WORKSHOP REPORT

BONUS RETURN

Turning waste into circular solutions for the Baltic Sea

FORMAS

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Mission Blue - Exploring Circular Interventions in the Baltic Sea Region

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Executive Summary

We know that the Baltic Sea is one of the planet's most vulnerable marine ecosystems. It is a partly enclosed sea with a retention time of around 30 years, surrounded by a drainage area four times as large as the sea area itself. It is inhabited by 90 million people in a highly industrialized landscape dominated by intensive agriculture, forestry and various industries.

Despite the wealth of knowledge and experience throughout the region and the actions over decades taken to abate pollution, eutrophication of the Baltic Sea from wastewater, agriculture, industry and atmospheric deposits remains a challenge. A combination of technical and policy innovations as well as financial and economic incentives are needed to transform the sources of nutrient pollution from land, watersheds, coastal areas and the open sea into potential resources.

This report summarizes results from the virtual workshop "Mission Blue", organized by the BONUS RETURN project on the 10th of June 2020.

The workshop had a dual purpose. First, it aimed at testing an architecture of a mission-oriented approach underpinned by a co-creation process. Second, the workshop sought to engage participants in a reflection about what kinds of interventions, and what 'innovation mixes' or 'innovation portfolios', have the highest potential to achieve transformative impact to accomplish missions in the context of the Baltic Sea.

The aim was to contribute to producing more tangible cross-sectoral prototype interventions that could be taken forward and further developed as impact projects within the broader umbrella of "Missions" for oceans. In line with HELCOM's goal for the region, the mission addressed in this workshop was of a Baltic Sea unaffected by pollution. Accordingly, interventions consisted of a selection of different measures to address a carbon and nutrient stock or flow.

To design interventions, we used the synopses of new measures or actions collected by HELCOM at the end of 2019 from regional stakeholders, and which would inform the update of the Strategic Plan for the Baltic Sea Action Plan (BSAP). This list was organized, categorized, and further developed by workshop participants. The preparatory process culminated with a list of 21 land-based, catchment-based or coastal/offshore-based measures, and organized into four categories: coordination, data, ecotechnologies and policy. The list of measures was used during the workshop to design interventions consisting of up to four measures each.

Forty-nine participants from Germany, Netherlands, Latvia, Poland, Denmark, Finland and Sweden representing funding agencies, research, branch organizations, the private sector, and regional organizations collaborated to develop five circular interventions that could address eutrophication in the Baltic Sea. For each intervention, participants identified the actors and processes, existing and required capabilities, and positive and negative impacts. The design of the interventions was guided by criteria related to circularity, efficiency, feasibility, co-benefits, innovation potential, coherence and risk.

1. A mission approach to healthy seas, coastal and inland waters

Healthy seas, coastal and inland waters are vital for our societies and the future of our planet. They are our planet's "lungs" and the single largest carbon sink in the world. By supplying freshwater, renewable energy and socio-economic benefits, they are also the source of all life on Earth and our planet's life-support system.

However, water resources from land to the coastal zones are being degraded with impacts on life supporting ecosystems, including the open ocean. Human activities, both upstream in the terrestrial system and in the coastal zones, have deteriorated estuaries, coastal areas and seas over extensive areas of the planet. Spatial planning mechanisms and governance systems to address water resources degradation have not produced clear and tangible management frameworks that are effective in overcoming conflicting or incompatible goals. Neither freshwater nor coastal ecosystems will be able to function properly and provide essential services if the current fragmented governance of land, water, coastal and marine resources continues unabated (Granit et al., 2014).

In Europe, a recent response to the "silo" approach to planning is the focus on missions[1]. Mission-oriented policies are understood as systemic public policies that draw on state-of-the-art knowledge to attain specific goals (Ergas, 1987) pertaining to grand societal challenges. Mission-oriented thinking requires understanding of the difference between industrial sectors, broad challenges, and concrete problems that different sectors can address to tackle a challenge (Mazzucato, 2018). This demands a shift in focus from ad hoc investments, for example in single-purpose infrastructure, towards policies that are steered towards transformational changes—such as the development of new general-purpose technologies that cut across sectors (Mazzucato & Penna, 2015).

While in recent years we have witnessed an increased focus on missions as the new framework for research and innovation in Europe, their operationalization is not entirely clear yet. The literature on mission-oriented policies remains largely conceptual so that learning outcomes from empirical cases are lacking. As a result, theoretical understanding and policy advice on how to manage mission-oriented initiatives are very diverse and often fail to address the key justifications for these policies in contrast to those of simply fixing market failures (Mazzucato, 2018). As the European Union increasingly moves towards mission-oriented policies to address at least five major missions (oceans, mobility, food, cancer and climate), there remain key questions and challenges when it comes to their implementation.

[1] https://eu2019.fi/documents/11707387/14482217/Presidency+discussion+paper+-+Missions+as+a+strategic+tool+in+Horizon+Europe.pdf/34b71109-edb4-ddb7-5b54-f7a5d55f0e2d/Presidency+discussion+paper+-+Missions+as+a+strategic+tool+in+Horizon+Europe.pdf.pdf

First, while there certainly is a need for grand ambitions to meet societal challenges, it is important that these ambitions can be realized in a fashion that deals with the many obstacles that emerge. As is highlighted by the growing literature in innovation policy that attempts to analyse the problems and possible solutions for managing megaprojects, a key success factor is to find ways to ***"split the cake"*** and divide large projects into smaller and preferably fairly independent components (Flyvbjerg, 2014) while maintaining a systemic understanding of the challenge.

Second, although a range of recommendations for governing missions have been formulated (Mazzucato, 2019), these require contextualization. This includes a process for identifying best practices that can support the shift towards mission-oriented thinking, an evaluation of existing organizational capabilities in public agencies, and the formulation of bottom-up roadmaps adapted to local contexts, rather than a "one-size fits all" approach. Identification of missing links, failures and bottlenecks in planning and innovation– but also recognizing the system's strengths, resources and knowledge (Mazzucato, 2018) is necessary for **aligning capacities with vision**.

A third challenge is related to the **how to** of missions for **moving from concept to practice**. Framing, defining and designing challenges are important parts of the puzzle, but the real question is how these challenges will be financed, implemented, and followed up. While missions require transformation of systems and landscapes rather than quick or short-term fixes, the barriers faced to implement and scale up solutions for transformation are not automatically addressed simply by formulating more ambitious plans. There is still a need to deal with the underlying structures that will define whether and how missions are implemented.

1.1 Realizing public value

Missions can benefit from tested solutions to respond to urgent problems in the short term, but they also need ambitious innovations that challenge the mainstream business models, redesign socio-technical systems, change urban and rural landscapes, and experiment with new governance, policy and economic frameworks.

While much of the regional innovation policy literature has focused on technological innovation (c.f Jeannerat & Crevoisier, 2016), **creating public value demands attention to place-based policies that promote inclusive network structures**, and to processes that enhance capabilities and ensure participation (Feldman et al., 2016). Place-based policies are important because missions require contextualization, including a process for identifying best practices that can support the shift towards mission-oriented thinking, an evaluation of existing organizational capabilities in public agencies, the identification of missing links, failures, and bottlenecks in planning and innovation.

Framing innovation in terms of public value, is part of the move towards understanding innovation in relation to transformative change, rather than mere technological advancement for economic growth. **Innovation for transformative change questions how science and technology policy should be used for meeting social needs**. Such framing is clearly reflected for example in Agenda 2030, which addresses the issues of sustainable and inclusive societies at a more fundamental level than previous agendas have done (Schot & Steinmueller, 2018). Reframing innovation as transformative change has shifted the focus in the innovation policy debate away from mere quantity or rate of innovation towards quality and direction of innovations (e.g., whether innovations help alleviate wicked problems) (Mazzucato, 2017).

While framing and defining public value are important parts of the puzzle for imagining a new kind of public policy, what often gets underscored is the urgency and impact of how these interventions will be operationalized in terms of resource allocation and actual policy shifts to realize public value.

A key question here is how public value is performed within specific systems and by specific actors (Uyarra et al., 2019). **Public value represents the values and concerns of those actors and institutions deemed responsible for defining them**. Consequently, the challenges and their solutions will also vary depending on how and by whom the system is defined and the geographies in which they are defined.

1.2 Enacting missions through participation

Recent discussions around creating public value for water, coasts and seas propose adopting a social innovation approach that bridges scientific knowledge, with innovation policy and users' perceptions.

Invest in institutional capacities to cut across sectors and governance levels. For instance, Hekkert et al., (2007) argue that for an innovation system to function well entrepreneurial activities, knowledge development, network formation, knowledge diffusion, guidance of search between technological options, market formation, resource mobilization and support from advocacy coalitions need to be in place. Kattel and Mazzucato (2018) highlight the importance of ensuring dynamic capabilities in the public sector. Capabilities are skills and routines within various layers of capacities, and they constitute what kind of capacity is there at any given point in time. Capabilities are dynamic because they interact across three levels - state, policy and administrative - and provide the drive for change that in turn feeds back into capacities through socio-political feedback mechanisms.

Create public value through local needs and define those needs in processes that are as bottom-up as possible (Uyarra et al., 2019). This includes investigating the role of innovation-orientated public procurement beyond the national levels in order to tap into available funding at subnational levels, while relating to the spatial footprint of public demand and its influence on local economies and labour markets (Uyarra et al., 2020). Uyarra et al., (2017) suggest that innovation-oriented public procurement, may be particularly relevant in cases of well-defined needs, or where local strengths in the knowledge base exist that could be used to address local and potentially global solutions. In this context, they introduce the concept of conversations to shape the participation and content of early dialogues among key stakeholders in public procurement, while maintaining anchorage to a location.

Public Private Partnerships (PPPs) can **cut across traditional financial, regulatory and communicative instruments to address innovation failures** (Hermans et al., 2019). PPPs are collaborative arrangements where private actors pool their resources with public sector organisations, including government agencies, associations and research organizations. PPPs are often highlighted as a mechanism to address complex problems beyond the reach of a single actor. Using the case of innovation in the agricultural sector in the Netherlands, they show how PPPs may function as a systemic policy instrument, by enhancing connections and alignment between innovating actors in innovation systems.

We draw on this literature to design an architecture of a mission-oriented approach that can initiate a conversation about the types of innovations needed in the Baltic Sea Region.

2. A mission architecture for the Baltic Sea Region

The challenges underpinning the Blue Baltic missions are complex, multidimensional, dynamic and uncertain, especially in the long run. Thus**, a reflection is needed about what kinds of innovation, and what 'innovation mixes' or 'innovation portfolios', have the highest potential to achieve transformative impact to accomplish missions that contribute to sustainable development.** However, the kind of actions necessary to address them will require bottom-up diffusion and co-production activities rather than mere technology push strategies (Coenen et al., 2015). Thus, innovation mixes for missions will need to include a wide variety of often interconnected technological, socio-economic and environmental innovations.

