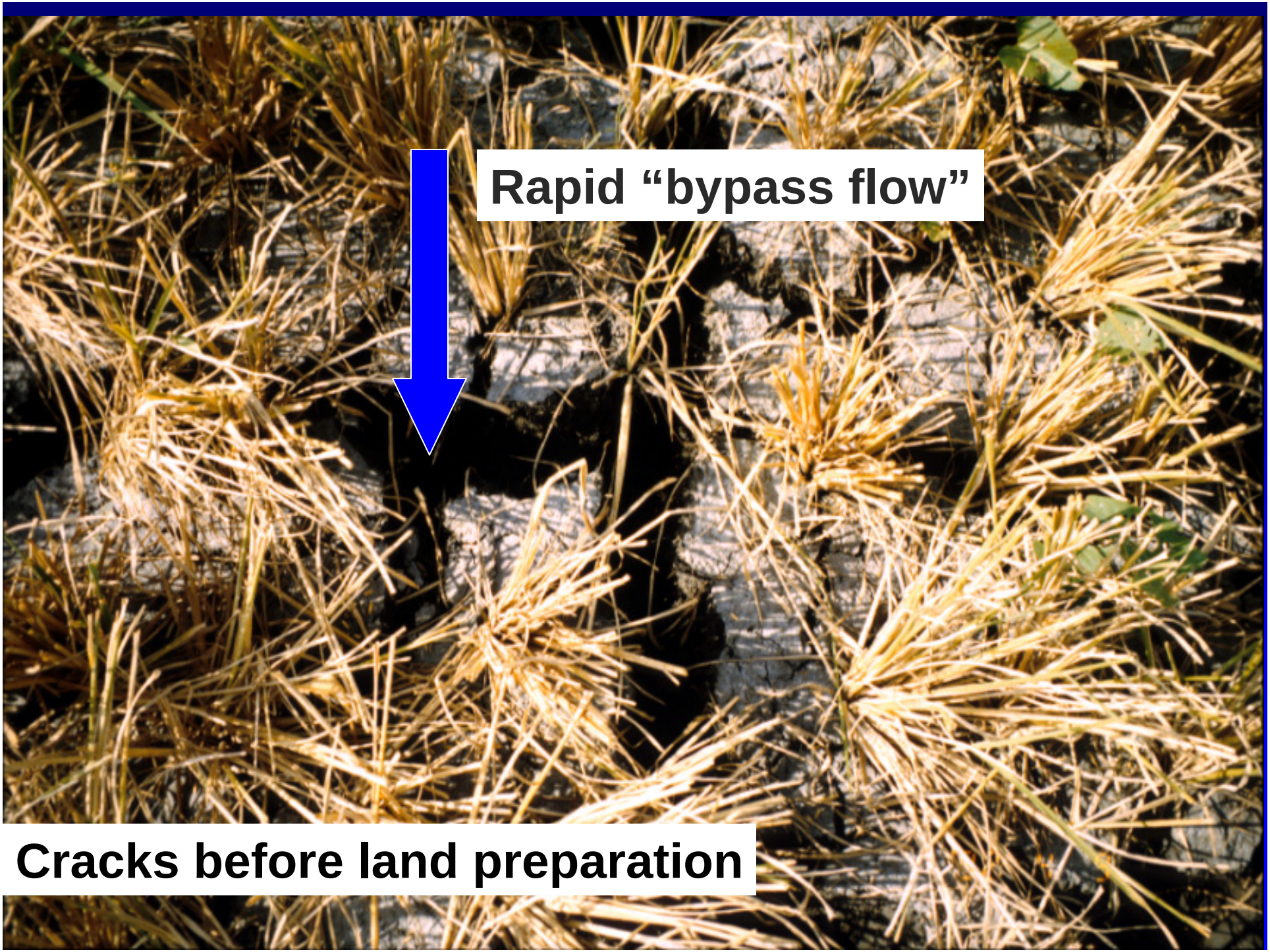
Plot-to-plot irrigation: difficult to control water depth and terminal drainage

=> construct field canals


Effect of uneven fields:
• Submerged spots
• Drought spots
• Weed growth
• Uneven nutrient distribution

