Nordic Biogas Conference

PARALLEL 3B. WED. 23 OCT. 2024. AALBORG. DK

CIRCULAR ECONOMY – WASTE MANAGEMENT – FEEDSTOCK AND FERTILILZER QUALITY

Circular Solutions for Nutrient Recovery
Building Sustainable Synergies Across Sectors in the Baltic Sea Region

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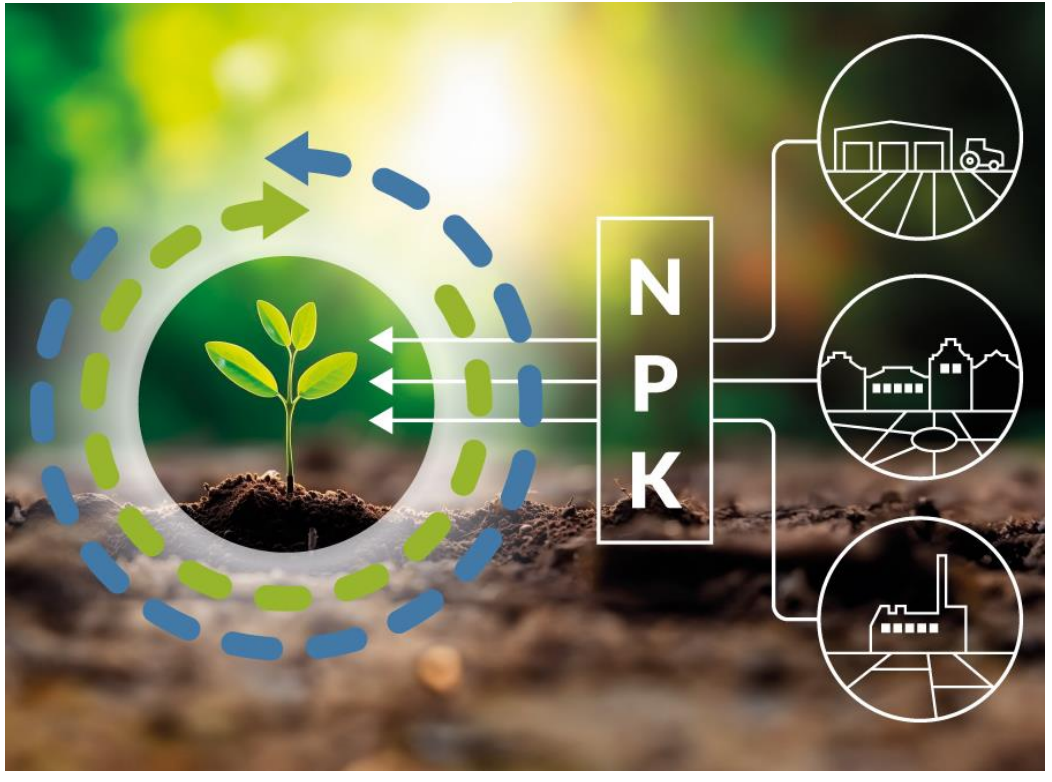
Interreg Baltic Sea Region

Co-funded by the European Union



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Circular Nutrients for a Sustainable Baltic Sea Region

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Vision and Long-term impact

HELCOM

Baltic Sea Regional Nutrient Recycling Strategy

Support the implementation of the Baltic Sea Regional Nutrient Recycling Strategy:

- Develop and promote standards for safe and sustainable recycling of nutrients
- Develop strategies for implementing nutrient recycling as a measure to improve national and regional nutrient balances
- Increase the acceptance and use of recycled nutrients
- Create business opportunities around nutrient recycling
- Improve policy coherence concerning nutrient recycling in the BSR

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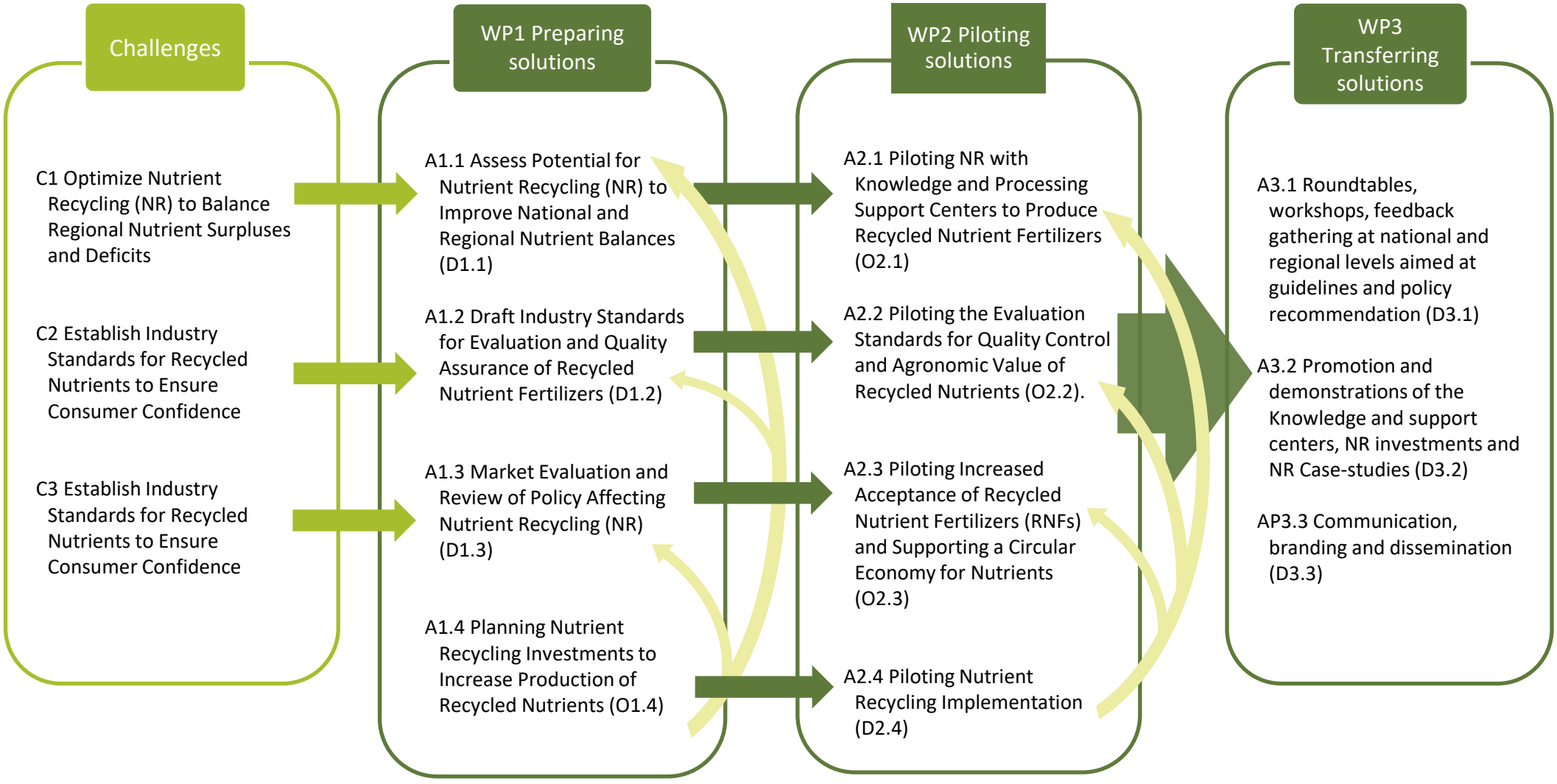
Challenges for nutrient recycling (NR) and Actions to solve them