The starting point of the present exercise is the integration of existing scientific and policy knowledge from the Baltic Sea Region to respond to calls within the EU to work towards mission-oriented innovation policy. Accordingly, we align the purpose and "mission" of the workshop to HELCOM's goal for the region - **"a Baltic Sea unaffected by pollution".**

The approach for the present workshop started from the conviction that to achieve the mission, linear models of "use and dispose of" are insufficient. Instead, **interventions that reduce-reuse-recycle-recover are crucial for closing the loop, limiting the total input of nutrients and pollutants into watersheds and the ocean, and at the same time addressing emissions from the extraction of raw materials**. Innovations that aim to capture the circularity of the water-coast-ocean system therefore need to be devised to capture both flows and stocks of pollutants.

Flows refer to the movement of nutrients and carbon from one place to another. For example, imported mineral fertilizers or animal feeds imply nutrients "flowing" onto the farm; when nitrate is lost from the soil by leaching to groundwater or when runoff waters take nutrients along with eroded topsoil to a nearby stream, nutrients and carbon are flowing into water streams; when water streams reach the ocean, the nutrient and carbon loads carried in the water flows into coastal waters. Another type of flow emanates from the food we eat. A substantial portion of food consumption and food imports are converted to human excreta. Although the improvement of centralized wastewater treatment plants have reduced the flow of phosphorus-rich wastewater into the sea, the situation across the region varies and, in some places, the water discharged is not only rich in nutrients but also in other pollutants and hazardous substances.

Stocks refer to legacies - of nutrients and carbon. Legacy sources in land can leak for decades, leading to time lags between the implementation of abatement measures and the realization of reductions in loads to downstream water bodies. These legacies play an important role for the state of eutrophication in the Baltic Sea. The Baltic Sea is characterized by a restricted water exchange with the open ocean and a large inflow of river water from the surrounding drainage basin. These factors, together with the natural sub-basin, are causing slow water exchange with a retention time of approximately 30 years. Furthermore, the sediment is also retaining and storing nutrients and organic matter through a so-called biological pump, whereby carbon through degradation processes is transported from the surface to the benthic sediment zone. However, connected to eutrophication, the stocks of phosphorus in the oxygen-free sediment diffuse into the water column, causing an internal phosphorus loading in the Baltic Sea which enhances further the level of eutrophication.

2.1 Methodology

The ambition of this workshop was to initiate a conversation about systemic interventions that can close nutrient loops and increase circularity. To do this, we pilot-tested a mission-oriented architecture underpinned by a co-creation approach that integrated gaming elements.

Building on the body of work introduced in the previous section, the workshop incorporated the following elements in its design:

1. **Process design** – what collaborative approaches are most suitable to define missions?
2. **Organization of a mission** – Which actors and expertise are necessary to construct cross-sectoral interventions?
3. **Framing interventions** – What are the key investments that could more efficiently contribute to achieving the mission?
4. **Process mapping** – How do actors and sectors connect with resources, capabilities and policies?
5. **Barriers and opportunities** – What capabilities -or lack of them- can help or hinder the mission?

Participants representing key sectors from around the Baltic Sea Region were invited to co-design specific interventions that would reduce the multiple pressures from stocks and flows on water, coasts and the sea, and thus bring us closer to achieving the overarching mission of a Baltic Sea unaffected by pollution.

Interventions are defined as innovative, cross-sectoral projects and their systems of actors, processes, capabilities and impacts. Interventions are concrete, time-bound, and measurable. They are formed by a number of individual measures or actions targeting single problems typically within a sector or geographic area, but when put together as an intervention, these measures have the potential to address several sectors and provide system solutions.

Forty-nine participants from Germany, Netherlands, Latvia, Poland, Denmark, Finland and Sweden representing funding agencies, research, branch organizations, the private sector, and regional organizations were divided into five working groups and tasked with designing an intervention (see Appendix D for the meeting agenda and Appendix A for the participants' list). To achieve this, the workshop followed a three-step approach, as illustrated in Figure 1, to design interventions.

- The "**Cook**" step presents the measures in a coherent way and allows space for reflecting upon the content, purpose, and potential missing links of the proposed measures. Based on this reflection, participants deliberate on the goal of the intervention and the most appropriate combination of measures to design the intervention.
- The "**Incubation**" step challenges participants to reflect upon the actors, process, capabilities, potential costs, and impacts of their intervention. This reflection is informed by pre-defined criteria.
- The "**Evaluation**" step is the process of reviewing the suitability of the intervention according to the pre-defined criteria, acknowledging its strengths and weaknesses and considering potential mitigation actions to counterbalance trade-offs.

To support the working groups and provide directionality, an expert panel consisting of 5 members with backgrounds in wastewater treatment and agriculture from the private sector, research, and sector associations was tasked with providing critical reflections to the arguments and propositions presented by the groups. The aim of the expert panel was to help the working groups design cross-sectoral interventions that would capture as much of the criteria as possible.

Figure 1. Three-step approach taken in the mission's workshop to develop interventions for increased nutrient circularity in the Baltic Sea Region.

2.1.1 "Cook" step

The measures, which were the starting point for designing the interventions, are part of the synopses collected by HELCOM at the end of 2019 from regional stakeholders, and which would inform the update of the Strategic Plan for the Baltic Sea Action Plan (BSAP). For the present workshop, this list of measures was organized, categorized, and further developed. Several of the participants were themselves proponents of some of these actions. The process culminated in a list of 21 land-based, catchment-based or coastal/offshore-based measures, and organized into four categories: coordination, data, ecotechnologies and policy.

Figure 2 provides an example of a measure description (all measure descriptions can be found in Appendix B). Each measure includes the following information:

- **Problem description:** The issue which the measure is trying to address.
- **Required actions:** processes, investments, or decisions required to implement the measure.
- **Expected effects:** from implementing the measure.
- **Type of measure:** can be either collaboration, data, ecotechnologies, or policy.
- **Area of operation**: refers to whether the measure is land-based, catchment-based, or coastal zone/offshore-based.

- **Stream:** Refers to flows or stocks of nutrients. Flows refer to the movement of nutrients and carbon from one place to another. Stocks refer to legacies – of nutrients and carbon e.g. in soil and sediment.

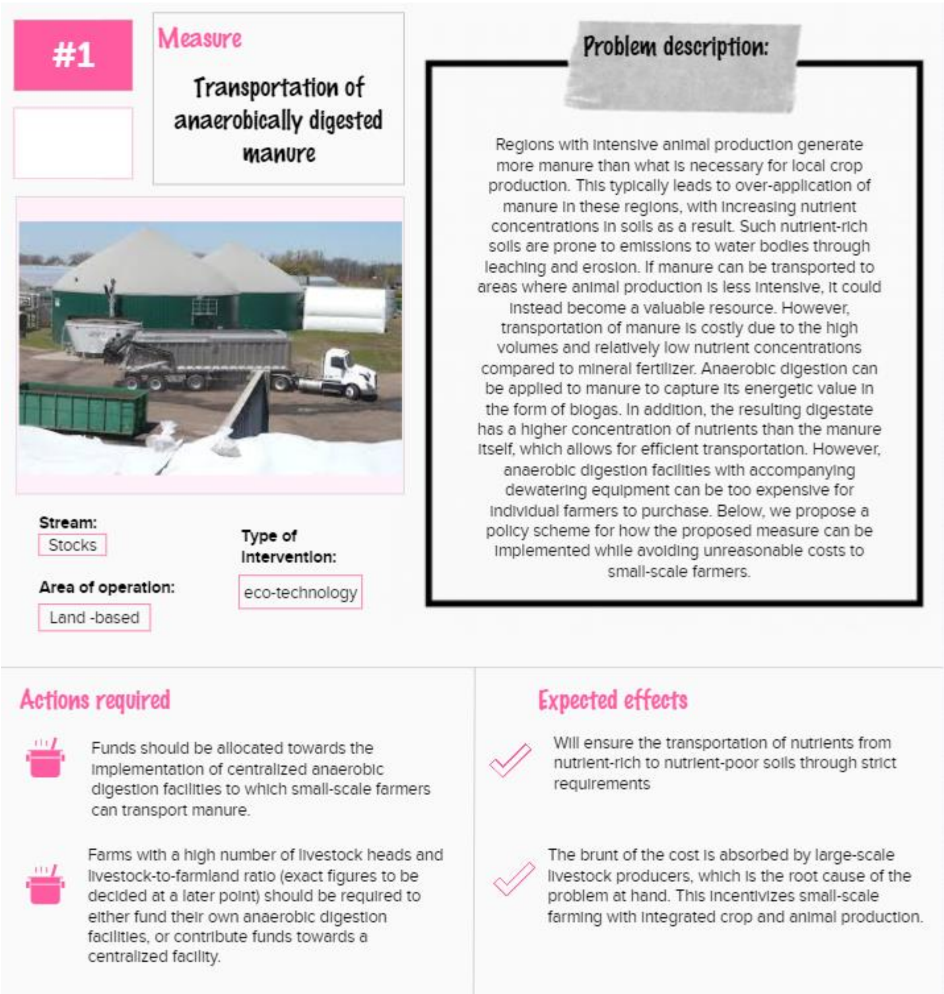


Figure 2. Description of one of the 21 measures available for the workshop participants.

Below is a list of all the provided measures organised according to category. This list was made available to the participants prior to the workshop.

COORDINATION MEASURES

C1	Improve knowledge transfer between farmers, authorities and decision makers.
C3	Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region.

DATA MEASURES

D1	Integrated and harmonized risk assessment of phosphorus losses from agricultural soils to surface water.
D2	Reporting estimates on the effects of agri-environmental measures on the main

	phosphorus fractions
D3	Definition of "New Hot Spots" of nutrient input into the Baltic and subsequent targeted measures to reduce the source.

ECOTECHNOLOGY MEASURES

E1	Recycling of nutrients and carbon in agricultural residues by use of anaerobic digestion
E2	Use of gypsum to reduce phosphorus loads from agricultural land
E3	Reducing internal phosphorus loads by metal bonding
E4	Reducing nutrient loading by farming and harvesting blue mussels
E5	Rehabilitation of hypoxic areas by oxygen pumping
E6	Source separation of sewage systems in newly built areas and in areas renovated
E7	Nutrient recovery in wastewater treatment plants

POLICY MEASURES

P1	Incentives to support the use and production of manure-based recycled fertilizers
P2	Prohibition of post-harvest application of manure and other organic fertilizers
P3	Tax on mineral fertilizers
P4	Reducing livestock densities and coupling livestock to the area of available farmland
P5	Allow coordination of abatement measures among HELCOM countries to ensure cost-effective nutrient abatement at the basin and Baltic scales
P6	Improved integration of BSAP targets with WFD targets
P7	Strengthening of HELCOM recommendation 28E/5 on municipal wastewater treatment
P8	Use the Common Agricultural Policy (CAP) to support agreed upon measures.