Wet land levelling

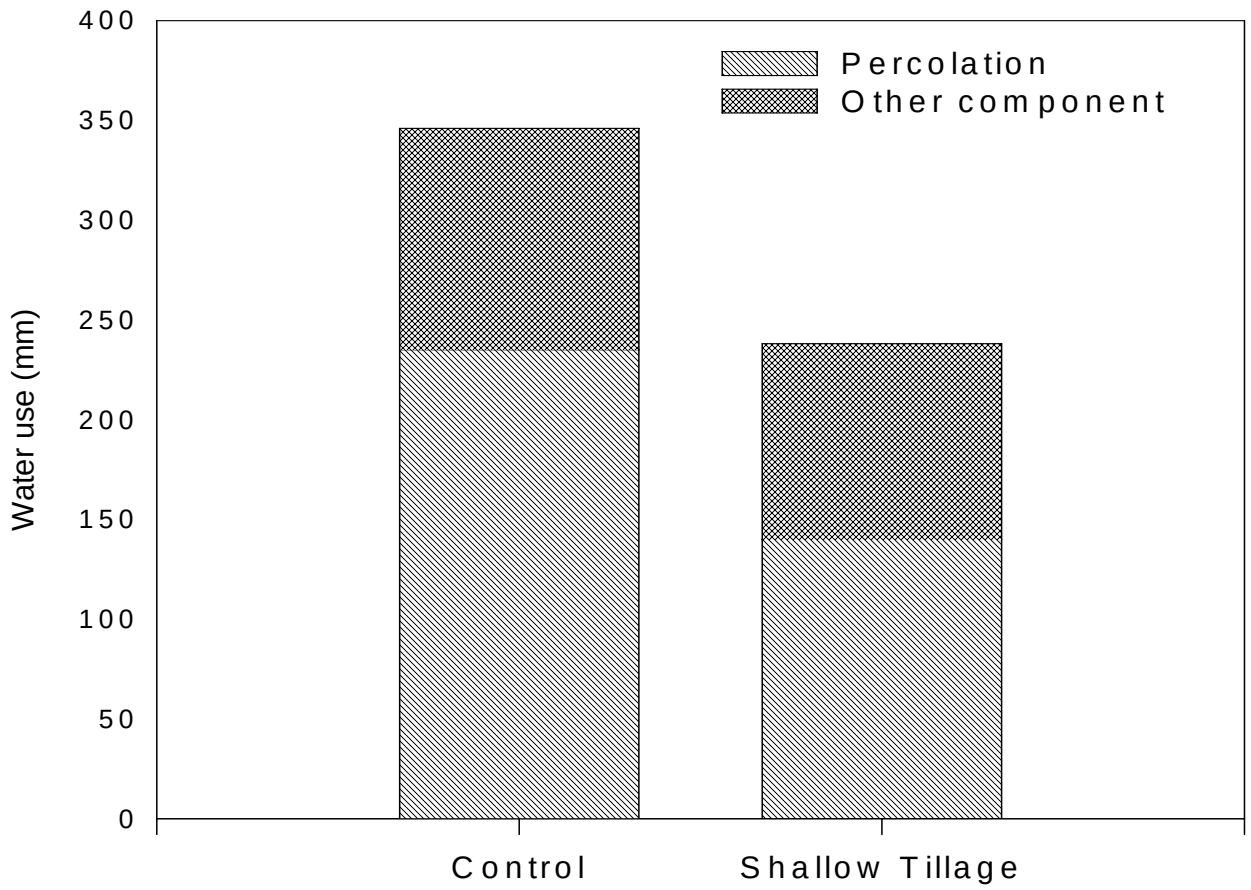
Modern technology: Laser-guided leveling



Cracks before land preparation

Shallow tillage to plough cracks

Water use in land preparation, Bulacan, 1993



Thorough puddling

One hole is plug out of bathtub!