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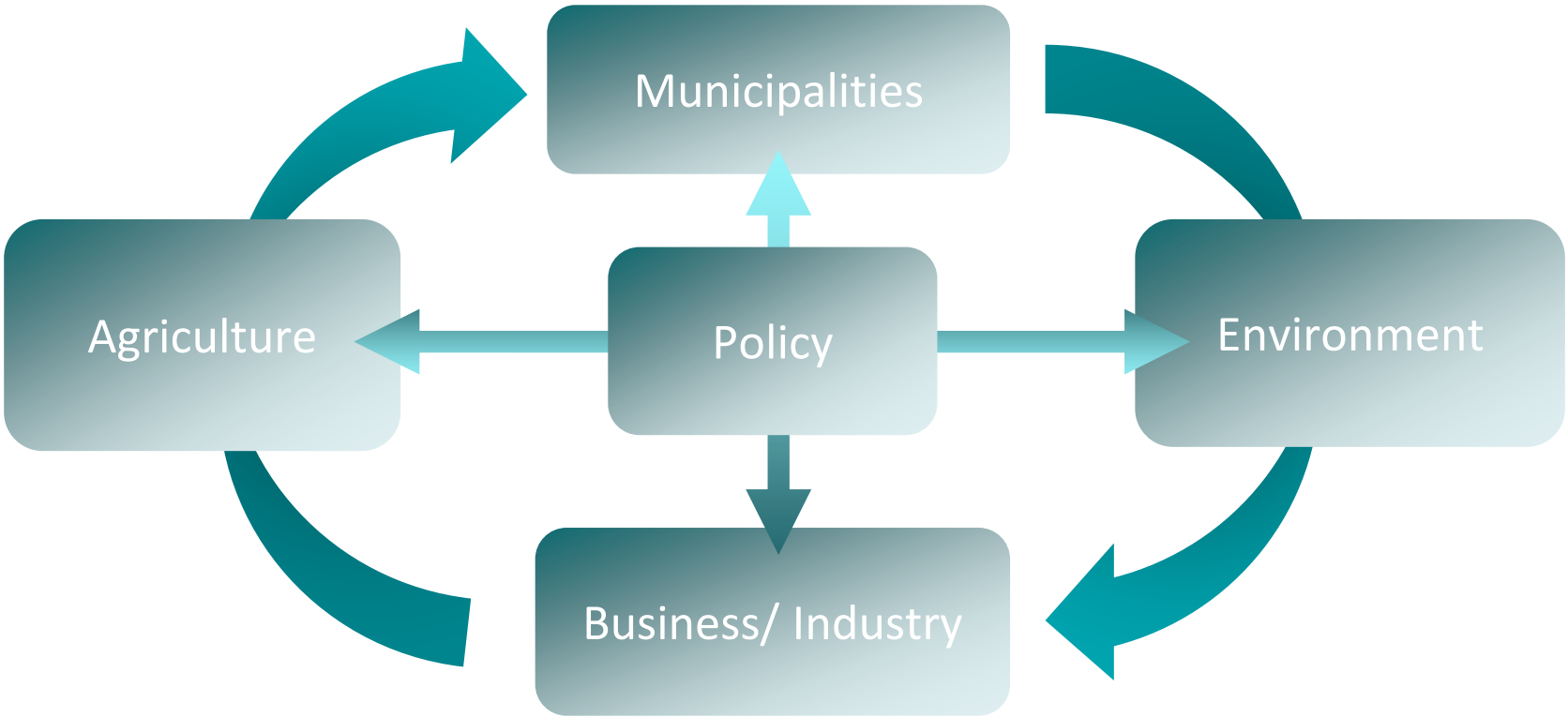
Need for Cross-Sector Collaboration



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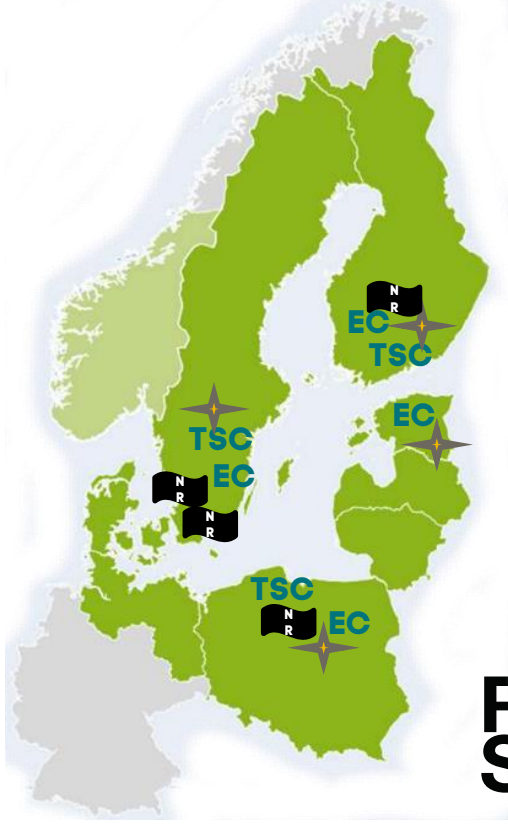
Piloting solutions for Nutrient recycling (NR)

A1 Creation of Technology Support Centers (TSC) for processing needs for nutrient recycling from various bio-streams (includes two investments); and case-studies of existing NR

A2 Creation of Evaluation Centers (EC) to determine the quality and agronomic potential of recycled nutrient fertilizers (includes one investment). Testing of Standards draft.