Prior to the workshop, participants were asked to familiarize themselves with the measures. To enable inclusion of all participants, an online document was shared with all participants two weeks prior to the workshop. During that time, participants had the possibility to digest the measure descriptions and suggest additional ones. During this preparatory process, an additional policy measure "P8 Use CAP to support agreed upon measures" was added to the list.

Through an online survey, participants were also requested to select one measure per category and to prioritize their selection. The selection of measures was used to divide participants into cross-sectoral working groups. The aim behind the group composition was to steer the discussions away from single factor "silo measures" and towards system solutions. Participants were thus divided into five working groups based on the outcome of the poll.

For the "cook" step of the workshop, facilitators were asked to reflect upon three main questions to discuss group dynamics and document the process followed to reach a decision about the measures selected to design the intervention:

1. How did your group select its measures?
2. What do you recall was difficult or easy?
3. What remarks were made by the participants on the measures?

Results from the selection of measures and reflections from the "cook" step are presented in Section 3.

2.1.2 "Incubation" step

To guide the design of the intervention, an "incubation" template (Figure 3) encompassing the following elements was provided to the five groups:

1. **Measures selected:** Participants identified the main measure and up to three supporting measures which would enable, strengthen or support the realization of the main measure.
2. **Actors and Processes:** Participants addressed the questions - who are the key actors that should be involved to make the intervention possible? What processes, policies, or national and international agendas relate to the intervention? Processes also referred to hinders or accelerators for the implementation of the intervention.
3. **Capabilities:** This component referred to resources available or needed, to support processes and make the intervention possible.
4. **Impacts:** This covered the following question - what are the potential direct and indirect, negative or positive impacts from the intervention upon society, health, the environment and the economy? Impacts were considered over time and scales: interventions could have positive impacts locally but negative repercussions on a larger scale, for instance by disrupting economies and value chains. Some interventions could have negative impacts in the shorter term, but a range of positive benefits and co-benefits in the longer run.
5. **Sequence:** This covered the following questions - when and how do each of the measures need to be implemented and in what order to provide the expected benefits? Some interventions might require a stepwise approach over a longer period of time. Others might require a long time to research and develop before the measure can be implemented. Some interventions might need to draw on existing solutions or policies in the short term before taking off. But others might only require some tweaking of existing structures and regulations, and might not require large investments or transformation, if political will is there.

The templates filled out by each of the five working groups for their respective intervention can be found in Appendix C.

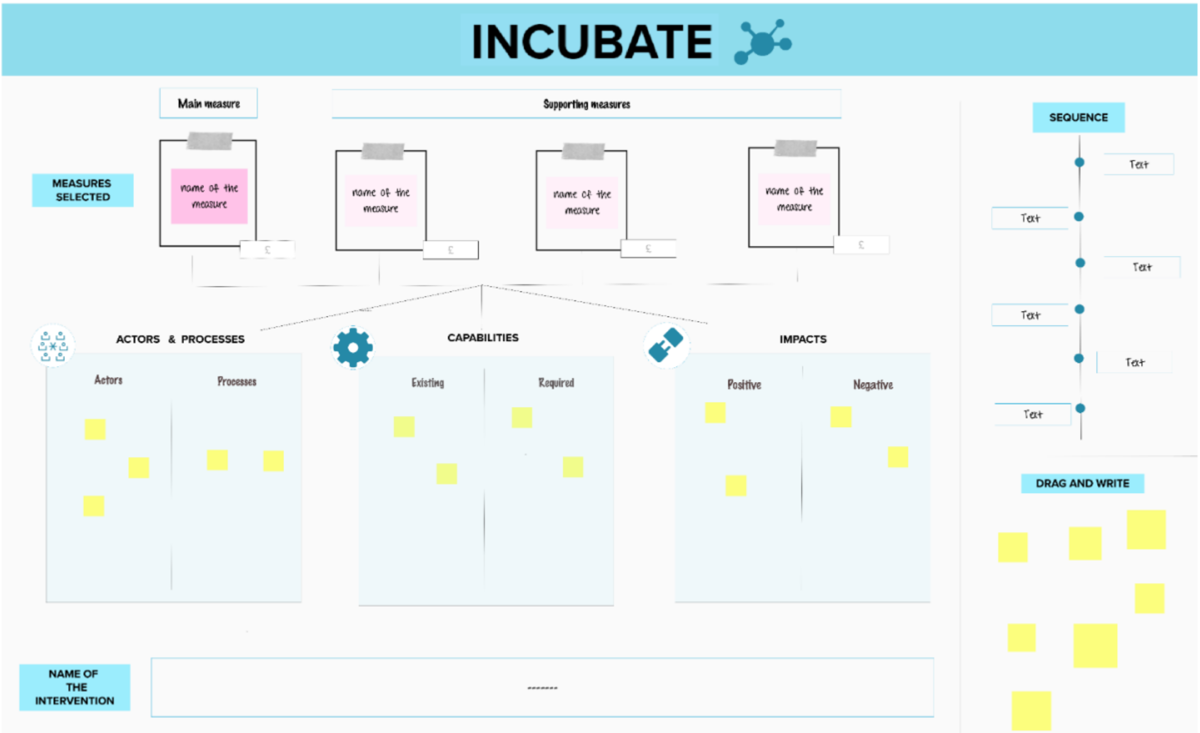


Figure 3. Incubate template to assemble for the intervention the relevant actors, processes, capacity needs and impacts.

During the "incubation" stage, facilitators were asked to reflect upon two main questions to discuss group dynamics and document the process followed to reach a decision about the intervention and the extent to which the group managed to integrate the criteria into its design:

1. How did your group build the intervention and think about the suggested criteria?
2. Was your group adequately cross-sectoral? What was positive or negative about having cross-sectoral groups?

2.1.3 "Evaluation" step

To guide the design the intervention, and subsequently reflect upon its strengths and weaknesses, all groups worked with an evaluation template (Figure 4) that included the following criteria:

1. **Circularity:** How does the intervention contribute to increased resource efficiency and recycling with regards to stocks and flows of nutrients?
2. **Efficiency:** How high is the total potential of the targeted flow/stock and how efficient is the proposed intervention with respect to that flow or stock?
3. **Feasibility:** How could the intervention be potentially financed? How bankable is the intervention and does it relate to existing investors? Why is the intervention worth investing in?
4. **Co-benefits:** This can refer to three aspects: i) multiple benefits provided by the intervention to other sectors or interventions; ii) no/low regret interventions that provide benefits under current scenarios; iii) multiple benefits that can contribute

to addressing other challenges, for example, clean air, energy efficiency, quality of life.

5. **Innovation:** Does the intervention suggest novel approaches, collaborations, techniques, management strategies, or steering instruments? Does it adopt novel approaches used in other regions but which can be applied in the Baltic Sea Region context?
6. **Coherence:** This can refer to policy alignment with international agendas (e.g., Agenda 2030, EU Farm to Fork, Water Framework Directive). It can also refer to other sectors' goals (e.g., urban interventions that might align with goals from rural agendas). It can also refer to alignment with existing national policies and spatial planning goals.
7. **Risks:** This refers to impacts from the interventions, as identified in the Incubation phase. Risks could also refer to external factors that could imply a risk to the intervention, for example, actors or global processes that could accelerate or hinder the implementation of the intervention.

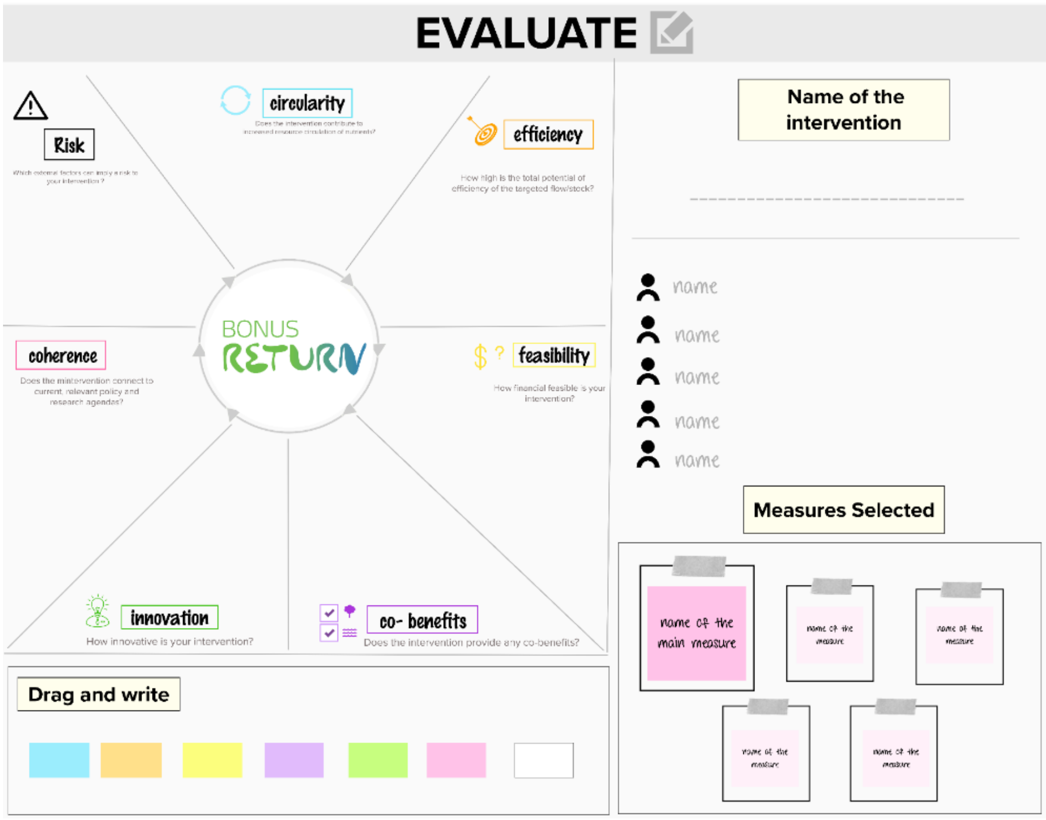


Figure 4. The intervention evaluation template covering the seven criteria: circularity, efficiency, feasibility, co-benefits, innovation, coherence and risk.

During this stage, facilitators were asked to reflect upon two main questions to discuss group dynamics and document the process followed to reflect upon the strengths and weaknesses of the intervention in relation to the outlined criteria:

1. What key arguments were brought up in this step?
2. How realistic was the chosen intervention and could it be tabled at a BSAP meeting of HELCOM?

2.2 Virtual tools

The workshop was initially planned as a two-day exercise where participants would have met in person to engage in in-depth discussions. However, due to the circumstances with the Covid-19 pandemic[2] the workshop was forcibly rescheduled to a five-hour (including breaks) digital workshop. This set-up placed great demands on preparation, engagement by the participants prior to the workshop, and required the use of new online collaborative virtual tools to enable the participatory element of the workshop.

