Implementing the WFD in the Rio Real Basin: Agricultural Best Practices

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Introduction & Outline

• WFD requires that Member States bring all water bodies to “good ecological status” by 2015
• Project Goal: Assist in implementation of the WFD in the Rio Real Basin with respect to agriculture
  – Identification of agricultural pressures in Rio Real basin
  – Recommendations for addressing pressures
  – Incentives and funding opportunities for implementing recommendations
Agricultural Pressures in Rio Real Basin

- Physical / Technical Challenges
  - Vineyards, Orchards, Olives
  - Polyculture (vegetables, rootstock, greenhouses)
  - Pig Farms
  - Agroforestry
  - Sanitary Landfill

- Social / Economic Challenges
  - Market / Globalization
  - Development (conversion of farmland)
  - Lack of regulation / enforcement of regulations
Land Use by Class in Rio Real Basin

- **Agriculture**: 54%
- **Urban**: 9%
- **Natural vegetation**: 24%
- **Water bodies**: 0%
- **Forest**: 12%
- **Industry and infrastructure**: 1%
Agricultural sub-Classes

- Polyculture: 44%
- Orchards, Vineyards, Olives: 48%
- Low-lying alluvial areas: 6%
- Agricultural areas with greenhouses: 0%
- Agricultural areas: 2%
Areas designated of RAN

- The delimitation of RAN should be revised, especially on areas with steep slopes
Pressures by Land Use: Orchards, Olives, Vineyards

• Issues / Challenges
  – Where planted on steep slopes, erosion and runoff lead to topsoil loss, sedimentation, and pollution of water bodies
  – Irrigation (Groundwater)
    • Saltwater intrusion
    • Scarcity
  – Flooding
  – Fertilizer and pesticide use
Pressures by Land Use:
Polyculture & Alluvial Valley Agriculture

• Issues / Challenges
  – Fertilizer and pesticide use
  – Proximity to river (flooding, runoff, erosion)
Pressures by Land Use: Pig Farms

- Issues / Challenges
  - Nitrogen pollution, eutrophication of water bodies
  - Smell
Pressures by Land Use: Agroforestry

- Issues / Challenges
  - Eucalyptus
    - Fire hazard
    - Changes soil chemistry
    - Invasion of native ecosystem
Pressures by Land Use:
Sanitary Landfill

- **Issues / Challenges**
  - **Over Capacity**
    - Serves 14 municipalities and 380,658 residents (2001)
    - Designed for 140,000 tons
    - Received 173,723 tons (2002)
    - Received 195,800 tons (2005)
  - **Cost**
    - Resioeste charged by state 2 euros per ton for overage (2002)
    - Resioeste raised municipal rates 8 euros from 29 to 37 euros per ton (2006)
Pressures by Land Use: Sanitary Landfill

• Issues / Challenges
  – Surface Water Contamination
    • Precipitation runoff of leachates into surface water
  – Groundwater Contamination
    • Leachate seepage into groundwater
  – Groundwater Recharge
    • Aquifer cannot be recharged from precipitation
Summary of Challenges & Recommendations

• Agriculture on slopes: Erosion, runoff, sedimentation, loss of topsoil, chemical pollution of water bodies
  – Zoning to keep some areas unplanted or restricted to certain practices
  – Contour planting
  – Cover crops
  – Setback / Riparian buffer
  – Reduced chemical use through compliance with EurepGAP and/or biological farming
Comparing average annual loading (1994-2002) at the outlet of a watershed using different techniques w/ and w/o winter crop planting

<table>
<thead>
<tr>
<th>Average annual prediction (1994-2002)</th>
<th>Background: up and downhill planting with conventional tillage</th>
<th>BMP1: contour planting with conventional tillage</th>
<th>BMP2: contour planting with conservation tillage</th>
<th>BMP3: contour planting with no-till</th>
<th>BMP4: contour strip cropping with no-till</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>no winter crop</td>
<td>with winter crop</td>
<td>no winter crop</td>
<td>with winter crop</td>
<td>no winter crop</td>
</tr>
<tr>
<td>Streamflow (mm)</td>
<td>420</td>
<td>416</td>
<td>419</td>
<td>415</td>
<td>418</td>
</tr>
<tr>
<td>% reduce</td>
<td>-0.9</td>
<td>-0.9</td>
<td>-2.0</td>
<td>-1.7</td>
<td>-1.7</td>
</tr>
<tr>
<td>Surface runoff (mm)</td>
<td>212</td>
<td>196</td>
<td>209</td>
<td>193</td>
<td>199</td>
</tr>
<tr>
<td>% reduce</td>
<td>-7.6</td>
<td>-7.9</td>
<td>-14.3</td>
<td>-12.8</td>
<td>-12.8</td>
</tr>
<tr>
<td>Sediment loading (kg/ha)</td>
<td>11120.75</td>
<td>7359.67</td>
<td>9215.48</td>
<td>5983.30</td>
<td>8751.77</td>
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<tr>
<td>% reduce</td>
<td>-33.8</td>
<td>-35.1</td>
<td>-43.7</td>
<td>-42.8</td>
<td>-42.5</td>
</tr>
<tr>
<td>% reduce</td>
<td>-8.6</td>
<td>-9.3</td>
<td>-15.1</td>
<td>-13.1</td>
<td>-13.0</td>
</tr>
<tr>
<td>% reduce</td>
<td>-17.7</td>
<td>-19.3</td>
<td>-23.8</td>
<td>-23.5</td>
<td>-23.8</td>
</tr>
</tbody>
</table>