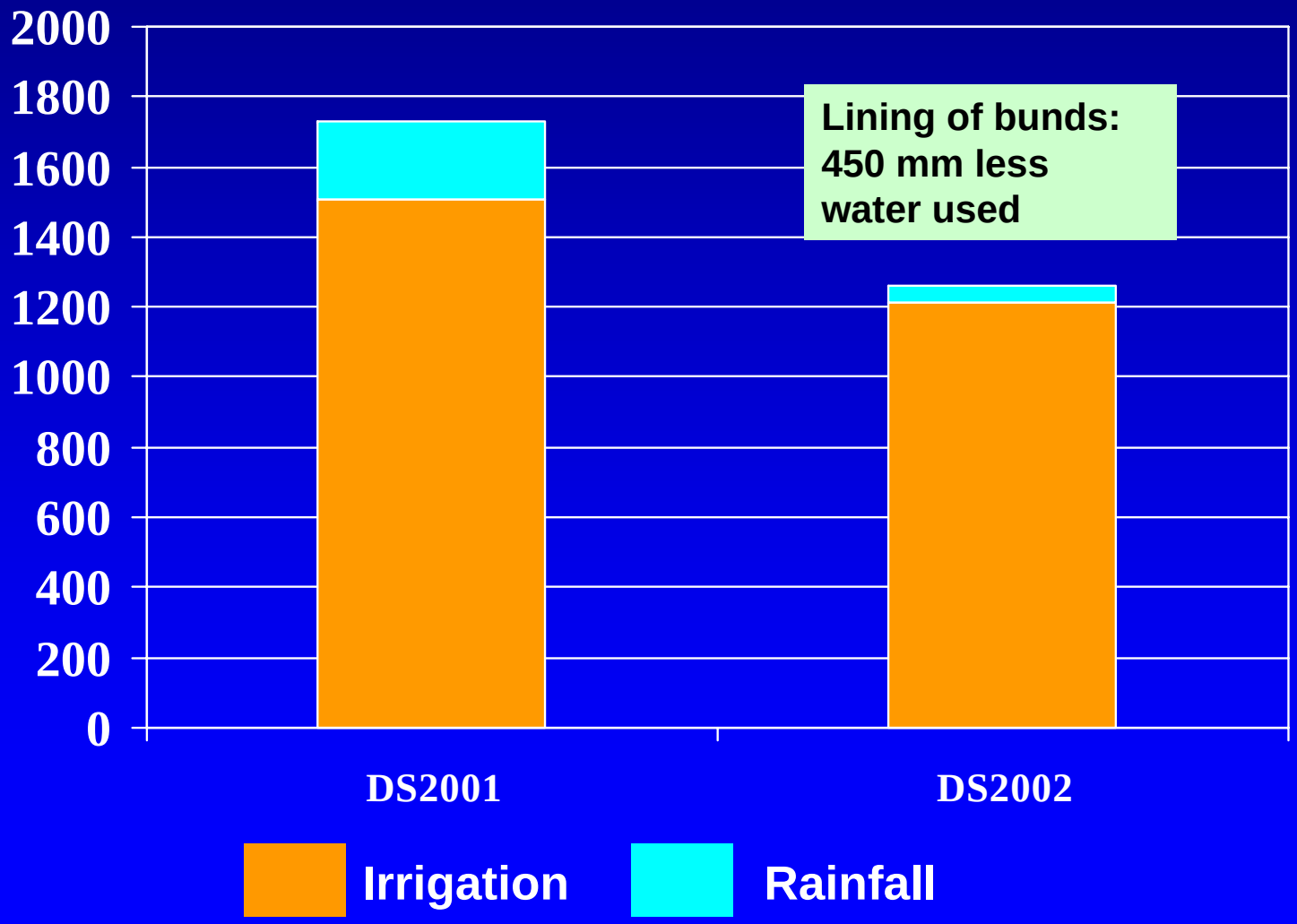

Construct good bunds; plaster well.
Check during season!

