Alternate wetting and drying (AWD)

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

Introduce periods without ponded water before re-irrigation

During periods without ponded water:

• No continuous percolation
• No continuous seepage
• Less evaporation
Alternate wetting and drying (AWD)
Intermittent irrigation (II)
Controlled Irrigation (CI)
One of key components in SRI
AWD in a silty clay loam soil with 70-200 cm groundwater

<table>
<thead>
<tr>
<th>Year</th>
<th>Treatment</th>
<th>Yield (t ha⁻¹)</th>
<th>Water (mm)</th>
<th>WP_{IR} (g grain kg⁻¹ water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>Flooded</td>
<td>5.0</td>
<td>2,197</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>AWD</td>
<td>4.0</td>
<td>880</td>
<td>0.46</td>
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<tr>
<td>1989</td>
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<td>5.8</td>
<td>1,679</td>
<td>0.35</td>
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<tr>
<td></td>
<td>AWD</td>
<td>4.3</td>
<td>700</td>
<td>0.61</td>
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<tr>
<td>1990</td>
<td>Flooded</td>
<td>5.3</td>
<td>2,028</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>AWD</td>
<td>4.2</td>
<td>912</td>
<td>0.46</td>
</tr>
<tr>
<td>1991</td>
<td>Flooded</td>
<td>4.9</td>
<td>3,504</td>
<td>0.14</td>
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<tr>
<td></td>
<td>AWD</td>
<td>3.3</td>
<td>1,126</td>
<td>0.29</td>
</tr>
</tbody>
</table>

### AWD in a heavy clay soil with 0-30 cm groundwater

<table>
<thead>
<tr>
<th>Year</th>
<th>Treatment</th>
<th>Yield (t ha(^{-1}))</th>
<th>Water (mm)</th>
<th>WP(_{IR}) (g grain kg(^{-1}) water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>Flooded</td>
<td>8.4</td>
<td>965</td>
<td>0.90</td>
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<tr>
<td></td>
<td>AWD</td>
<td>8.0</td>
<td>878</td>
<td>0.95</td>
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<tr>
<td>2000</td>
<td>Flooded</td>
<td>8.1</td>
<td>878</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>AWD</td>
<td>8.4</td>
<td>802</td>
<td>1.07</td>
</tr>
<tr>
<td>2001</td>
<td>Flooded</td>
<td>7.2</td>
<td>602</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td>AWD</td>
<td>7.7</td>
<td>518</td>
<td>1.34</td>
</tr>
</tbody>
</table>

Tuanlin, China (1999-2000); Munoz, Philippines (2001)
Continuously flooded

Alternate wetting and drying

Yield (t/ha)
Note: heavy clay soil with shallow groundwater (0-30 cm deep)
Effect of less water (SSC => AWDn)

Effect of less water ($AWD_n$)

Yield versus water input in two experiments in India. Top curve data (♦) are from Cuttack, Orissa, (Jha et al., 1981), and bottom curve data (◊) are from Pantnagar, Uttar Pradesh (Tripathi et al., 1986).
Conclusions from research

Amount of water input depends on soil type and hydrology

Amount of water reduced with AWD depends on soil type and hydrology

Implementation of AWD (number of days without ponded water before re-irrigation) depends on soil type and hydrology

=> site-specific implementation
Safe AWD concept and implementation

- Multi-location field exps (Phil., India, China)
- On-farm, multi-stakeholder pilot sites
- Socio-economic evaluation at pilot sites

- Water is underground when you can’t see it
- Rice roots can tap underground water
- “Safe threshold” for underground water defined
  => reduced water input 15-30% without yield loss

- Simple key messages for farmers
- Simple tool for farmers
A practical indicator to irrigate
“Safe AWD practice”

1. Irrigate when water is 15-20 cm deep (simple tool!)

2. Keep 5-cm flooded at flowering

Main idea to convey:
- Water is there even when you can’t see it
- Create confidence by farmers
- Farmers then to experiment with threshold value
- No recipe for soil type, hydrology, variety, ..
- “Usual” nutrient management
- Keep first 2 weeks flooded if many weeds
Avoid deep soil cracking => bypass flow
Knowledge Transfer for Water-Saving Technologies in Rice Production in the Philippines

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²: National Irrigation Administration, Groundwater Irrigation System Reactivation Project, Tarlac, Philippines
³: Philippine Rice Research Institute (PhilRice), Muñoz, Philippines
Main TTWS pilot sites