A3 Piloting increased acceptance of NR through demonstrations and field trials (✦) with recycled nutrient fertilizers

A4 Piloting the four commercial investments in NR



Step-by-Step Process for Manure Recycled Pellets at RISE piloting solutions plant, at More Biogas Sweden, Kalmar.

1. Collection and Transport of Manure

- **Source Identification**: Collect manure from livestock farms, mainly cattle or pig slurry.
- **Transport to More Biogas Facility**: Use slurry tankers to transport the raw manure to the More Biogas facility. Ensure that the tankers are equipped to prevent spillage or emissions during transport.

2. Pre-treatment and Acidification

Acidification for Nitrogen Retention:

- At More Biogas, manure is **acidified** using sulfuric acid to bring the pH down to approximately **6.0**. This step reduces ammonia volatilization, retaining nitrogen in the form that can be better utilized during pelletization and for crop use.
- Add approximately **4.8 liters of sulfuric acid per cubic meter** of manure. Ensure the acidification is well-mixed to achieve uniform pH levels throughout the slurry.

3. Anaerobic Digestion

Digestion Process:

- The manure is fed into **anaerobic digesters** to produce biogas (a mixture mainly composed of methane and carbon dioxide).
- During this process, organic matter is broken down, and methane is captured for energy use, either for electricity, heat production, or upgrading to vehicle fuel.
- The remaining **digestate** (a nutrient-rich slurry) is stored for further processing.

4. Separation of Digestate

Solid-Liquid Separation:

- Separate the digestate into **solid and liquid fractions**. The separation is typically performed using decanters or screw presses.
- The **solid fraction** contains a higher concentration of organic matter and nutrients (particularly phosphorus), which makes it suitable for pellet production.

5. Drying the Solid Fraction

Drying Process:

- The solid fraction of the digestate is dried to reduce moisture content, ideally to below **15%**. This can be done using either:
- **Belt dryers**, which use waste heat from biogas combustion for energy efficiency.
- **Drum dryers** or other suitable drying technologies.
- Proper drying ensures that the material is suitable for pelletizing and reduces the risk of mold growth during storage.

6. Pelletizing

Pellet Formation:

- The dried digestate is fed into a **pellet mill**. The material passes through a ring die, where it is compressed under high pressure to form pellets.
- **Additives** may be mixed with the digestate prior to pelletizing to improve the binding properties, nutrient content, or shelf life of the pellets.
- **Cooling and Storage**: After pelletizing, the hot pellets are cooled using an air cooler and stored in bulk or bagged form for easy handling and transportation.

7. Quality Control

- **Nutrient Analysis**:

Conduct a **nutrient analysis** of the pellets to determine their content of nitrogen (N), phosphorus (P), potassium (K), and other micronutrients. This ensures consistency and helps in marketing the product as a fertilizer.

- **Testing for Pathogens**:

Test the pellets for any residual **pathogens** or contaminants to ensure they meet safety standards for use in agriculture.

8. Distribution

- **Packaging**:Package the pellets into bags (typically **25 kg** bags or bulk bags) for ease of distribution. This also allows for easier transport and application.
- **Transportation to Farms**:The pellets can be transported to farms that require organic fertilizers. Since the pellets are dense and concentrated, transport is more efficient compared to liquid digestate.

9. Application in Agriculture

Field Application:

- The pellets can be applied to fields using standard **fertilizer spreaders**. Because they are dry and concentrated, they are easier to store and apply in precise amounts compared to raw manure or liquid digestate.

Benefits to Crops:

- The slow release of nutrients from the pellets helps to improve **nutrient use efficiency** and provides a steady nutrient supply to crops, reducing the need for synthetic fertilizers.
- They also contribute to **improving soil health** by adding organic matter, which helps in retaining moisture and enhancing soil structure.

Advantages of Manure Recycled Pellets:

- **Reduced Nutrient Loss**: The acidification step prior to anaerobic digestion and pelletizing helps to reduce **ammonia emissions**, ensuring more nitrogen is retained in the product.
- **Ease of Handling**: Pellets are easier to handle, store, and transport compared to liquid manure.
- **Cost Efficiency**: Reduced volume and concentrated nutrients lower **transport costs** and allow for **targeted nutrient application**, leading to better economic returns.
- **Circular Economy Contribution**: By utilizing manure and digestate from the biogas plant, the process closes the nutrient loop, returning valuable nutrients back to the soil and reducing reliance on synthetic fertilizers.