Rat hole in bund

Bund lining

Water input, including land preparation (mm)

IRRI farm DS 2001-2002



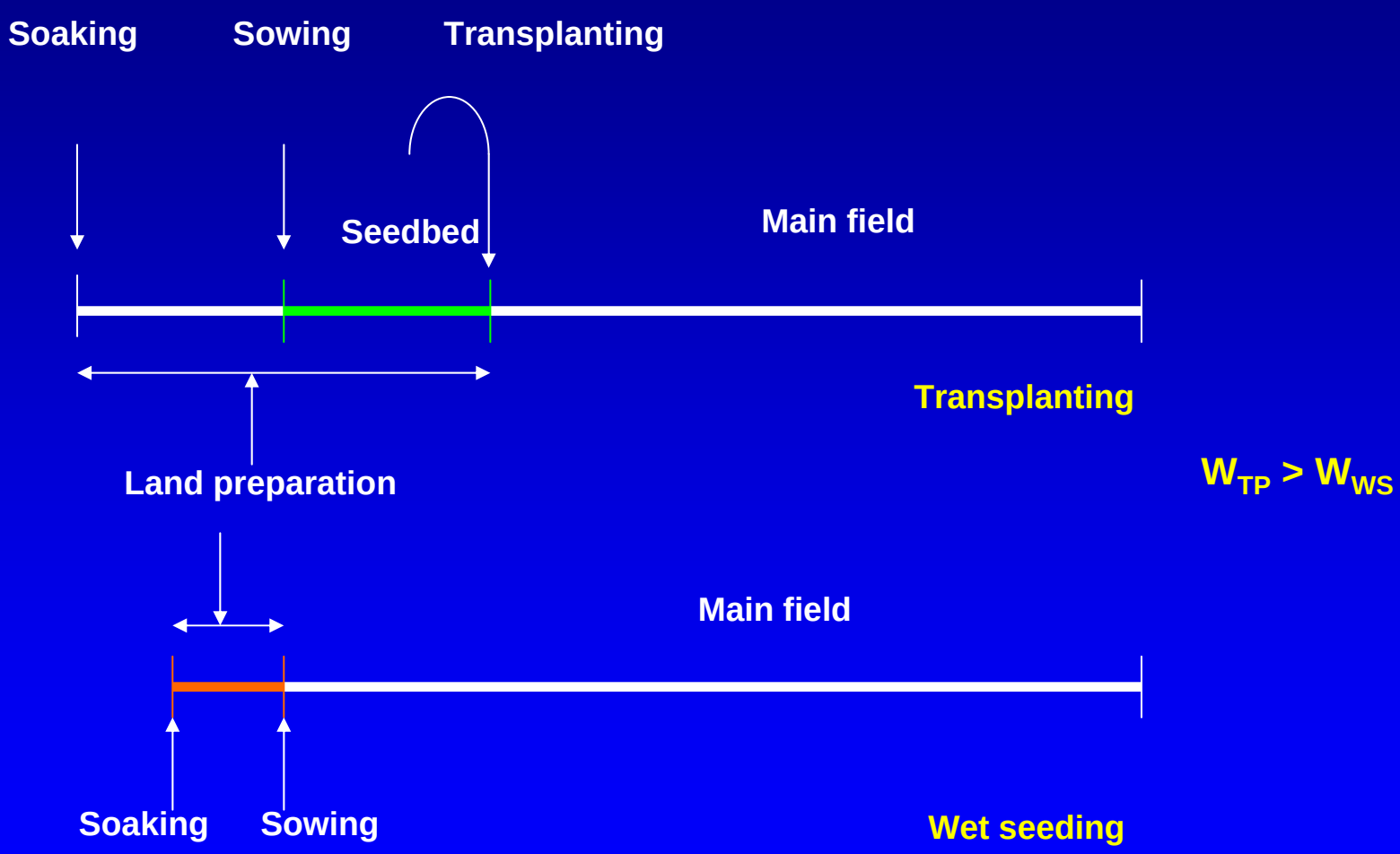
Innovative farmer in Mekong Delta, Vietnam

2. Crop establishment

- Short land preparation phase
- Communal seed beds
- Efficient use of rainfall (cropping calendar)
- Crop establishment:
  - Direct wet seeding
  - Direct dry seeding
  - Zero till