Beforehand, all participants received an information package which introduced the concepts, approach, and tasks for the workshop. A few days prior to the workshop, participants received a link to Zoom – the virtual meeting venue, and a link to the working group in Mural – a digital workspace - which contained all the prepared templates. During the workshop, Mural allowed participants to simultaneously interact with their respective groups' through the templates. Each group was guided through the templates by a moderator and supported by a member of the expert panel who followed them throughout the workshop.

Using the cook templates, each working group agreed on the main and supporting measures. Then, the incubate and evaluate steps were carried out where participants provided input by filling in digital sticky notes that were positioned within the prepared templates. All the templates were collected and available in Appendix C.

Initially, expected outcomes and impact from the on-site workshop included:

- Tangible roadmaps to be taken forward and developed into full-fledged impact projects aimed at achieving SDG 14 targets and the grand challenge of attaining "healthy oceans, coasts and inland waters".
- Operationalization of a mission-oriented process that can be replicated for other missions.
- Feedback and peer review from an expert panel of funders and policy makers, industry and civil society on critical flows and pathways.
- Fostering of a dedicated network of decision makers, designers and scientists who can steer the mission forward and secure resources to realize the designs.

Because of the online format, sessions had to be cut shorter, the game component had to be toned down, and the level of ambition adjusted.

3. Results: Designing mission-oriented interventions for the Baltic Sea Region

Out of the forty-nine participants that signed up for the workshop, eight of them did not make a selection and were therefore assigned to groups by the organizers.

[2] https://en.wikipedia.org/wiki/COVID-19_pandemic

Figure 5 shows the frequency of selection for each measure (data in parentheses). Each participant could select up to four measures. Not all participants selected four measures, and not all participants followed the instructions to select one measure per category. The measure that was selected most times was a coordination measure: “C1 Improve knowledge transfer between farmers, authorities and decision makers”, followed by “D3 Definition of ‘New Hot Spots’ of nutrient input into the Baltic and subsequent targeted measures to reduce the source”.

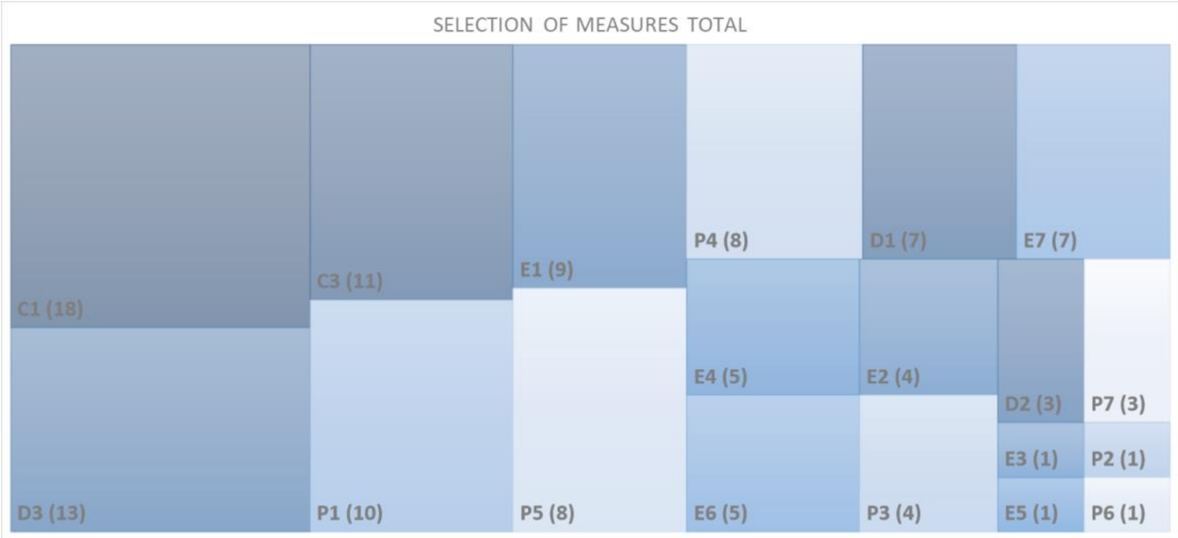


Figure 5. Frequency of chosen measures by the participants prior to the workshop

Besides from selecting up to four measures, participants needed to prioritize one of them. Table 1 shows the measures prioritized by most participants. C1 was prioritized most times, followed by C3 and E6 “Source separation of sewage systems in newly built areas and in areas renovated”. C1 and C3 are thus the measures that have been selected most times as well as prioritized by most participants.

Table 1. List of measures ranked according to priority by the workshop participants.

Measure	Prioritized
C1 Improve knowledge transfer between farmers, authorities and decision makers.	9
C3 Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region.	6
E6 Source separation of sewage systems in newly built areas and in areas renovated	5
E4 Reducing nutrient loading by farming and harvesting blue mussels	4

D3 Definition of “New Hot Spots” of nutrient input into the Baltic and subsequent targeted measures to reduce the source	3
P3 Tax on mineral fertilizers	3
P5 Allow coordination of abatement measures among HELCOM countries to ensure cost-effective nutrient abatement at the basin and Baltic scales	3
E2 Use of gypsum to reduce phosphorus loads from agricultural land	2
D2 Reporting estimates on the effects of agri-environmental measures on the main phosphorus fractions	1
E1 Recycling of nutrients and carbon in agricultural residues by use of anaerobic digestion	1
E3 Reducing internal phosphorus loads by metal bonding	1
E5 Rehabilitation of hypoxic areas by oxygen pumping	1
E7 Nutrient recovery in wastewater treatment plants	1

Based on the pre-selection of measures each of the five working groups had a pool of priority measures (based on the information in Table 1) that the group in combination had selected. Participants then had to negotiate the final group selection that would be used to design the intervention. Results from the selection of measures in the working groups show common traits as follows:

Several groups selected coordination measures. All five working groups chose C1 (Support and improve knowledge exchange between farmers, authorities and decision makers at national and international levels for all stakeholders) as a measure. Four working groups chose C3 (Annual field-level fertilizer planning and farm-gate nutrient balancing, including quotas for recycled fertilizers for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region) as a measure. The main differences across working groups was on the choice of the eco-technology measures. These were:

- E6 (source separation in sewage systems)
- E7 (nutrient recovery in WWTPs)
- E4 (blue mussels)
- E1 (recycling agro-residues using AD)
- E2 (gypsum to trap soil P) in combination with E3 (reducing internal phosphorus loads by metal bonding)

When it comes to data measures, two working groups chose D1 (Integrated and harmonized risk assessment of phosphorus losses from agricultural soils to surface water) and two chose D3 (Definition of “New Hot Spots” of nutrient input into the Baltic and subsequent targeted measures to reduce the sources).

Working groups 1 and 4 were most similar in the composition of the intervention, as both groups selected C1, C3 and D1 as measures.

Only one working group chose a policy measure as the key measure (P4 Reducing livestock densities and coupling livestock to the area of available farmland). The lack of policy measures may be explained by the fact that the WGs were asked to choose only 4 measures and most chose an extra coordination measure instead of a policy measure.

Working groups 1 and 2 developed interventions that included both agriculture and wastewater components. Working groups 3 and 5 developed interventions that focussed on land and sea-based measures while working group 4 focused on agriculture measures.

Figure 6 provides an overview of the five interventions with their respective measures. The following subsections provide more detail on each intervention as well as the dynamics in the working groups for reaching decisions at each step of the cook, incubation, and evaluation process.

During the incubation step the working groups identified actors and processes to be involved with the named interventions and measures, reviewed existing and additional required capacities and examined the impacts of the measures - both positive and negative. There were areas of commonality worth describing here.

Regarding actors, the WGs emphasised national government authorities, farmer organisations, HELCOM, business, research, consumers, information and network sources. For the actor processes these actors would be involved with, the WGs named national programmes encouraging farmgate nutrient balancing, circular systems, monitoring of nutrient levels in soil, catchment areas and in the Baltic Sea, incentive programmes and knowledge sharing among stakeholders, training of farmers, development of reuse products and strategies and certification programmes (e.g. REVAQ for sewage sludge in Sweden).

Regarding existing capacities to carry out the suggested measures the WGs named current knowledge on hotspots, eutrophication, nutrient levels, losses to the catchment areas, national regulatory systems, research experience, existing platforms and networks, farmer organisations, current reductions in emissions from wastewater treatment systems and ongoing reductions in fertilizer use.

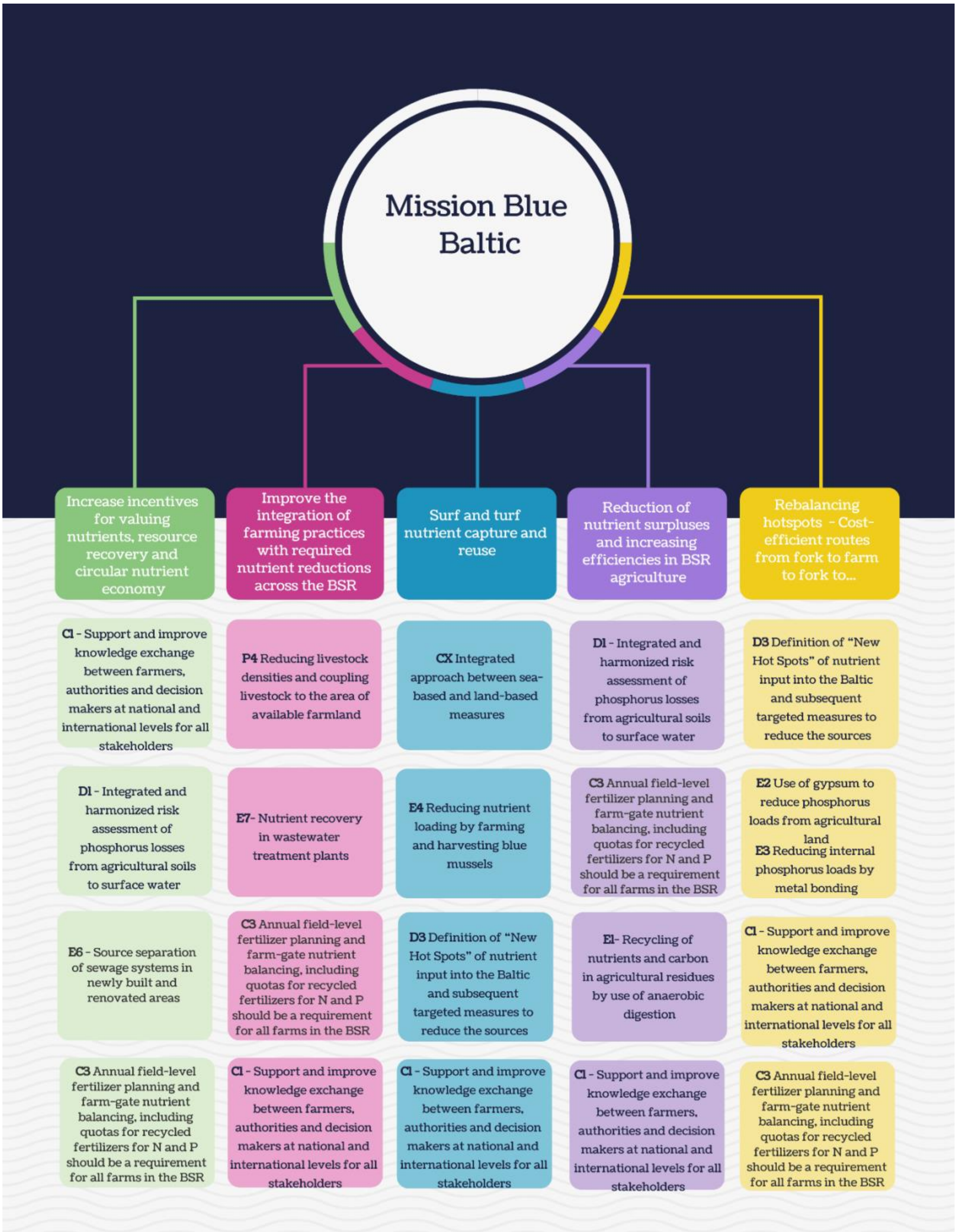


Figure 6. Overview of the interventions and measures chosen by the five working groups.

