DIGITALIZATION IN SWEDISH AGROECOLOGICAL CONTEXTS

SYNERGIES, TECHNOLOGY UPTAKE AND FUTURE INNOVATION PATHWAYS

FEDRA VANHUYSE & AZILIZ LE ROUZO
STOCKHOLM ENVIRONMENT INSTITUTE
SWEDEN
CANDIES

SESSION 6: Agroecology and digitalization

#AEEUFORUM2023
PRESENTATION OUTLINE

➢ Which synergies can be found between digitalization and agroecology?
➢ What is the use and uptake of digital technologies in Swedish agroecological contexts?
➢ What are farmers’ perspective on digitalization?
➢ What role do digital technologies play in sustainable food system transformations?

The Carbon Neutral Digestive Initiative – Enhancing Systems (CANDIES)

Investigates how environmental information and digital tools can potentially support a transformative shift in our food production and consumption patterns.

Funders: Vinnova, Formas
Partners: Nagoon, Urban Deli

RESEARCH DESIGN

GOAL: gain new insights on how digital tools can be used in the agroecological context

METHODOLOGY: a mixed-methods sequential explanatory design

Data collection:
• Survey shared between the months of May to August 2023
• Focus group discussions – upcoming

Data analysis:
• Quantitative analysis: descriptive and inferential statistics
• Qualitative analysis: social practice theory
SWEDISH CONTEXT

A SILENT PROTO-AGROECOLOGICAL TRANSFORMATION?

• Important share of small-scale mixed-farms and organically farmed agricultural land suggests that proto-agroecological practices are omnipresent
• Yet, to date the term is only used by a limited number of actors
• Sweden at the forefront of food system transformation?
  ✓ Ambitious policy targets for organic farming
  ✓ KRAV-label
  ✓ REKO-Ringen – short food supply chain network
• High-level of digital literacy, limited digital divide
• Sweden ranks 2nd on the global innovation index
# CONCEPTUAL FRAMEWORK

## INVESTIGATION OF SYNERGIES ACROSS AGROECOLOGICAL PRINCIPLES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input reduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biodiversity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synergy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic divers.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Know. co-creation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social values/diets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connectivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land &amp; nrm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RESULTS

SAMPLE DESCRIPTION

Gender
- Male: 42%
- Female: 53%
- N/A: 3%
- Non-binary: 2%

Occupational status
- Full time: 52%
- Part time: 38%
- Other: 10%

Agricultural Education
- Yes: 35%
- No: 58%
- Similar: 7%

Education
- Bachelor's degree: 17%
- Master's degree: 17%
- Doctorate degree: 5%
- Trade/technical: 8%
- Certificate: 14%

Certification status
- Certified EU eco-label: 10%
- Certified KRAV: 25%
- Not certified but in conversion to organic farming: 2%
- Other: 16%

Age Range
- 25-34: 7
- 35-44: 25
- 45-54: 10
- 55-64: 13
- >65: 5

Agricultural Education
RESULTS

TECHNOLOGY UPTAKE

USE OF PRECISION TECHNOLOGIES

17% Precision irrigation technologies
8% Precision technologies for sowing, cultivation and harvesting
5% Precision technologies to monitor animal health
3% Remote sensing to monitor crop health
2% Remote sensing for pest control
2% Remote sensing for soil monitoring

USE OF ROBOTIC EQUIPMENT

8% Drones
5% Automatic feeding systems
2% Robotic milking machines
2% Collaborative robots

USE OF DIGITAL SALES PLATFORMS

80% Social media platforms
27% E-commerce platforms
10% Specialized mobile applications

USE OF DIGITAL TRAINING AND LEARNING PLATFORMS

65% YouTube videos
40% Online workshops
12% Web communities
12% Podcasts
# RESULTS