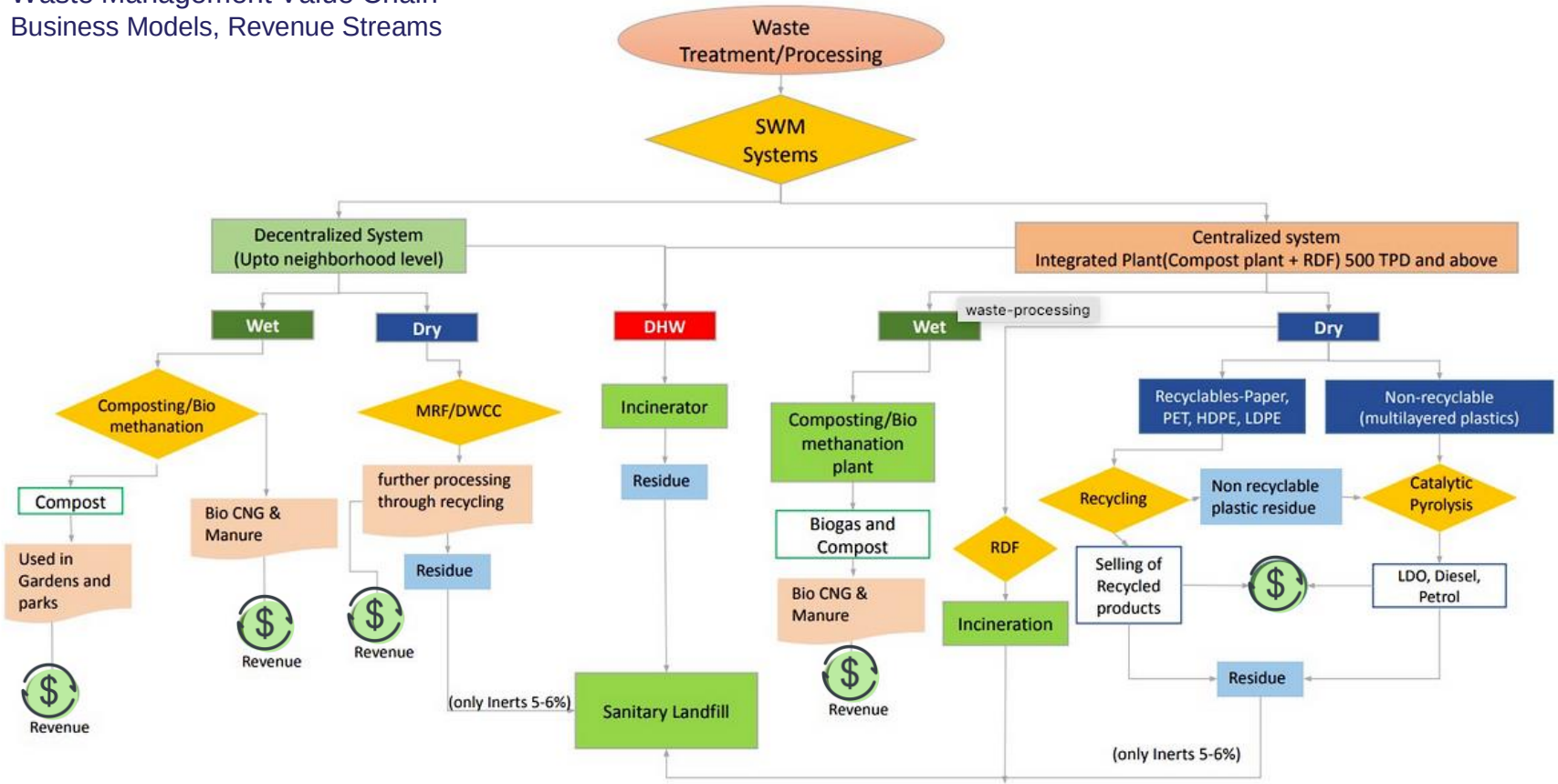
MARKET ACCESS

KUSHAAGRA Innovation Foundation (KIF) Maharashtra India

Waste Management Value Chain
Business Models, Revenue Streams

Key

- **SWM Systems**: Solid Waste Management Systems.
- **MRF**: Material Recovery Facility
- **DWCC**: Dry Waste Collection Center
- **DHW**: Domestic Hazardous Waste – waste from households that is considered hazardous (e.g., batteries, chemicals).
- **RDF**: Refuse-Derived Fuel
- **CNG**: Compressed Natural Gas
- **TPD**: Tons Per Day



Ref: KIF, *Waste Management Value Chain- bhagya.* Internet access at https://kushaagra.org/waste-management-value-chain-bhagya/. Accessed 16 Oct. 2024

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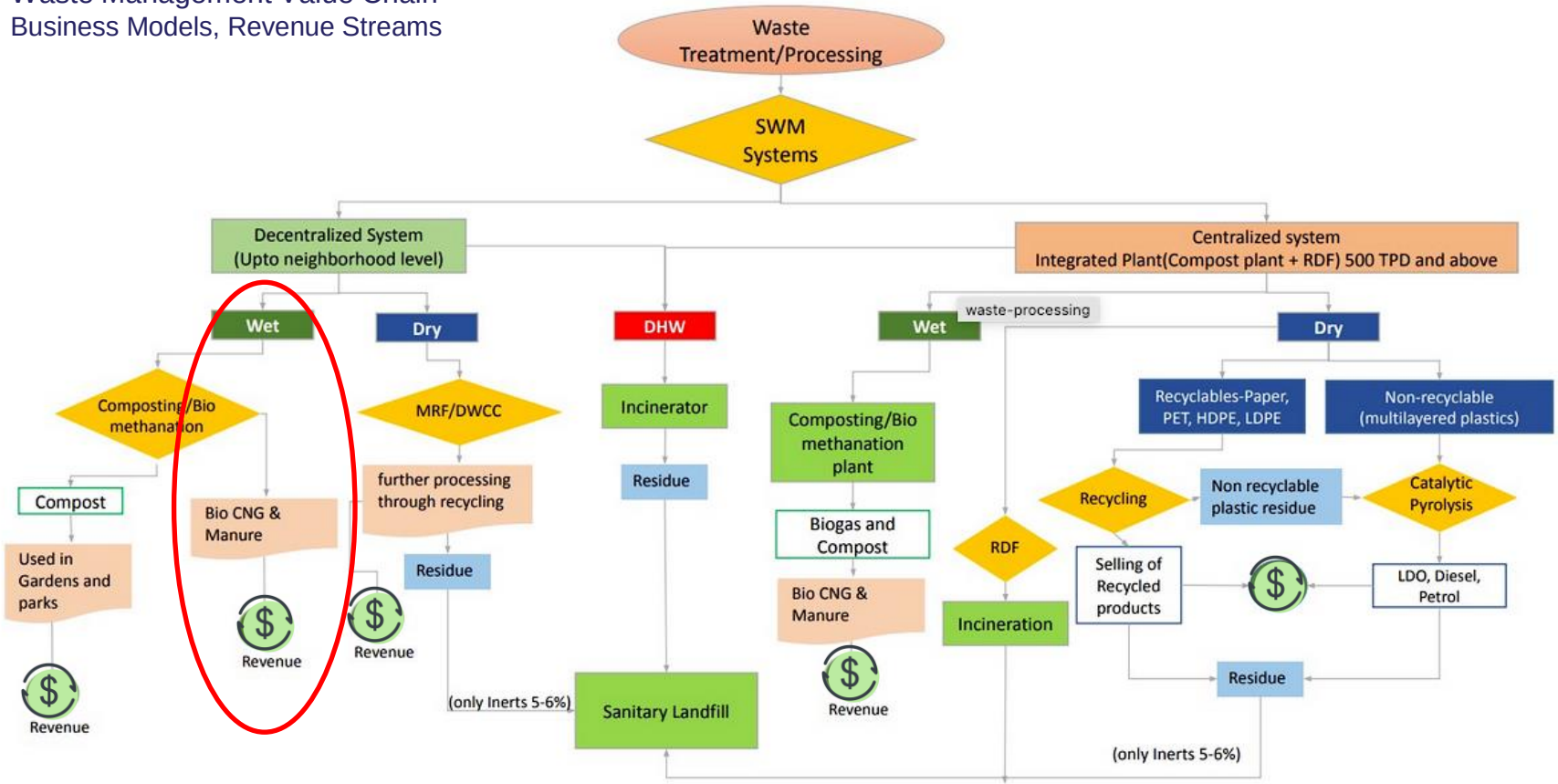