In terms of the impacts of the measures, positive ones included further reduced nutrient emissions to the Baltic Sea to meet the HELCOM recommendations, improved best practices in manure storage, management and spreading on croplands, improved cooperation between farmers and authorities, increased use of ecotechnologies to capture and reuse nutrients from agriculture wastes including manure and increased use of mussel farms to reduce nutrient levels in the coastal and open areas of the Baltic. Possible negative impacts of carrying out the interventions and measures included increased costs to consumers, farmers and government in order to achieve the lowered emissions, possible decreases in livestock densities in certain hotspot areas, resistance among farmers to take on practices (e.g. phosphorus balancing and indices) that may only have impacts at the larger scale and over the long term, possible disagreement among HELCOM partner countries on the level of change required in order to meet the emissions requirements and circularity goals.

Appendix C contains the detailed deliberations of the 5 working groups including the cook, incubate and evaluate steps and observations made by the participants. The summary of the five interventions and component measures is seen in Figure 6.

4. Discussion

In Section 1 of this report we highlighted three challenges related to the operationalization of missions. In this section we reflect upon these challenges by drawing on insights from the workshop.

4.1 Splitting the cake

The first challenge is related to finding ways of dividing large and ambitious interventions into smaller, independent but systemic components.

Studies show that despite their growing popularity, megaprojects – large-scale, complex projects delivered through various partnerships between public and private organisations (Flyvbjerg et al., 2003) – often fail to meet cost estimates, time schedules and project outcomes and are motivated by vested interests which operate against the public interest (van Marrewijk et al., 2008). Because the type of interventions required to accomplish a mission are of a systemic nature, there is a risk that missions are interpreted as a new buzzword for megaprojects. Thus, there is a need to find ways of “splitting the cake” into coherent and manageable units without losing a systems perspective or falling into “silo” approaches.

However, **designing independent but systemic components is a real challenge**. Whilst studies find that sector-focused planning is a major barrier for innovation in water and wastewater utilities (Barquet et al., 2020; Trapp et al., 2017), overcoming this hurdle in contexts with constrained resources and capacities, is not an easy task. First, many public agencies are built around silos and escaping these is neither easy nor supported by the surrounding environment. Second, to walk away from silo-structures a new structure or mode of organization needs to be set in place.

The group composition designed for this workshop was a test for mimicking new ways of organizing to set cross-sectorial and multi-purpose strategies at the forefront. The experiences from this were not as straightforward as initially expected. Participants were divided into WGs based on the measures they selected. The aim was to provide diversity across sectors and backgrounds while maintaining some commonalities. The measures selected by the participants were then the most immediate pool of options to use for building the interventions. Thus, a different group composition would have resulted in a different pool of measures. According to the instructions however, the initial selection of measures was not set in stone and participants could select any measure (even beyond the pool of measures). But all groups accepted the initial selection. Thereafter, most groups prioritized the measures that had initially received most votes (though this was not part of the instruction). In several cases, groups sacrificed the quality of the intervention (a different selection of measures could have improved the intervention) for the sake of avoiding confrontation especially given the short-time frame, as explained by one participant. This could be interpreted as reflecting at least two things. On the one hand it reflects the spirit of cooperation and pragmatism that characterises the Baltic Sea Region and which has led to improvements in, for instance, integrated coastal zone management (Zaucha, 2014). On the other hand, **this experience highlights the difficulty of escaping the established structures and ways of organizing, even when these might be hindering progress**.

Second, the expectation that a cross-sectoral group design would allow for breaking off from silos and searching for multi-purpose solutions, did not entirely materialize. Some participants found it difficult to get onboard due to a perceived lack of expertise in the selected measures. Others found it difficult to reach a deeper level of specificity. Most groups got stuck already at the beginning of the exercise when trying to define the purpose of the intervention that would guide the prioritization of the measures (i.e. selecting the main and supporting measures). An aspect that this experience flashes is that **there might be a “right” time to stay within silos before going cross-sectoral**. For instance, one of the participants suggested first cementing ideas within sectors, and only once these have been developed, encourage a cross-sector mode of organization. This hints towards the concept of modular organization, whereby independent units (in our case WGs) work separately to assemble the whole (in our case the interventions). Peng and Mu (2018) highlight the importance of matching organizational structures to product development and provide evidence in support of modularity, particularly for more complex products and larger organizations. However, their results show that modularity seems to be more adequate at later stages of product development. At early stages, organisations primarily face the challenge of idea generation and as such an integral organisational architecture can better meet this need because it affords faster and more effective cross-disciplinary interaction and fertilisation.

The previous point highlights an important aspect. **The challenges that missions face are not necessarily technical. Rather, organizational challenges might be the most complex hindrance as these tend to be deeply rooted in cultures and values**. Thus, further investigation is needed into what the ‘right’ ways of organizing might be, and when cross-sectoral collaboration might be most efficient to apply. Literature in organizational design could provide inputs for designing organizations and their modules or sub-units (Worren, 2018).

4.2 Aligning capacities with vision

The second challenge pertains to identifying the resources and capacities available and those that are needed in the context in which the intervention will be launched. To do this, a vision of the alternative future and the benefits that such a vision is expected to bring about is necessary to "bridge the gap between strategic visions and innovative interventions" (Andreani et al., 2019). This vision needs to be grounded in specific needs and local opportunities and could **"start with an actor-oriented approach and treat stakeholders as actors of change"** as suggested by one of the participants.

The participant's suggestion is indeed well aligned with the more people-centric and decentralized approach proposed under the so-called "smart city 2.0", which has a strong focus on citizen needs (Trencher, 2019). In this vision, technology is understood as only one driver of change, along with community and policy that are used to achieve at least five types of outcomes: productivity, sustainability, accessibility, wellbeing, liveability, and governance (Yigitcanlar et al., 2018). Such a vision thus prompts **an exploration of how technology and the use of data can be used to tackle social problems and to improve the urban living experience and wellbeing of residents, in contrast to understanding technology as an end in itself** (Trencher & Karvonen, 2019).

So what would such a vision imply in terms of capacities and resources? For starters, such a vision begs reframing the question posed at the inception stage, for example, from *what is the best technology to reduce nutrients?* to *what are the missions or societal challenges that the reduction of nutrients could help address?* Changing the framing of the problem was indeed mentioned as a required organizational capacity in Intervention 1. The purpose of reframing is to put at the core of the analysis the societal challenges, rather than sectors, to be addressed. It also allows optimizing technologies, as highlighted by the group in Intervention 1, by shifting the focus away from ad hoc investments, such as single purpose infrastructure (e.g., centralized wastewater treatment plants to treat water), towards the development of new general-purpose and cross-sectoral technologies (e.g., diversified wastewater treatment plants that reduce, recycle and recover nutrients for multiple uses). Such an approach will be increasingly favoured over single-purpose investments; **"as finance becomes more restrictive in the future, there is a need to make effective interventions that produce win-win-wins"**, highlighted a participant.

Cross-sectoral and transboundary collaboration is often highlighted as the crux of nutrient management (HELCOM, 2020). This is also highlighted in interventions designed in the workshop where all groups included measure C1 "Improve knowledge transfer between farmers, authorities and decision makers" as one of the four selected measures. In the group discussions, improving communication and creating mechanisms for information flows between farmers, wastewater treatment plants, and authorities was flagged as crucial to be able to adopt more integrated solutions that incorporated a user-perspective. Participants highlighted that while "all groups mentioned different variations of the word 'integrated, integration' to indicate that several things need to be connected" and "all groups want science-based, cost-effective and inclusive processes", **the question is "how to get all things onboard?"**

Once again, drawing on the smart city 2.0 approach**, data is framed as an indispensable driver of citizen engagement and co-creation since it can provide the basis for more effective problem identification and the design of more efficient solutions** (Gooch et al., 2015; Kitchin, 2014). Some go as far as to assert that the future role of governments will shift from the direct provision of public services towards the provision of data to allow the formation of more innovative public services that are operated by a more diverse group of stakeholders (Almirall et al., 2016).

The power of data was similarly highlighted by participants to improve knowledge brokerage and connection between sectors (Intervention 2). While data availability and quality has improved for the BSR, particularly when it comes to biophysical parameters, more data are needed to, for instance, define "hotspots" of nutrient input into the Baltic Sea (Interventions 3 and 5); longer-term studies are necessary to obtain a better picture of plant uptake of nutrients and hazardous substances (Intervention 2); data on aspects like energy efficiency, and the quantification of environmental externalities and co-benefits into cost assessments is necessary to allow for long-term comparison between different solutions, for example source-separation versus centralized wastewater treatment (Intervention 2); policy studies exploring different scenarios to regulate fertilizer levels, farm size and composition which are better adapted to local realities, could inform CAP and the farm-to-fork strategy (Interventions 2 and 4); market analyses to explore push and pull factors for reusing nutrients and by-products, like farmed mussels, should be further explored (Intervention 3); there is also a need for better understanding of consumers' attitudes, including changing diets, and the role that food imports versus increased national food production may play in the accumulation of nutrients, cadmium and hazardous substances, but also respond to concerns over food security (Interventions 2 and 3).

Beyond data, there is a need to strengthen civic participation and increase awareness of the challenges in the region. Today, there are coastal communities in the region whose inhabitants are largely unaware of risks like saltwater intrusion, overfishing, and even eutrophication. This unawareness contributes to unsustainable practices of water and the sea. While, in the context of the Baltic Sea, there are numerous national and international platforms and organizations that can facilitate such exchange, a challenge is reaching out beyond the 'already convinced'.