Sedimentation experiment with cover crops and mulching

<table>
<thead>
<tr>
<th>Month</th>
<th>Rain (in.)</th>
<th>Mulch</th>
<th>None</th>
<th>Barley</th>
<th>None</th>
<th>Fescue</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov</td>
<td>2.48</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.16</td>
</tr>
<tr>
<td>Dec</td>
<td>5.2</td>
<td>0.16</td>
<td>2.48</td>
<td>1.04</td>
<td>0.12</td>
<td>1.04</td>
<td>3.32</td>
</tr>
<tr>
<td>Jan</td>
<td>3.44</td>
<td>trace</td>
<td>0.68</td>
<td>0.28</td>
<td>tr</td>
<td>0.16</td>
<td>2.6</td>
</tr>
<tr>
<td>Feb</td>
<td>16.54</td>
<td>trace</td>
<td>14.96</td>
<td>3.3</td>
<td>14.48</td>
<td>4.96</td>
<td>23.2</td>
</tr>
<tr>
<td>March</td>
<td>3.96</td>
<td>trace</td>
<td>2.88</td>
<td>0.48</td>
<td>tr</td>
<td>0.76</td>
<td>2.68</td>
</tr>
<tr>
<td>Totals</td>
<td>31.62</td>
<td>0.16</td>
<td>21</td>
<td>5.1</td>
<td>14.6</td>
<td>6.92</td>
<td>32.48</td>
</tr>
</tbody>
</table>

Source: Ben Faber, UC Cooperative Extension, Ventura-Santa Barbara Counties
## Cover Crops
### Benefits & Drawbacks

<table>
<thead>
<tr>
<th>Potential Benefits</th>
<th>Potential Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved soil structure and water infiltration</td>
<td>Increased cost for seed</td>
</tr>
<tr>
<td>Improved orchard access on wet soils</td>
<td>Increased management</td>
</tr>
<tr>
<td>Improved weed suppression</td>
<td>Increased water use</td>
</tr>
<tr>
<td>Improved beneficial insect habitat</td>
<td>Competition for soil moisture and nutrients</td>
</tr>
<tr>
<td>Addition or conservation of nitrogen</td>
<td>Increased frost hazard</td>
</tr>
<tr>
<td>Addition of organic matter to the soil</td>
<td>Increased vertebrate pests</td>
</tr>
<tr>
<td>Cooler summer orchard environment</td>
<td></td>
</tr>
<tr>
<td>Reduced reflective sunburn of fruit</td>
<td></td>
</tr>
<tr>
<td>Reduced soil erosion and nutrient runoff</td>
<td></td>
</tr>
<tr>
<td>Reduced dust</td>
<td></td>
</tr>
</tbody>
</table>

University of California Sustainable Agriculture Research and Education Program
http://www.sarep.ucdavis.edu/bifs/plum.htm
Riparian Buffers

Source: Stream Notes, 1(3).
Summary of Challenges & Recommendations, cont.

• Irrigation: Groundwater scarcity, Saltwater intrusion
  – Permitting to limit groundwater withdrawal
  – GW recharge
  – Less water-intensive crops in water-scarce areas
Summary of Challenges & Recommendations

- Flooding
  - Levee removal or setting back banks
    - Allows flooding without ponding
    - Overtopping more likely to be gentle/gradual with wider levees, resulting in more fine sediment (nutrient-rich, good for crops), less coarse sediment and scour
Summary of Challenges & Recommendations

• Pollution (agro-chemicals and animal waste)
  – Compliance with EurepGAP and other standards
  – Biological farming
  – Bio-filter with cover crops and native riparian vegetation
  – Enforce current regulations on pig waste treatment
  – Possibly extend pig farm regulations to smaller farms, re-zone to limit extent of pig farms
  – Use of fertilizer/pesticide tax (polluter pays principle)
### 6. SOIL AND SUBSTRATE MANAGEMENT

#### 6.1 Soil Mapping
- 6.1.1 Have soil maps been prepared for the farm?  
  Reomm.

#### 6.2 Cultivation
- 6.2.1 Have techniques been used that are proven to improve or maintain soil structure, and to avoid soil compaction?  
  Reomm.

#### 6.3 Soil Erosion
- 6.3.1 Are field cultivation techniques used to reduce the possibility of soil erosion?  
  Minor Must

### 7. IRRIGATION/FERTIGATION

#### 7.1 Predicting Irrigation Requirements
- 7.1.1 Have systematic methods of prediction been used to calculate the water requirement of the crop?  
  Reomm.
- 7.1.2 Is predicted rainfall taken into account when calculating irrigation application?  
  Reomm.
- 7.1.3 Is evaporation taken into account when calculating irrigation application?  
  Reomm.