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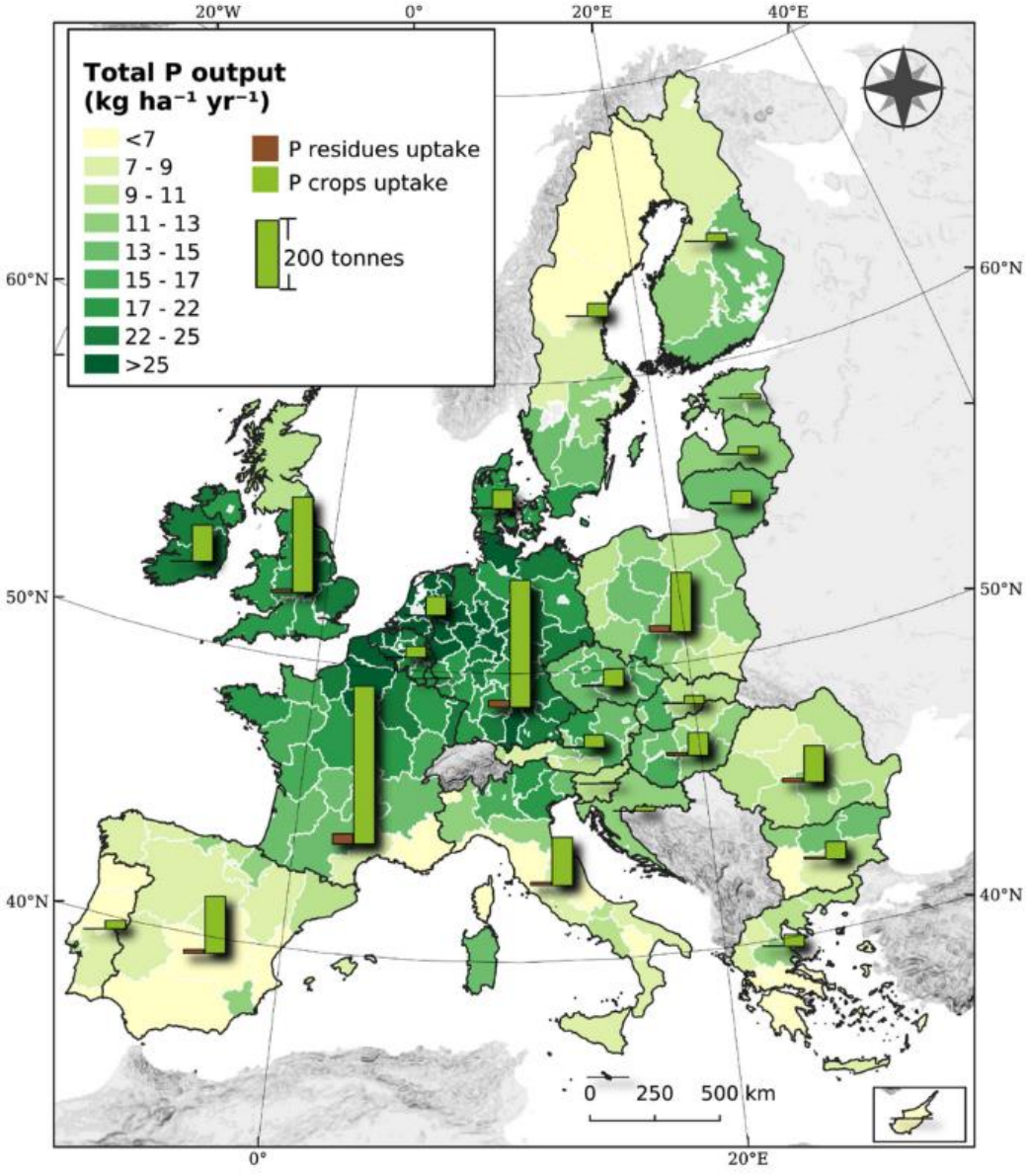
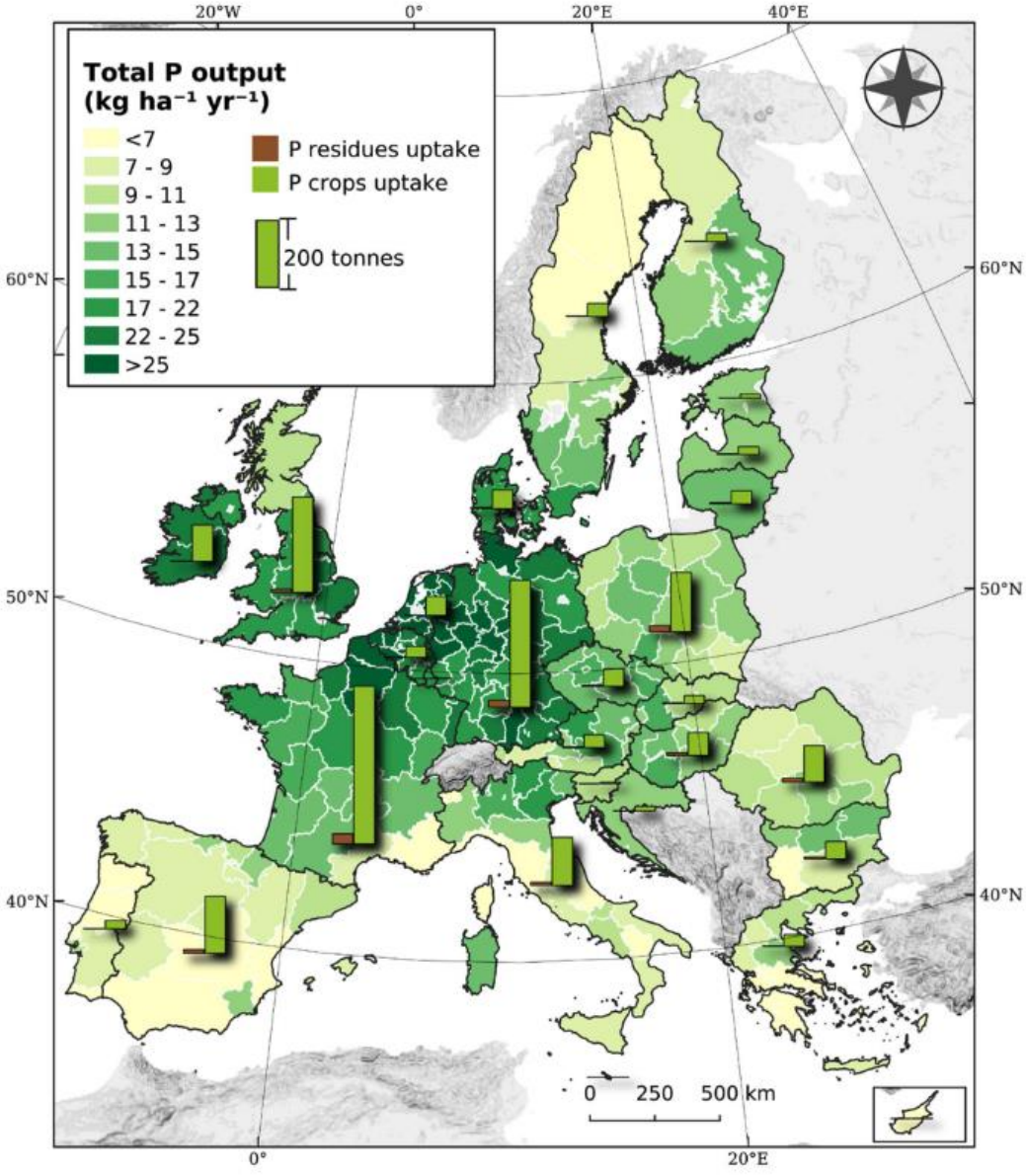