4.3 Moving from concept to practice

A third challenge is about finding ways of working that allows us to move beyond the formulation of ambitions to really allow the operationalization of the mission.

"The ideas mentioned today are not entirely new in themselves. Rather, what is new are the potential ways of implementing them", explained a participant at the workshop. "The solutions to address the mission might lie in the means of implementation", concluded another participant. So, what needs to be done in order for cities to be successful when designing and implementing their missions?

Workshop participants identified **innovation beyond technology development and steered towards business models, product development, public procurement, and diversification of technologies and services in utilities**, as fundamental for transformational interventions.

Innovation for transformation will require collaboration for designing service-oriented business models and product design strategies (Calabrese et al., 2018) that build on three aspects of the circular economy: slowing product loop (e.g. extending product lifecycle), closing the loop (e.g. reuse, refurbish, recycle), and narrowing the loop (e.g. less resource use) (Bocken et al., 2016). However, to achieve this connection, **there is a need to move beyond technology development - the technical efficiency of an innovation - by supporting product development - that matches a need -, and increase knowledge on the functioning of the entire value chain**. For instance, participants highlighted that we very little about consumers' attitudes towards recycling and reuse is known, and therefore more research is needed to understand the market mechanisms required to close loops. Similarly, **user approaches need to be integrated into product design to guarantee user-friendliness, efficiency, and competitiveness while providing more sustainable options** (e.g. fertilizer).

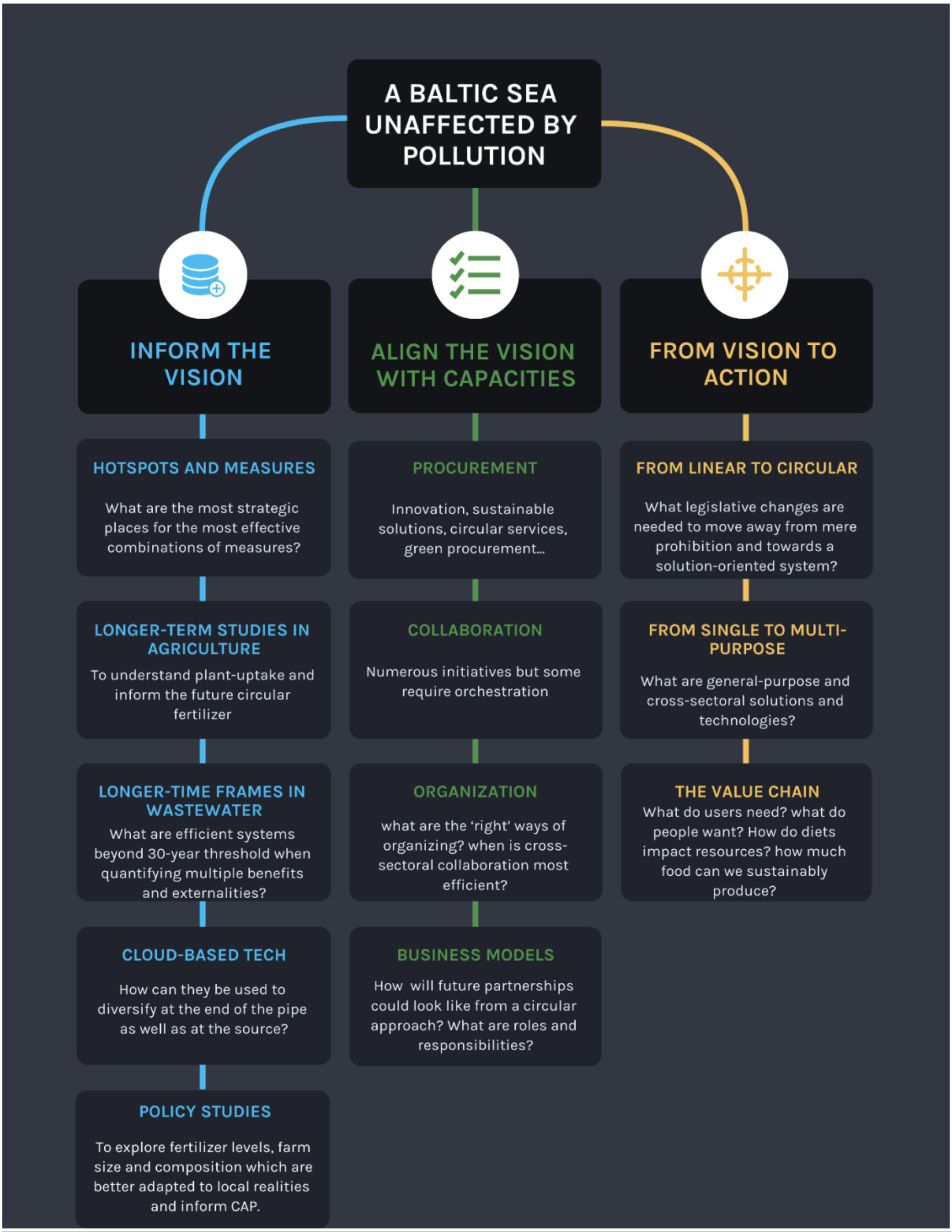
Apart from market mechanisms and technical readiness, implementing and upscaling innovations are, to a large extent, conditioned by the regulatory environment. In the public sector, a key mechanism for introducing new technologies and services is through public procurement. Public procurement constitutes a major share of public spending and is increasingly recognized as an untapped potential for driving the transition towards a circular economy. Public procurements account for about 14% of the EU GDP, and involve over 250,000 contracting public authorities (Pircher, 2020). **The criteria for winning contracts in procurement processes carries an important function of signalling the market to develop certain products and services** according to the set procurement criteria. If the procurement criteria are directed towards rewarding low cost alternatives, the development of new innovations will respond accordingly by developing low cost products and services. However, if the procurement criteria include environmental and social performance or even circular economy performance, new products and services will be designed to align to these criteria (Ahlström et al., 2020).

5. Concluding remarks

This report has summarized the process, approach, and outcomes of "Mission Blue" a participatory online workshop hosted by BONUS RETURN, which had the purpose of contributing with recommendations for operationalizing a mission architecture for healthy water, coasts and seas and through such architecture co-design system interventions for a healthy Baltic Sea.

The workshop, originally intended as a 2-day physical exercise, was carried out online with the help of collaborative software. While this setup was a precondition for conducting the exercise with participants from around the Baltic Sea Region under the circumstances of

COVID-19, the approach piloted here was highly exploratory and would have benefited from the physical dynamics that allow for high levels of creativity and interaction.



An overview summary of the conclusions, recommendations and leading questions generated during the workshop.

Figure 7.

Despite the limitations that an online setup present, stakeholders provided input and insights based on their own expertise. This sort of brainstorming methodology is useful to flag possible interventions. But to truly develop these into something that could be tabled for example at a BSAP meeting, requires a further series of steps building the logic based on technical assessments, using available data and results from previous and ongoing relevant interventions. To move from theory to practice, there is a need to explore more in-depth what the barriers are to make these interventions feasible. Figure 7 summarizes the conclusions of this workshop and proposes recommendations and leading questions for considerations in the future development of interventions for a healthy Baltic Sea Region.

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Appendix A. List of participants and experts

WG1
Moderator: Linn Järnberg, SEI
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- Marek Giełczewski, WULS Poland
- Arne Brummerloh, Julius Kuehn-Inst Germany
- Robin Harder, Chalmers Univ Sweden
- Jennifer McConville, SLU Sweden
- Anders Branth Pedersen, Aarhus University, Denmark
- Sari Väisänen, SYKE Finland
- Tapio Salo, LUKE Finland
- Pim de Jager, Aquacare Netherlands

WG2
Moderators: Somya Joshi and Elin Leander, SEI
Participants:

- Søren Pedersen, Copenhagen University
- Zanda Melnalksne, Farmers Parliament
- Genevieve Metson, Linköpings University
- Biljana Macura, SEI
- Mikael Skou Andersen, Aarhus University
- Erik Kärrman, RISE
- Niels van Helmond, Utrecht University
- Mark Rasmussen, SEI
- Kari Ylivainio, LUKE
- Petra Wallberg, Formas

WG3
Moderator: Erik Sindhöj, RISE
Participants:

- Angela Schultz-Zehden, Submariner Network
- Sirkka Tattari, SYKE
- Julia Tanzer, Proman
- Filippa Ek, SEI
- Emilija Žilinskaitė, SLU
- Neil Powell, Uppsala University
- Sten Stenbeck, RISE
- Kaj Granholm, BSAG
- Georgia Destouni, Stockholm University

WG4

Moderator: Arno Rosemarin, SEI
Participants:

- Mikolaj Piniewski, WULS
- Marcus Ahlström, RISE
- Mateusz Sekowski, CDR Brwinów
- Minna Sarvi, LUKE
- Katrin Kuka, Julius Kuehn-Inst
- Thao Do, Uppsala Uni
- Henning Lyngsø FOGED, Organe Institute
- Maria Kämäri, SYKE
- Tord Söderberg, A2T
- Jon Wessling, LRF

WG5
Moderator: Olle Olsson, SEI
Participants:

- Emma Lundin, RISE
- Steven Bachelder, Uppsala University
- Jennie Larsson, WMU
- Kaisa Riiko, HELCOM
- Kari Ylivainio, LUKE
- Ludwig Hermann, Proman
- Jari Koskiao, SYKE
- Tomasz Okruszko, WULS
- Prashanth Kumar, Aquacare
- Jan Eksvärd, INACRE

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Mural graphics - Nhilce Esquivel, SEI

Panel of Experts

Mats Johansson, is a Senior Partner at Ecoloop. Mats has over 20 years of experience in municipal and household water and wastewater planning. Mats has participated in the development of the Marine and Water Authority and the Swedish Environmental Protection Agency's guidance on municipal water planning. He has been secretary in two state investigations, the first on sustainable water services, and the second and most recent on a non-toxic circular recycling of phosphorus from sewage sludge, which has proposed, among other things, new rules for the treatment of sewage sludge, requirements for the extraction of phosphorus from sewage sludge and also how future upstream work for sewage treatment plants can be developed.

Georgia (Gia) Destouni is Professor of Hydrology, Hydrogeology and Water Resources and Head of Department of Physical Geography at Stockholm University. Her research has explored issues related to exchanges of groundwater and surface water, water on land and in the atmosphere, freshwater and saltwater in coastal areas and environmental impacts of various human activities, such as agriculture and its irrigation, urbanisation, mining, hydropower and other energy supply. She previously served as the Secretary General of the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas). She has over 200 publications in the fields of hydro-climate, hydrological transport, hydro-geophysics, water environment, and received the Henry Darcy Medal of the European Geosciences Union in 2013.

Jon Wessling is responsible for water and environmental issues at the Swedish National Farmers' Association (LRF) in the Mälardalen region. Jon works with all aspects related to water – drainage and irrigation, quality, groundwater levels, flooding and droughts - in agriculture. As regional representant for Mälardalen, he provides expertise on the impacts that factors like policies, incentives or climate have upon farmers. Previous to LRF, Jon worked at the County Government (Länsstyrelsen) of the Södermanland region.