Lump into community seed beds

Effect of direct seeding



$W_{TP} > W_{WS}$

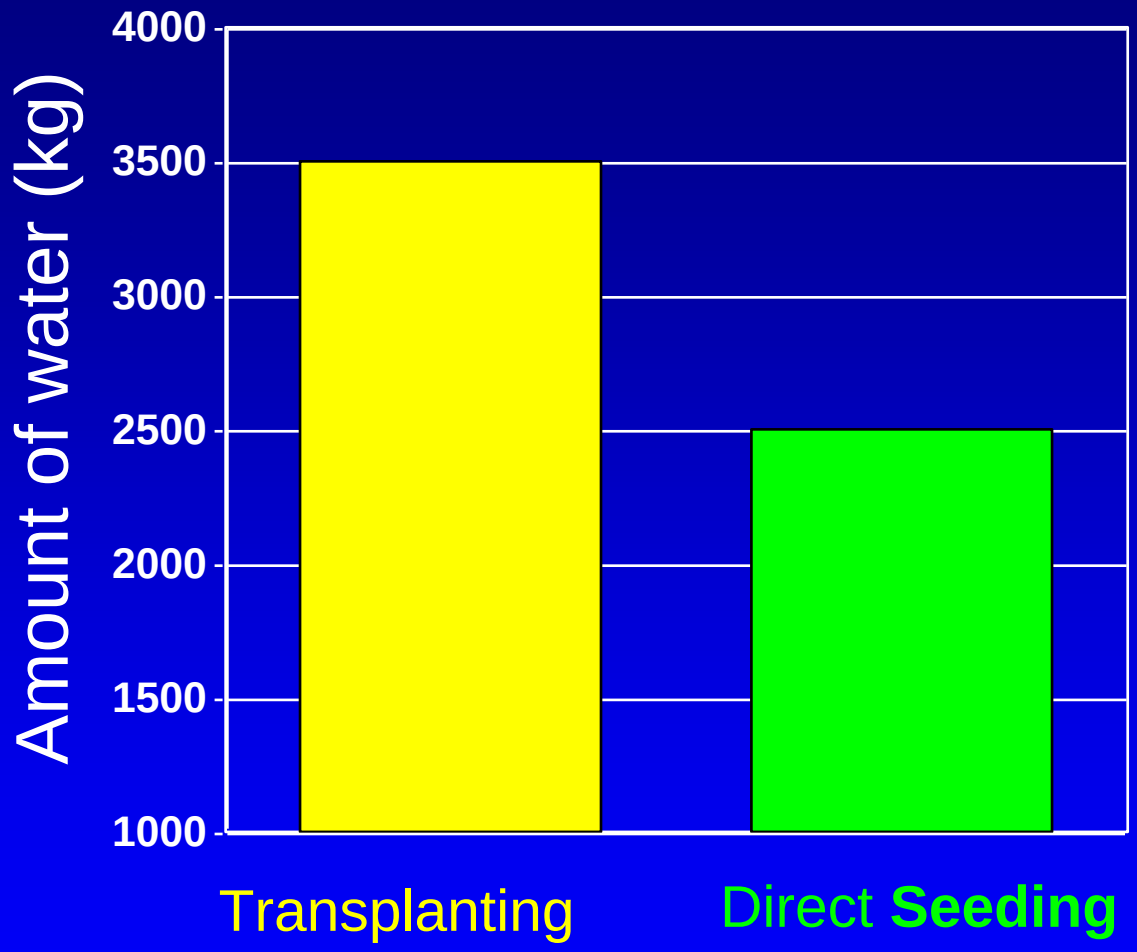
Direct wet seeding

Direct wet seeding: drum seeder

Direct dry seeding

Zero till in direct dry seeding

Effect of direct seeding



Amount of water applied to the field to produce 1 kg of rice (MUDA, Malaysia)

