A long-term field experiment: Effect of buffer strips on erosion and nutrient losses in boreal conditions

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Presentation outline

• Current BS situation in Finland
• Lintupaju experimental site
• Results: surface runoff, erosion, PP, DRP and TN
• Rainfall simulation study in laboratory
• SWOT analysis
Current buffer strip situation in Finland

- **1 m wide edges** must be along main ditches and water courses on every farm (basic regulation)

- **3 m wide filter strips** must be along water courses on the farms committed to environment payments

- **Over 3 m wide riparian zones** under perennial vegetation are targeted to arable land along water courses and main ditches, on arable parcels in Natura 2000 areas and groundwater areas, and parcels bordering a wetland that are managed under an environmental contract. Vegetation is moved and removed from the zone annually or managed by grazing. (RDP)

Neither fertilization nor plant protection are allowed.

RDP=Rural Development Programme for Mainland Finland 2014–2020

Target region for over 3 m wide riparian zones

- 33 000 ha (450 €/ha/yr )
- 24 000 ha (500 €/ha/yr )
A 6-plot field was established on a clay soil in 1989-1990.

Buffer strip (BS) experiments started in 1991.

(1) NBS = No buffer strip
(2) GBS = Grass buffer strip
(3) VBS = Vegetated buffer strip (scrubs, trees, herbs)

AnaEE (pan-European research infrastructure)?

Fig. Jaakko Heikkinen, Luke


Current situation on VBS and NBS

September 2016

3 May 3, 2017
Mean annual surface runoff

  - NBS: 120 mm (Autumn 10%, Summer 20%, Spring 80%)
  - GBS: 130 mm (Autumn 10%, Summer 20%, Spring 80%)
  - VBS: 140 mm (Autumn 10%, Summer 20%, Spring 80%)

- Pasture (2003–spring 2006)
  - NBS: 100 mm (Autumn 10%, Summer 10%, Spring 80%)
  - GBS: 110 mm (Autumn 10%, Summer 10%, Spring 80%)
  - VBS: 120 mm (Autumn 10%, Summer 10%, Spring 80%)

- No-till (2006–2016)
  - NBS: 60 mm (Autumn 6%, Summer 24%, Spring 70%)
  - GBS: 70 mm (Autumn 6%, Summer 24%, Spring 70%)
  - VBS: 80 mm (Autumn 6%, Summer 24%, Spring 70%)
Mean annual load of total solids in surface runoff

![Graph showing total solids in surface runoff for different tillage practices and seasons.](chart.png)
Mean annual load of particulate P in surface runoff
Mean annual load of DRP in surface runoff

  - NBS: 0.1 kg ha⁻¹
  - GBS: 0.2 kg ha⁻¹ (7%)
  - VBS: 0.3 kg ha⁻¹ (+71%)

- Pasture (2003–spring 2006)
  - NBS: 0.4 kg ha⁻¹
  - GBS: 0.3 kg ha⁻¹ (18%)
  - VBS: 0.2 kg ha⁻¹ (36%)

- No-till (2006–2016)
  - NBS: 0.5 kg ha⁻¹
  - GBS: 0.8 kg ha⁻¹ (8%)
  - VBS: 0.7 kg ha⁻¹ (7%)
Mean annual load of total N in surface runoff

  - Autumn: 62%
  - Summer: 48%

- Pasture (2003–spring 2006)
  - NBS: 15%
  - GBS: 14%

- No-till (2006–2016)
  - NBS: 34%
  - GBS: 40%
P concentrations in simulated surface runoff water

0 = Before Freezing
1 = After 1 freezing and thawing event
2 = After 2 freezing and thawing events

## SWOT analysis for buffer strip results

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<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
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<tbody>
<tr>
<td>- Effective in retaining soil particles, particle P and TN in surface runoff.</td>
<td>- Most runoff exists in winter and spring when BSs are not effective in retaining nutrients.</td>
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<td>- Protection against erosion on steep slopes</td>
<td>- In spring high DRP losses from BSs due to frozen broken plant tissues.</td>
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<td>- Use of manure, fertilisers and plant protection products is not allowed on BSs (near watercourses).</td>
<td>- Increased DRP losses due to high P content in soil surface.</td>
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<tr>
<th><strong>Opportunities</strong></th>
<th><strong>Threats</strong></th>
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<tr>
<td>- Annual moving of plants and removing swath delays the increase of P content in soil surface.</td>
<td>- Nutrient losses may increase in drainage water.</td>
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<td>- Nutrient retaining may be increased for a while on VBSs under trees.</td>
<td>- Shading may increase erosion risk due to loss of plant cover under the trees.</td>
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<td>- Narrow BS may be sufficient for pasture and no-till fields.</td>
<td>- Exceptionally severe weed infestations</td>
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Thank you!