Total phosphorus removal per country and region. Green bars aggregate P crop removal per country and brown ones are the aggregated P removal with residues.

Ref: Panagos, P., Muntwyler, A., Liakos, L. *et al.* Phosphorus plant removal from European agricultural land. *J Consum Prot Food Saf* **17**, 5–20 (2022). https://doi.org/10.1007/s00003-022-01363-3



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Sweden, in the context of crop production and environmental impacts:

1.Phosphorus as a Critical Nutrient: P is essential for plant growth but has become a limiting factor due to imbalanced use and environmental regulations. Effective management is necessary to support sustainable agriculture without contributing to environmental issues like eutrophication.

2.Dependence on Imported Phosphorus: Sweden, like other European countries, relies on imported P fertilizers, and this dependence has implications for food security and agricultural production.

3.Challenges with Phosphorus Management: The study highlights that excessive use of P fertilizers in the past has led to environmental concerns, including water pollution. The shift towards more balanced use is now critical to meet the EU's Farm to Fork Strategy goals.

4.Regional Variability in Phosphorus Availability: Within the EU, there is significant variability in the availability of P in soils, influenced by factors like soil properties and historical fertilization practices. Northern European countries, including Sweden, tend to have more P-saturated soils, which requires careful management to prevent environmental losses.

5.Phosphorus Removal and Recycling: The removal of P through crop harvesting and residues in Sweden contributes to the nutrient balance but must be managed to avoid deficits or surpluses. Recycled nutrients, including those from bio-based fertilizers, can help maintain this balance but require careful integration into farming practices.

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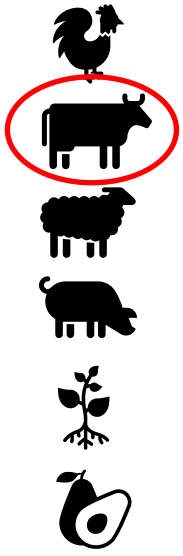
SCENARIO BUILDING for NORDIC MARKETS

Bio-based fertilizers Value Chain: Production to Market

Process: Anaerobic digestion of organic waste, generates biogas and a nutrient-rich by-product, digestate.
Output: The digestate can be processed into a solid or liquid bio-based fertilizer, offering a sustainable alternative to synthetic fertilizers.



Collection of Organic Waste → Transport to Processing Facilities → Processing of Organic Waste → Bio-methanation → Production and Packaging

Sources

Decentralized Collection Systems

Centralized Collection Systems

Logistics

Intermediate Handling at Material Recovery Facilities (MRFs) directed toward composting or bio-methanation units

Process: Aerobic decomposition to produce compost, which is rich in nutrients like N, P, K
Output: The compost is used as a bio-based fertilizer suitable for improving soil health in gardens, parks, and agricultural fields.

Product **Refinement**

Product **Packaging** for various markets

Market Channels → End Users and Application → Revenue Streams and Circular Economy Benefits

Local Markets

Agricultural Cooperatives

Retail Outlets

Export Potential

Farmers

Gardens and Parks

Households

Revenue Generation

Environmental Benefits

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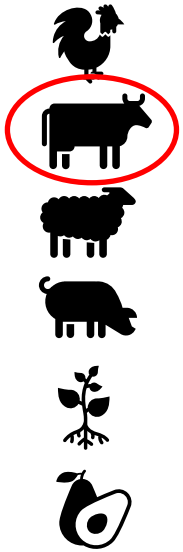