3. Crop growth period

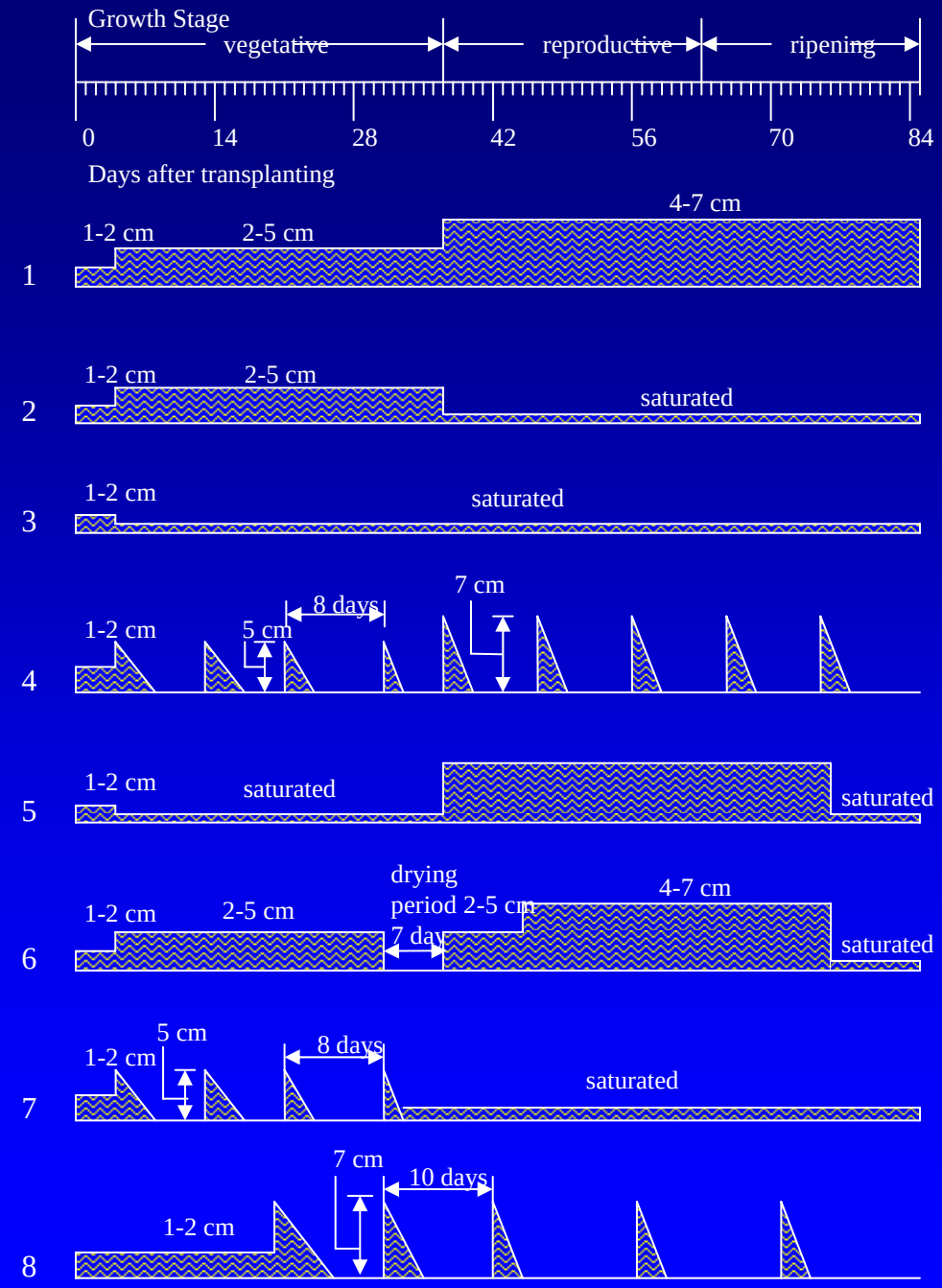
- Good bund maintenance (e.g., rat holes)
- Reduced evaporation
- Reduced percolation and seepage through decrease pressure head
  - Reduced ponded water depth
  - Saturated soil culture
  - Raised beds
  - *Alternate wetting and drying (separate)*
- *Aerobic rice (separate)*

Water management during crop growth

Keep ponded water depth at 5-10 cm or lower (reduced pressure head => less SP)

Saturated soil culture: just keep soil at saturation (many small irrigation gifts)

Keep 5-cm flooded around flowering!