## BARRIERS TO ADOPTION ACROSS 4 CATEGORIES OF DIGITAL TECHNOLOGIES

<table>
<thead>
<tr>
<th>Barriers to adoption</th>
<th>Precision Technologies</th>
<th>Robotic equipment</th>
<th>Digital sales platforms</th>
<th>Digital platforms for training and learning purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td>High investment cost</td>
<td>25</td>
<td>30</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Equipment is too complex to use</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Equipment is not appropriate for my farm’s context and size</td>
<td>23</td>
<td>27</td>
<td>6</td>
<td>N/A</td>
</tr>
<tr>
<td>The added value is unclear</td>
<td>12</td>
<td>16</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Equipment is not compatible with my farming objectives</td>
<td>10</td>
<td>12</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Equipment is difficult to integrate with current equipment</td>
<td>12</td>
<td>12</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Access to neutral and reliable information on the equipment is limited</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Lack of experimental access to equipment hinders adoption</td>
<td>12</td>
<td>16</td>
<td>4</td>
<td>N/A</td>
</tr>
<tr>
<td>Equipment does not allow me to reach the desired audience</td>
<td>N/A</td>
<td>N/A</td>
<td>5</td>
<td>N/A</td>
</tr>
<tr>
<td>Use of equipment is time intensive</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>14</td>
</tr>
<tr>
<td>All of the above</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>None of the above</td>
<td>5</td>
<td>5</td>
<td>26</td>
<td>32</td>
</tr>
</tbody>
</table>
## Results

### Farmers’ Perspectives on Digital Technologies

<table>
<thead>
<tr>
<th>MEANING</th>
<th>MATERIAL</th>
<th>COMPETENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disengagement:</strong> Farmers express a lack of interest in digital technologies</td>
<td><strong>Affordability:</strong> high cost of equipment and limited investment capacity</td>
<td><strong>Complexity:</strong> Not-self teachable and requires external training</td>
</tr>
<tr>
<td><strong>Misunderstanding:</strong> Farmers feel that their practices and challenges are poorly understood</td>
<td><strong>Scalability:</strong> lack of flexibility of equipment makes it difficult to integrate in small-scale farms</td>
<td><strong>Time:</strong> Limited resources available</td>
</tr>
<tr>
<td><strong>Nature symbiosis:</strong> Farmers see the intimate relationship with nature in their work jeopardized by digitalization</td>
<td><strong>Repairability:</strong> the increased complexity of equipment means that farmers can no longer repair it and have to seek external support</td>
<td></td>
</tr>
<tr>
<td><strong>Sustainable paradigms:</strong> Farmers are skeptical of the role digitalization plays in sustainable futures</td>
<td><strong>Added value:</strong> unclear to what extent digital technologies bring additional value</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General alignment and perceived usefulness of digital tools on a 4-point Likert scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived usefulness of digital platforms for sales</strong></td>
</tr>
<tr>
<td><strong>Perceived usefulness of digital tools for training and learning purposes</strong></td>
</tr>
<tr>
<td><strong>Interested in using more digital technologies</strong></td>
</tr>
<tr>
<td><strong>Alignment of digitalization with farming practices</strong></td>
</tr>
<tr>
<td><strong>Perceived usefulness of precision farming technologies</strong></td>
</tr>
<tr>
<td><strong>Perceived usefulness of robotic equipment</strong></td>
</tr>
</tbody>
</table>
RESULTS

WEAK SYNERGIES BETWEEN AGROECOLOGICAL PRINCIPLES AND DIGITAL TECHNOLOGIES

• Digital technologies are found to have a neutral to moderately positive association with agroecological principles...but with rather large divergencies amongst respondents (min standard-deviation > 0.80)

• Agroecological principles where digital technologies were found to be most in adequation with are "co-creation of knowledge" and "participation" while "biodiversity" and "fairness" were the least aligned.

• The surveyed farmers found their farming practices and objectives to be rather strongly aligned with the 13 agroecological principles (3.39).
THANK YOU!