Petra Wallberg is Senior Research Officer, responsible for research issues related to sea and water at the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS). She has a PhD in marine ecotoxicology from Stockholm University. Previous to FORMAS, Petra has 20 years of experience of governance and practice of sea and water related issues. Petra has worked with environmental policy issues at different national authorities (Swedish EPA, Swedish Chemical Agency and Swedish Radiation Protection Agency) and as a Senior Environmental Consultant at SWECO and at the Swedish Environmental Research Institute (IVL), with particular focus on environmental impact assessment in marine and freshwater environments.

Jan Eksvärd is a senior expert in sustainable development at Inspire Action & Research AB. Previously, Jan worked for the Swedish National Farmers' Association (LRF) as an expert on sustainable development with a focus on food and biomass production. His expertise spans areas such as resource efficiency, GMOs, organic production, plant protection, sewage systems, various climate issues, and the development of sustainable cities. He was active in committees that assess research projects at Formas, Vinnova, and the Swedish Agricultural Research Foundation and is active in the assess committee EIP-Agri (European Innovation Partnership) and in the boards of Oscar och Lili Lamms stiftelse and two farms. He was also a member of the Swedish Chemicals Agency's supervisory board and participated in a number of governmental investigations, the latest about ban of use of sewage sludge.

Appendix B. Measure descriptions

COOK

#C1

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Measure

Improve knowledge transfer between farmers, authorities and decision makers

Source: SLF 2007 https://static-lantbruksforskning.s3.amazonaws.com/uploads/attachments/SLF_VB_2007_till_tryck.pdf

Stream: Flows and stocks

Type of measure: Coordination

Area of operation: Land -based

Problem description:

Policies and support mechanisms should foster knowledge transfer from research to practical actions; both in national and international context. Often language used for communicating messages is too official and poorly understandable for the potential target groups. Direct contact methods are the most efficient means of knowledge transfer co-production of knowledge and they should be supported. These are meetings, discussions and training on field and on farm, opening the communication and knowledge transfer to and between farmers. Direct contacts should also be promoted for direct communication between scientists, policymakers and farmers. Evaluation and analysis of the efficiency of agricultural and environmental advisory systems in the Baltic Sea countries is needed. The aim would be to learn from the strengths of the other countries and to adjust the national advisory system accordingly.

Actions required

Through the Baltic Farmers' Forum on Environment (BFFE) https://www.mtk.fi/bffe the national farmer associations around the BSR have created a communications capacity to deal with eutrophication issues involving local catchment areas and the EU WFD. BFFE was formed by the Nordic Farmers Council (NFC) in 1998 and represents some 2 million farmers around the Baltic Sea Region. BFFE also has observer status within HELCOM and provides position documents and guidelines for best practices. BFFE has also arranged science conferences e.g. on agricultural water protection.

The results and recommendations of projects like BONUS RETURN, SuMaNu, Tools2Sea, etc. need to be communicated through BFFE to BSR farmers and efforts need to be made to obtain feedback from the farmer organisations in order to refine further action protocols regarding abatement of nutrient emissions from agriculture.

Expected effects

Better sharing of knowledge and promotion of learning about nutrient management among agriculture stakeholders around the BSR. More informed policy and action plans on the part of the agriculture communities around the BSR.

#C3

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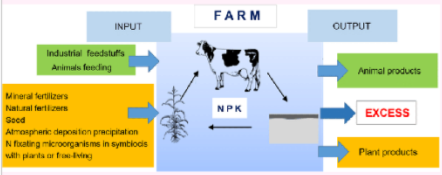
Measure

Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region



Source: FAO 2004 http://www.fao.org/3/y5749e/y5749e06.htm

Stream: Flows and Stocks

Type of measure: Coordination

Area of operation: Land -based

Problem description:

To optimise nutrient use efficiency on farms and to enhance nutrient recycling, annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region. Norms or guidelines for economically optimal N and P fertilizing rates that farmers can adjust for local conditions and expected yields should be developed for all relevant crops and updated regularly at a national level. To have a full picture of the soil nutrient supply capacity, soil analysis data and field cultivation history, including crop rotation, should be taken into account. Farm-gate nutrient balancing should be done annually after harvest to be able to follow the nutrient use efficiency on the farm.

Actions required

National ministries of agriculture for the BSR countries to agree on a common policy under the EUSBSR to develop and advise on farm-gate nutrient balancing.

Incentives to develop this tool for increasing nutrient use efficiency will be a certification system whereby farms are classified whether they are balancing fertilizer applications with soil nutrient monitoring crop offtake, crop rotations, and basing manure applications on P crop requirements.

An important component in this development will be agreed upon maximum surplus levels of P per hectare per year.

Expected effects

A system for assessing farmgate nutrient surpluses will be set up. This will allow farmers to save on excessive manure and fertilizer applications and still obtain optimal harvests. Surpluses will be limited to environment-friendly levels and nutrient losses to catchment areas will be therefore reduced to acceptable levels within the targets for river basins and the national emission targets outlined by HELCOM.

The certification systems will ensure that the targets are being met. If however they cannot be met due to e.g. high LSUs per ha, limitations could then be applied to the size of these animal farms and alternative farming strategies e.g. increase in oilseed or feed crops could be developed.

COOK

#D1

£

Measure

Integrated and harmonized risk assessment of phosphorus losses from agricultural soils to surface water

Source: SLU 2019 https://www.slu.se/en/ew-news/2019/11/reducing-phosphorus-leaching-from-arable-soils/

Stream: Flow

Type of measure: Data

Area of operation: Land- and watershed-based

Problem description:

In order to efficiently reduce losses of phosphorus from agricultural soils it is essential to first understand the associated risk. This measure proposes that risk assessments of phosphorus losses from agricultural land to surface water should be conducted across the Baltic Sea Region.

Actions required

- Development of P-indices, including joint sharing of input data parameters and a common P-index model, resulting in the capacity to map croplands and fields in the BSR according to their P levels and P-loss risk.
- Proposal of norms for P fertilising for the most common crops; introduction to countries where they don't exist or improvement of their existing or flat rate general norms.
- Verifying the effects by simulations with watershed models.

Expected effects

- Will decrease P loading of the Baltic Sea by improved targeting of agri-environmental BMPs by more accurate knowledge of risk areas.
- Will reduce farmers' costs by more accurate P fertilization according to crops' needs.

#D2

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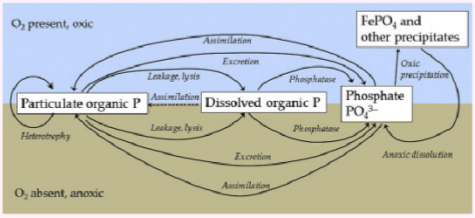
Measure

Reporting estimates on the effects of agri-environmental measures on the main phosphorus fractions



Source: Dodds & Whiles (2020) https://doi.org/10.1016/B978-0-12-813255-5.00014-4

Stream:

Flow

Type of measure:

Data

Area of operation:

Watershed-based

Problem description:

Currently, BSAP targets are given as a sum of all species of P. P losses from agriculture mainly consist of particulate P (PP) and dissolved P (DP). Problematic for the agriculture is 1) measures that decrease erosion and PP increase the loading of DP (Dodd and Sharplet 2016) and 2) for eutrophication, DP is more potent than PP (Baker et al 2014). Estimates on the long-term bioavailability of PP range between 20% and 60% (Uusitalo et al 2003). There is a risk that further efforts to reduce TP result in decreases in PP but increases in DP. This accelerates the eutrophying potential of P loading, as found in several sites in the USA (Jarvie et al 2017). For BSAP, we should define the effects of currently used and proposed measures on PP and DP loading. The final aim is to encourage the HELCOM countries to include P fractions in their load monitoring programs and to base load reduction measures on cost-effectiveness analysis accounting for P bioavailability.

Actions required

Currently, only total nutrient loads are reported to HELCOM and soluble P is also measured less frequently than total P. This measure requires that the measurement of soluble P is included in the monitoring programmes.

In addition, it must be clarified whether the measurement method is similar in all countries of the Baltic Sea region.

Expected effects

When P is divided into fractions, the measures (BMPs) can be more precisely targeted. New studies (e.g. Uusitalo 2018) show that the proportion of soluble P may increase with increasing winter vegetation cover.

At the same time, it would be important to reduce the soil P status. According to Puustinen et al. (2019), also the gradual decrease of the soil P-status would reduce the leaching of soluble P. Such a large decrease in soluble P would fully compensate for the increase in dissolved P leaching due to no-till cultivation.

COOK

#D3

£

Measure

Definition of "New Hot Spots" of nutrient input into the Baltic and subsequent targeted measures to reduce the source (1)

Source: WATERCHAIN
https://www.videsinstituts.lv/en/projects/water/reducing-nutrient-inflows-into-the-baltic-sea

Stream: Flows and Stocks

Type of measure: Data

Area of operation: Watershed-based

Problem description:

Using existing monitoring and reporting schemes (e.g. PLC), this measure aims at finding current Hot Spots of nitrogen and phosphorus input into the Baltic Sea. Building up on the measure of the last BSAP where Hot Spots of intensive rearing of cattle, poultry and pigs that were not fulfilling the requirements in the revised Annex III of the Convention were identified, this new measure would identify any current source, thus making it possible to tackle the sources of high nutrient input. Especially for phosphorus as a finite resource an efficient strategy for recycling instead of net loss into the Baltic has to be developed.

Actions required

- New 'hot spots' must be precisely defined. It should also be clarified how they differ from previous HELCOM 'hot spot' areas. Identifying hot spots requires reliable, accurate-resolution map-based data.
- The countries of the Baltic Sea catchment area do not have a coherent GIS data with a precise resolution, but use their own national GIS data.This measure requires the compilation of high resolution uniform GIS data for the entire Baltic Sea catchment area.

Expected effects

- If the hot spots can be precisely defined, measures can be targeted at these areas. When measures are targeted, they can also be implemented cost-effectively.
- When the nutrient, sediment or carbon loads in the area and their origin are known in more detail, measures suitable for different loads can also be specified at the planning stage.

#E1

£

Measure

Recycling of nutrients and carbon in agricultural residues by use of anaerobic digestion

Source: Hsu (2016) https://phys.org/news/2016-06-farm-to-food-aims-effect-manure-antibiotic.html

Stream: Flow

Type of measure: eco-technology

Area of operation: Land -based

Problem description:

Recycling of agricultural residues (horse manure, set-a side grass and grass from buffer zones) by use of centralized anaerobic digestion which produces biogas, and liquid and solid digestate phases. Anaerobic digestion is an advanced treatment method that employs microorganisms to break down and convert biodegradable matter into products that include biogas, liquid fertilizer and solid matter. The digestates produced, such as N and P, can be applied back to fields as organic fertilizers. The digeststates produced are more accessible for plant-uptake due to their high concentratation of nutrients and cleaner from pathogens than previous to treatment. A key aspect of this measure is to recycle the substances that are not utilized today (manure, set a side grass, etc.). Apart from fertilizers, digestates can also be used to produce biogas. At a farm-level biogas can allows farmers to operate 'off the grid' and reduce reliance on utilities.