Y	W_{in}	WP_{IR}
5.0	2,197	0.23
4.9	1,059	0.46
4.6	914	0.50
4.0	880	0.46
5.2	1,693	0.31
5.2	2,187	0.24
4.5	874	0.52
4.0	870	0.46

Guimba, Philippines, 1988

Saturated soil culture (SSC)

	Yield (t ha^{-1})	Water (mm)	WP_{IR} (g grain kg^{-1} water)
Transplanted			
Flooded	7.4	694	1.06
SSC	6.7	373	1.81
Wet seeded			
Flooded	7.6	631	1.20
SSC	7.3	324	2.27

Munoz, Philippines, 1991

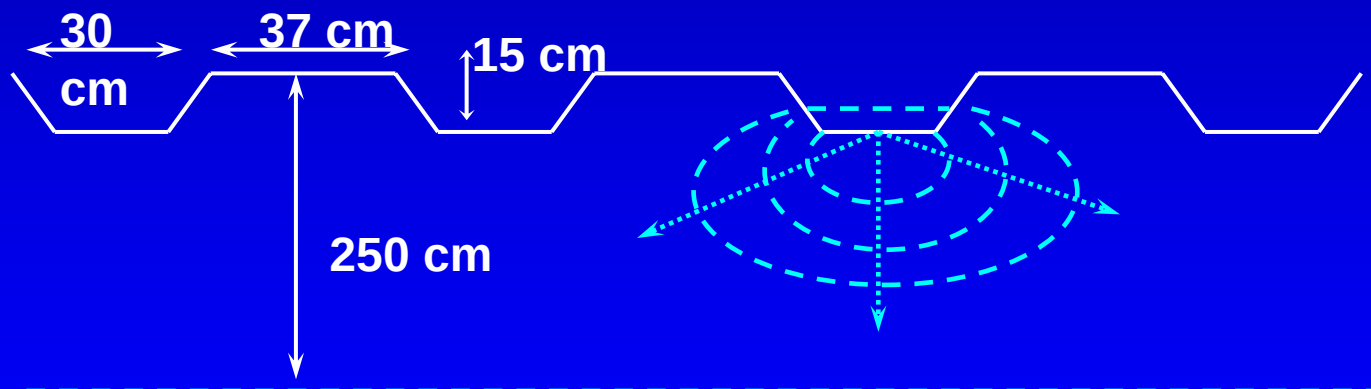
SSC in dry-seeded rice

	Yield (t ha^{-1})	Water (mm)	WP_{IR} (g grain kg^{-1} water)
1996			
Flooded	4.3	1,417	0.31
SSC	4.2	1,330	0.32
1997			
Flooded	4.7	1,920	0.25
SSC	4.5	1,269	0.36

San Jose City, Philippines, 1991

Raised bed cultivation in India

Raised beds; alternate irrigation (furrows); Ghaziabad, Uttar Pradesh, India; Rice-Wheat Consortium site



Rice on raised beds to keep soil saturated

Meerut and Ghaziabad (Delhi), India

Rice on raised beds; Punjab, India

Raised and flat beds at Field Capacity

	Yield (t ha^{-1})	Water (mm)	WP_{IR} (g grain kg^{-1} water)
2001			
Flooded	5.5	1,609	0.34
Beds FC	3.2	1,030	0.35
Flat FC	3.2	928	0.31
2002			
Flooded	5.4	1,578	0.34
Beds FC	3.7	992	0.38
Flat FC	3.7	1,032	0.36

Delhi, India

Extreme measures: reduce E by plastic film

China: thousands of ha
In North China Plain
In upland crops
(maize, cotton, melon,.)

Experimentation in rice
Some farmer adoption

Rice farmers adopting plastic film in Shiyan, China (6000 ha)

- **Higher soil T => earlier establishment**
- **Less E**
- **Less weeds**
- **Higher yields**

Applying film: make sure there is no air between film and soil

Pierce holes for transplanting seedling

New machine development: can cover the film and pierce holes at the same time, operated by only one person

Irrigate through furrows: keep soil below saturation

Clear film from land after harvest. Waste disposal?