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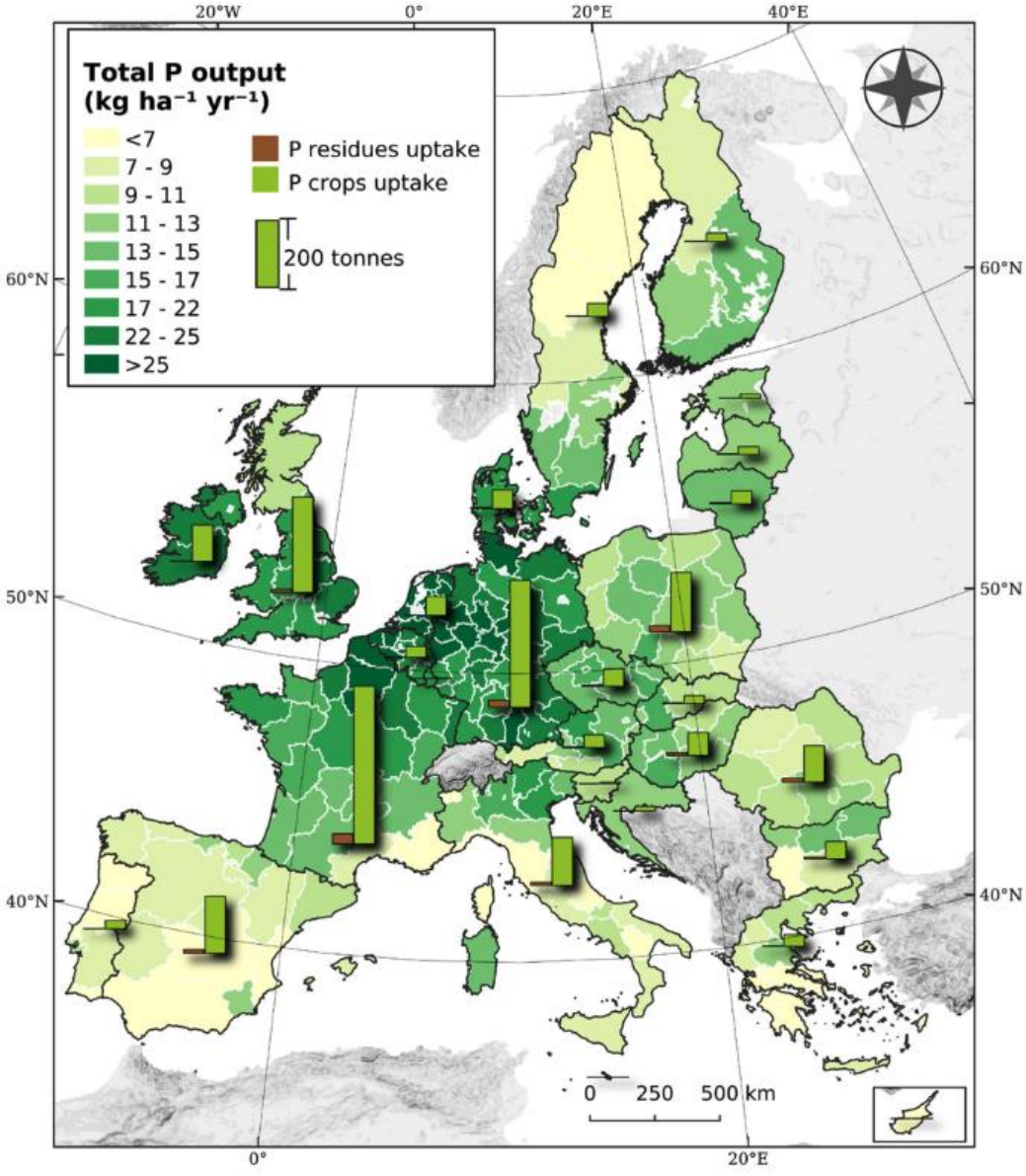


To improve market access for bio-based fertilizers in Sweden, considering the high processing and distribution costs, several strategies can be employed to enhance competitiveness and profitability:

1. Collaborative Production Models

•**Shared Facilities**: Establish shared processing facilities that are co-owned by multiple producers or cooperatives. This can help reduce capital investment and operational costs, making processing more economically feasible.

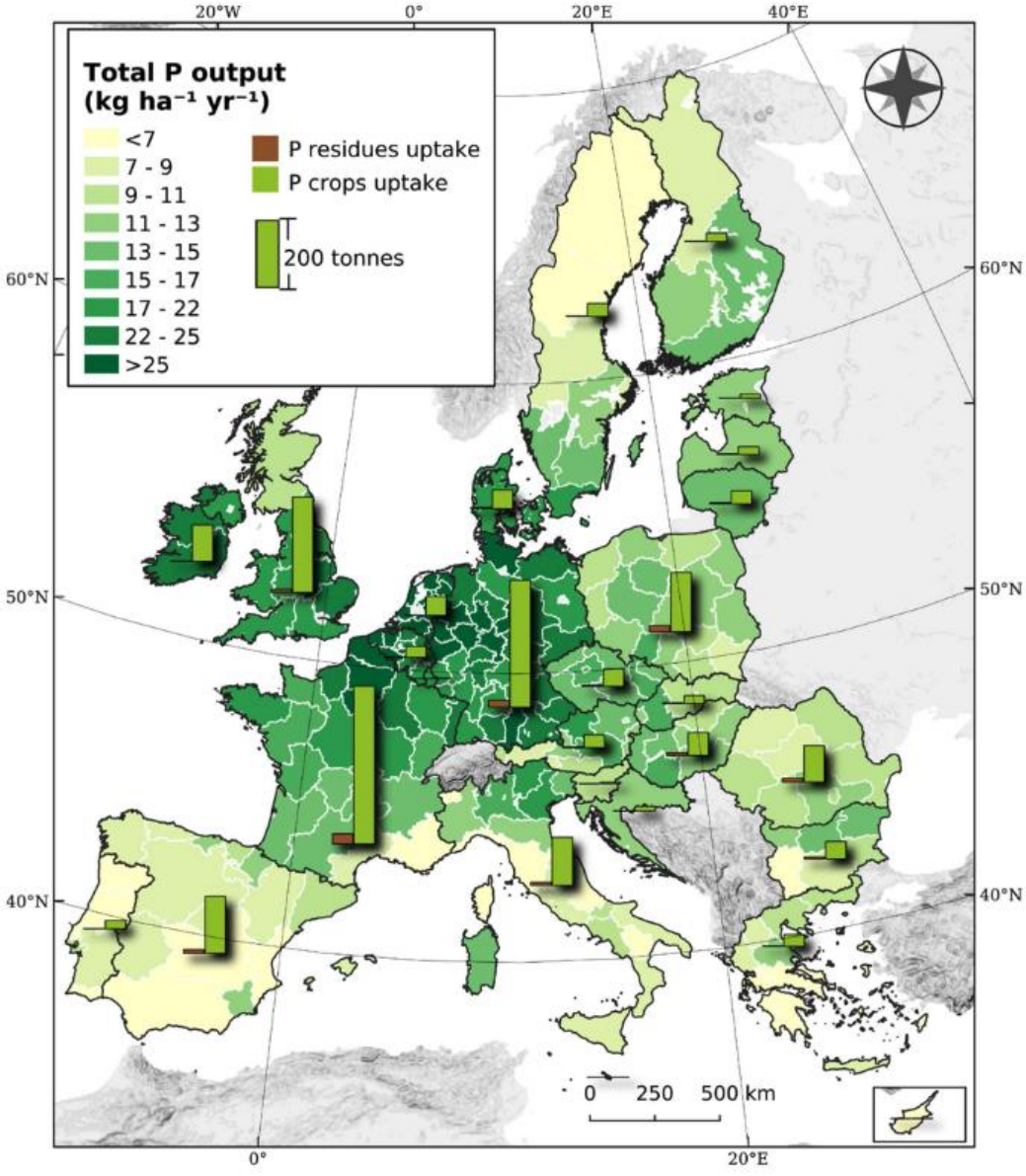
•**Local Community Composting**: Develop smaller-scale, community-based composting projects that produce bio-based fertilizers closer to the source of organic waste. This can reduce transportation costs associated with centralized production.