Central Luzon

- Canarem
- Pansi
- Dapdap

Nueva Ecija:
- Dolores
- Gabaldon
Pump systems: paying for the water

Deepwell systems TGISRP
• P38 – Canarem

Shallow tubewells
• Dolores
• Gabaldon
Technology extension (popular seminars)
**Controlled irrigation**

**Training material**

<table>
<thead>
<tr>
<th></th>
<th>Vegetative phase</th>
<th>Reproduction phase</th>
<th>Ripening phase</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Variable</td>
<td>35 days</td>
<td>30 days</td>
</tr>
</tbody>
</table>

**Option 1**

- Basal application of N, P, K fertilizer
- 2-5 cm depth of submergence
- Drain
- 2-3 weeks

**Option 2**

- 1-2 weeks
- 0-5 cm depth of submergence
- Mid season drainage

**Option 3**

- 1-2 weeks
- Mid season drainage
- Maybe 3 days without standing water or drained period

**Alternate wetting and drying**
Key message on posters and brochures

Control your irrigation to save water and get high yields!

Paddy fields do not require standing water always

1. Before flowering
   - Re-irrigate when water is 15 cm below soil surface
   - Look for water under the ground by making a hole

2. At flowering
   - Always keep flooded (for one week)

3. After flowering
   - Re-irrigate when water is 15 cm below soil surface
   - Look for water under the ground by making a hole

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Use of same posters in Mekong delta, Vietnam (2006)
Use of extension leaflets in Mekong delta, Vietnam (2006)
Demonstration and evaluation

Monitoring inputs: irrigation water, seeds, fertilizer, pesticides, labor use, etc.
And outputs: grain yield and quality
Controlled irrigation vs. Farmers' practices
The “Lighthouse”: Centre for technology diffusion

Farmer school days
100-200 participants (2/year)
Irrigation water used (mm)
Grain yield (t/ha)

**P-38, Canarem**

<table>
<thead>
<tr>
<th>Year</th>
<th>Upper</th>
<th>Middle</th>
<th>Lower</th>
<th>Ave</th>
</tr>
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<tbody>
<tr>
<td>2002 Dry season</td>
<td><img src="image1" alt="Graph Image" /></td>
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<td>2003 Dry season</td>
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</tbody>
</table>

**Nueva Ecija**

<table>
<thead>
<tr>
<th>Year</th>
<th>Dolores</th>
<th>Gabaldon</th>
<th>Ave</th>
<th>Dolores</th>
<th>Gabaldon</th>
<th>Ave</th>
</tr>
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<tr>
<td>2003 Dry season</td>
<td><img src="image1" alt="Graph Image" /></td>
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<td><img src="image1" alt="Graph Image" /></td>
</tr>
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Water productivity (kg/m³)

P-38, Canarem

Nueva Ecija

2002 Dry season 2003 Dry season

Water productivity (mkg/ cu.m.)

CI FP

Upper Middle Lower Ave Upper Middle Lower Ave

2002 Dry season 2003 Dry season

Water productivity (mkg/ cu.m.)

CI FP

Dolores Gabaldon Ave Dolores Gabaldon Ave

2002 Dry season 2003 Dry season
### Average cost and returns

**Dry season 2002:**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Canarem (Deepwell)</th>
<th>Gabaldon (Shallow tubewell)</th>
<th>Dolores (Shallow tubewell)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Farmers practice</td>
<td>AWD</td>
<td>Farmers practice</td>
</tr>
<tr>
<td>Gross return ($/ha)</td>
<td>1026</td>
<td>1026</td>
<td>1301</td>
</tr>
<tr>
<td>Total production cost ($/ha)</td>
<td>485</td>
<td>364</td>
<td>987</td>
</tr>
<tr>
<td>Net profit ($/ha)</td>
<td>541</td>
<td>662</td>
<td>314</td>
</tr>
<tr>
<td>Difference</td>
<td>121</td>
<td>170</td>
<td>(33)</td>
</tr>
</tbody>
</table>
Conclusions for AWD

- An average water savings of about 20% was attained in both deepwell and shallow tubewell systems.
- No significant yield difference has been observed between AWD and FP plots.
- Farmers achieved an average increased net profit of about $65 per ha in deepwell and shallow tubewell systems.
- Community benefits: more water available for irrigation and less social tension when water is scarce!