#### 7.2 Irrigation/Fertilization Method
- 7.2.1 Has the most efficient and commercially practical water delivery system been used to ensure the best utilization of water resources?  
  Reomm.
- 7.2.2 Is there a water management plan to optimise water usage and reduce waste?  
  Reomm.
- 7.2.3 Are records of irrigation/fertilization water usage maintained?  
  Reomm.

#### 7.4 Supply of Irrigation/Fertilization Water
- 7.4.1 Has irrigation water been abstracted from sustainable sources?  
  Reomm.
- 7.4.2 Has advice on abstraction been sought from water authorities?  
  Reomm.

### 8. CROP PROTECTION

#### 8.1 Basic Elements of Crop Protection
- 8.1.1 Has the protection of crops against pests, diseases, and weeds been achieved with the appropriate minimum crop protection product input?  
  Minor Must
- 8.1.2 Do farmers apply recognised PPR techniques?  
  Reomm.
- 8.1.3 Have anti-resistance recommendations been followed to maintain the effectiveness of available crop protection products?  
  Minor Must
- 8.1.4 Has assistance with implementation of PPR systems been obtained through training of staff?  
  Minor Must

### 13. ENVIRONMENTAL ISSUES

#### 13.1 Impact of farming on the Environment
- 13.1.1 Does the farmer understand and assess the impact his/her farming activities have on the environment?  
  Reomm.
- 13.1.2 Has the farmer considered how he/she can enhance the environment for the benefit of the local community, flora and fauna?  
  Reomm.

#### 13.2 Wildlife and Conservation Policy
- 13.2.1 Has a conservation management plan been established either individually or on a regional basis?  
  Minor Must
Summary of Challenges & Recommendations

• Agroforestry (eucalyptus)
  – Encourage other types of agroforestry
    • e.g., fund set-aside programs for eucalyptus, subsidies for conversion to cork oak
  – Discourage rural abandonment through EU development funds
    • e.g., EAGGF: early retirement aid, compensation for less favored areas
Summary of Challenges & Recommendations

• Sanitary Landfill
  – Re-locate
    • to handle greater capacity
    • away from groundwater recharge points for aquifer
    • away from groundwater contamination point
  – Industrial waste
    • Ensure all industrial waste is handled in separate facility
Organic Agriculture: Trends and Opportunities

Trends in Organic Food Sales in Europe

<table>
<thead>
<tr>
<th>Country</th>
<th>Turnover in Million US-Dollars 2000</th>
<th>% of total food sales</th>
<th>Yearly expected growth rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>2,100-2,200</td>
<td>1.6-1.8</td>
<td>10-15</td>
</tr>
<tr>
<td>Italy</td>
<td>1,000-1,050</td>
<td>0.9-1.1</td>
<td>10-20</td>
</tr>
<tr>
<td>France</td>
<td>800-850</td>
<td>0.8-1.0</td>
<td>10-15</td>
</tr>
<tr>
<td>UK</td>
<td>1,100-1,200</td>
<td>1.0-2.5</td>
<td>15-20</td>
</tr>
<tr>
<td>Switzerland</td>
<td>450-475</td>
<td>2.0-2.5</td>
<td>10-15</td>
</tr>
<tr>
<td>Netherlands</td>
<td>275-325</td>
<td>0.9-1.2</td>
<td>10-20</td>
</tr>
<tr>
<td>Denmark</td>
<td>350-375</td>
<td>2.5-3.0</td>
<td>10-15</td>
</tr>
<tr>
<td>Austria</td>
<td>200-225</td>
<td>1.8-2.0</td>
<td>10-15</td>
</tr>
<tr>
<td>Sweden</td>
<td>175-225</td>
<td>1.0-1.2</td>
<td>15-20</td>
</tr>
<tr>
<td>Total</td>
<td>7,000-7,500</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Additional Recommendations

Globalization and Marketing

– Invest in alternative income sources such as tourism
– Develop specialty products for niche markets
  (EU can help fund these)

Cork Tiles
Native forest, gro-forestry (cork oak) on steep slope

Vineyard & Orchard on gentle slope; contour planting &/or cover crops to reduce erosion & runoff, & increase infiltration

Floodplain with
Orchards & Vegetables
No levee, allowed to flood & drain

-10m Riparian setback
Native Vegetation

Rio Real - Clean & free-flowing!

-10m Riparian setback
Native Vegetation

Orchards, Vineyards & vegetables between river & levee

Crops or shrubs on levee, set back from river

Reeds, Willow, & Ash in riparian buffer
Finding Funding at the Local Level

- Taxation on Fertilizers & Pesticides
  - Polluter Pays Principle
  - Decreased Chemical Loads
  - Good Ecological Status
  - Lowered Carbon Footprint