2. Government Subsidies and Incentives

•**Subsidies for Bio-Based Products**: Advocate for government subsidies specifically for bio-based fertilizer production to offset the high costs of processing and distribution.

•**Carbon Credits**: Engage with carbon credit schemes that reward the reduction of greenhouse gas emissions through bio-based fertilizers, providing an additional revenue stream.

•**Grants for Technological Upgrades**: Seek grants for adopting more efficient processing technologies that can lower production costs over time.



3. Market Differentiation and Branding

•**Eco-Certifications**: Obtain eco-certifications (e.g., organic, sustainable agriculture certifications) that can increase the perceived value of bio-based fertilizers among environmentally conscious consumers and farmers.
•**Local and Sustainable Branding**: Emphasize the local production and sustainability aspects in marketing campaigns. Highlight the lower carbon footprint compared to imported synthetic fertilizers.

4. Innovative Distribution Models

•**Direct-to-Farm Sales**: Utilize direct sales channels through e-commerce platforms, bypassing traditional retail channels to reduce distribution margins. This can work well for smaller farms looking for cost-effective solutions.
•**Subscription Models**: Introduce subscription services for bio-based fertilizers, offering regular deliveries to farmers throughout the growing season. This can ensure consistent demand and help manage cash flow.
•**Local Hubs for Distribution**: Establish local distribution hubs in rural areas to shorten the transportation distances, thereby lowering the costs of reaching end-users.

5. Scaling Production Through Waste Stream Optimization

•**Leveraging Agricultural and Food Waste**: Collaborate with the food processing industry to secure a steady stream of organic waste materials, reducing raw material costs for producing bio-based fertilizers.

•**Integrate with Biogas Production**: Combine bio-methanation processes with fertilizer production, where biogas plants also produce digestate as a fertilizer by-product, providing dual revenue streams (biogas and fertilizer).

6. Awareness Campaigns for End-Users

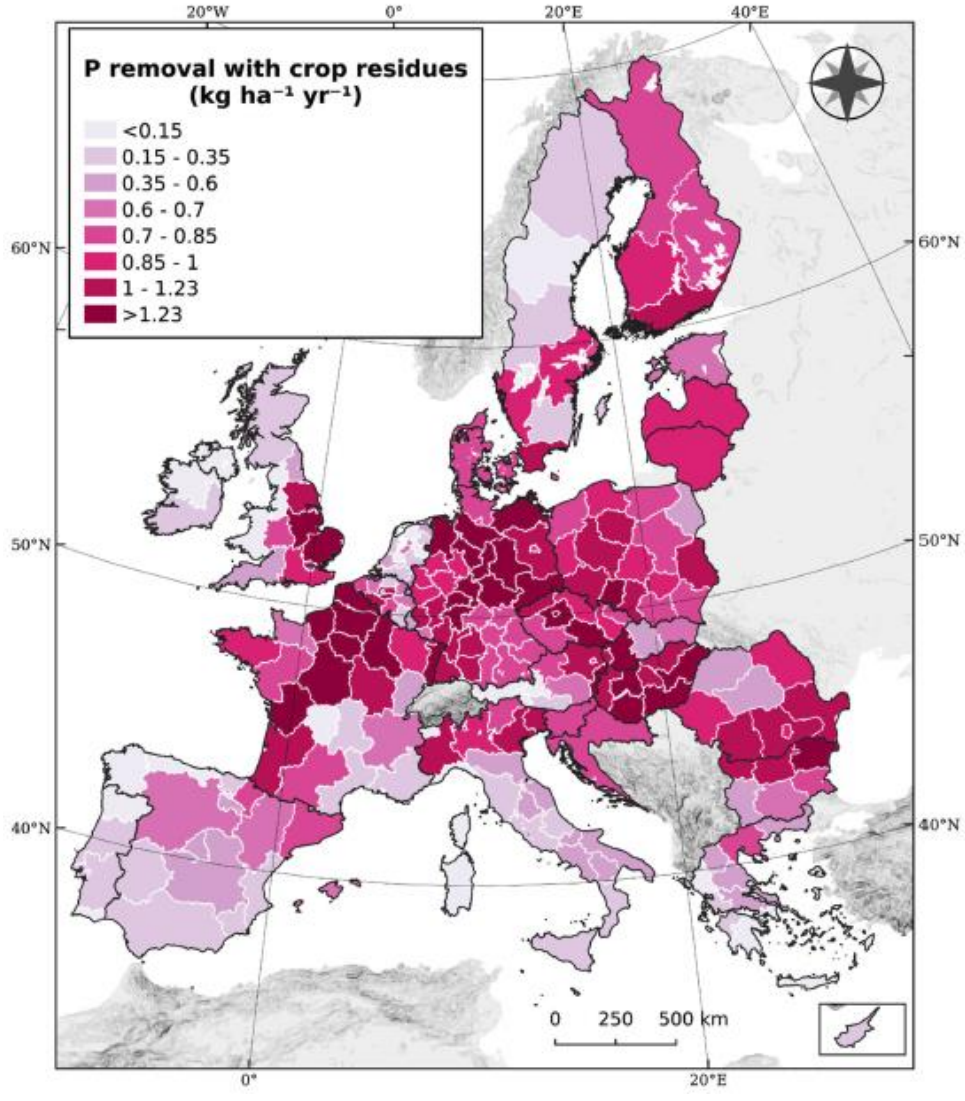
•**Demonstration Farms**: Set up demonstration farms in different regions to showcase the effectiveness of bio-based fertilizers compared to conventional fertilizers. This can help build trust and encourage adoption.

•**Workshops and Training**: Conduct workshops for farmers on the benefits and application techniques of bio-based fertilizers, emphasizing long-term soil health and reduced dependency on chemical inputs.

7. Niche Markets and Export Potential

•**Organic Farming Sector**: Target organic farmers who are willing to pay a premium for sustainable and certified inputs, making up for higher production costs.

•**Export to Neighboring Markets**: Explore export opportunities to markets in the EU where there may be a demand for high-quality bio-based fertilizers, especially in countries with stringent environmental regulations.



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THANK YOU

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