Actions required

- Construction of centralized biogas plants capable of digesting various biowastes.
- Using the digestates (concentrated sources of nutrients with propitious N:P ratio) in fields poor in nutrients and carbon as valuable organic fertilizers.

Expected effects

- Improved soil structure, higher water retention capacity => less surface runoff, higher crop yields and lower erosion & nutrient leaching.
- Increased organic carbon content of agricultural soils.

COOK

#E2

£

Measure

Use of gypsum to reduce phosphorus loads from agricultural land

Source: BONUS RETURN 2020 https://www.bonusreturn.eu/policy-briefs/policy-brief-the-role-of-gypsum-soil-amendments-in-reducing-coastal-nutrient-run-off-in-finland/

Stream: Flow

Type of measure: eco-technology

Area of operation: Land -based

Problem description:

Gypsum (CaSO4*2H2O) application to the surface of soil provides a new measure that can effectively reduce phosphorus runoff from agricultural fields. Gypsum application increases the ionic strength of soil pore water. It creates larger aggregates of soil particles, calcium bridges and affects phosphorus binding, which reduces erosion and phosphorus losses to waterways. Importantly, phosphorus remains fully available to plants. A vital additional benefit is reduction in the loss of dissolved organic carbon. These beneficial effects occur immediately after the dissolution of gypsum, last for about five years and are achieved without any loss of crop yields or taking land out of cultivation.

Actions required

- Development of a Baltic Sea wide plan to implement the use of gypsum in the coastal areas, and to include gypsum in the national agricultural support schemes.
- Amendment of the EU Common Agricultural Policy (CAP) and HELCOM recommendations to promote gypsum application in the Baltic Sea catchments. The currently scheduled CAP reform for 2021 is a particularly important opportunity.
- Additional research on the economic, environmental and societal benefits of gypsum in countries outside of Finland.
  Ref. Bonus Return Policy Brief (Finland)
  https://www.bonusreturn.eu/policy-briefs/

Expected effects

- This measure reduces run-off P pollution by 50%, reduces demand for virgin-mined phosphorus, and reuses industrial waste. The measure is rather new and currently extensive piloting and research are underway in Finland to document the effectiveness of this practice, and to identify any negative side effects.
- Modelling shows that the large scale application of gypsum on coastal drainage areas in Finland, Sweden, Denmark and Poland offers a way to generate approximately 10% of all needed phosphorus reductions

COOK

#E3

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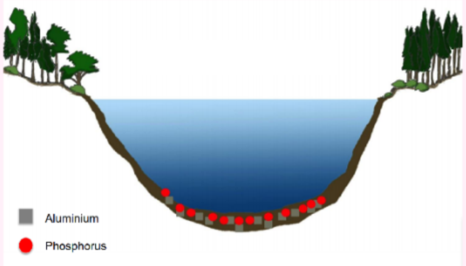
Measure

Reducing internal phosphorus loads by metal bonding



Huser (n.d)
https://www.stockholmvattenochavfall.se/globalassets/pdf1/samradsunderlag/djurgardsbrunnsviken/djurgardsbrunnsviken-brian-huser_sv.pdf

Stream: Stocks

Type of measure: eco-technology

Area of operation: Watershed and coastal zone-based

Problem description:

Eutrophication combated through phosphorus inactivation by addition of aluminium or iron has been tested at small scales, inner-bay-level, in Sweden (Malmaeus & Karlsson 2013, Huser 2014, Rydin 2014, Rydin et al. 2017, Rydin & Kumblad 2019, Kumblad & Rydin 2019, www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6522-5.pdf?pid=3831).

Actions required

This technology by its nature should be limited to smaller closed coastal water bodies with a high legacy P level in the sediments and little or no chance for hydrological events that could wash out the sediment

Expected effects

Chemical fixation of phosphate in sediments rendering it unavailable to the water column thus reducing the risk of phytoplankton and cyanobacterial blooms.

COOK

#E4

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Measure

Reducing nutrient loading by farming and harvesting blue mussels

Source: Baltic Sea Center 2018 https://www.su.se/ostersjocentrum/english/communication/policy-briefs/policy-brief-mussel-farming-in-the-baltic-sea-1.390835

Stream: Stocks

Type of measure: eco-technology

Area of operation: Coastal zone-based

Problem description:

The measure comprises enabling natural recruitment of blue mussels onto artificial farming substrates such as ropes (longlines) or nets hanging vertically in the water mass. Natural mussel growth and eventual harvest of mussels lead to nutrient removal (Kraufvelin & Díaz 2015).

Actions required

This biotechnology removes phytoplankton which in turn have taken up nutrients - to make an impact on lowering nutrient levels in coastal areas - would require widespread mussel culture. Latest paper on this https://www.sciencedirect.com/science/article/pii/S0048969719361406 suggests putting these mussel farms out in large scale in the central Baltic as well.

Expected effects

- Nutrient removal

COOK

#E5

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Measure

Rehabilitation of hypoxic areas by oxygen pumping

Source: Eurofish Magazin
https://www.eurofishmagazine.com/sections/aquaculture/item/142-aeration-systems-and-pure-oxygen-in-aquaculture

Stream: Stocks

Type of measure: eco-technology

Area of operation: Offshore zone-based

Problem description:

Combating hypoxia through oxygen pumping has been suggested as a measure to improve the conditions of the Baltic proper and in hypoxic coastal waters (see e.g. Stigebrandt & Gustafsson 2007). The suggested technology involves the pumping of aerated surface water to the bottom depths in order to achieve a 2 ppm oxygen level year round. Negative impacts include destruction of the halocline and thermocline, thus mixing of the water column. Conley (2012) advises against large-scale application of this approach. https://www.nature.com/articles/486463a

Actions required

Local agreement between government and stakeholders if the application will be set up within a restricted zone with national jurisdiction. For offshore application, international agreements would be necessary.

Expected effects

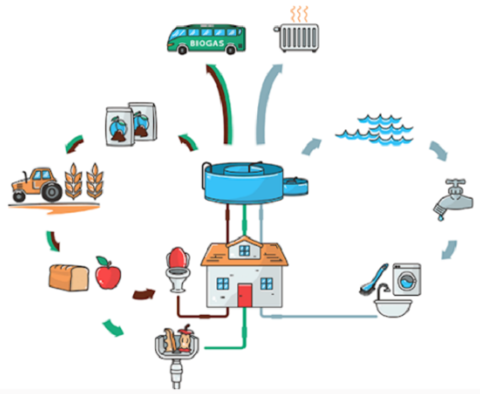
Decreased anoxic conditions and improved oxygen levels in benthic zones and sediment thus reducing the mobility of water soluble phosphate from sediment. Reduced availability of phosphate in the water column thus controlling the seasonal development of phytoplankton, in particular cyanobacteria that can fix atmospheric nitrogen (ie these are P-limited).

#E6

£

Measure

Source separation of sewage systems in newly built areas



Stream: Flow

Type of measure: eco-technology

Area of operation: Land -based

Problem description:

Source-separated systems are systems where different sewage fractions are sorted at the source. This means that sewage fractions can be treated separately at the treatment plant. This includes separate treatment of toilet drains (a relatively small flow volume rich on nutrients and organic matter) and water containing urine, faeces and bathing, and washing water (a relatively large flow volume poor on nutrients and organic matter). By treating the streams separately, there is a possibility for nutrient recovery and increased biogas production.

Actions required

Address "challenges identified regarding planning and implementation of source separation are

1) adaptation to laws and regulations,
2) cooperation with the agriculture,
3) anchoring with contractors, and
4) communication with residents.

Regarding the technology, experiences of sewer transport of Blackwater are few but promising. It was indicated that elderly vacuum systems have quite many disruptions compared to conventional sewer systems. There are on the other hand no negative experiences of new applications of vacuum systems. The treatment and extraction of nutrients from blackwater is not a very developed area and there is a need for a market for recycling in order to further develop the area" (Kärrman et al., 2017).Cost assessments show varying results in comparison with the established centralized system.

Expected effects

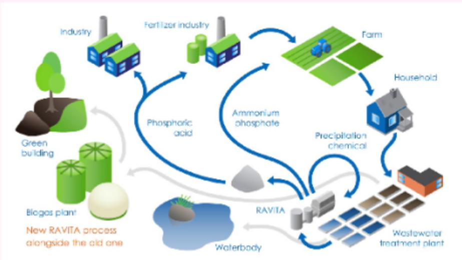
Future requirements regarding water emissions and nutrient recycling can be fulfilled with the introduction of source separated waste and wastewater systems.Specifically, source separation systems have the potential to fulfil the environmental target of nutrient recycling and could therefore be considered for new city districts or in areas where the sewer system and the buildings need renovations.

#E7

£

Measure

Nutrient recovery in wastewater treatment plants



RAVITA: https://www.youtube.com/watch?v=B_JQe4WqWeA

Stream: Flow

Type of measure: eco-technology

Area of operation: Land -based

Problem description:

Nutrient (N and P) and carbon (BOD) removal and capture as part of wastewater treatment in order to improve the water quality of emitted wastwater from municipal sewage treatment plants and to provide materials for reuse. Such processes include activated sludge removal of N and P and collection in sludge, struvite precipitation of N and P, ammonia stripping into ammonium sulphate, anaerobic digestion producing methane gas, etc.

Actions required

Investments at the municipal level to perform upgrades of existing WWTPs to include ecotechnologies. Review and reform of water and sanitation user fees. Justification of the investments based on national advisories linked to HELCOM recommendations and catchment-determined WFD stipulations.

Expected effects

Improvement in wastewater emission quality and quantity. Production of reuse products including biogas, sludge, struvite, etc that can have commercial value and increase circularity of nutrients and carbon

COOK

#P1

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Measure

Incentives to support the use and production of manure-based recycled fertilizers

Source: Lpelc 2018 https://lpelc.org/storing-manure-on-small-farms/

Stream: Flows and stocks

Type of measure: Policy

Area of operation: Land -based

Problem description:

Direct support to the use of recycled nutrients is recommended as they must be made a viable alternative to mineral nutrients from the perspective of an individual farmer. Investment support for farm structures, such as storages and machinery, enabling the use of recycled nutrients may also be important for the market of recycled nutrients to develop. Support for businesses in contracting services specialized to recycled nutrients should also be considered. To support the formation of "regional nutrient redistribution centres" to process and produce manure-based fertilizer products, investment subsidy for manure processing plants should be set.

Actions required

- Development of a BSR market place for recycled nutrient products based on the new EU regulations. Protocols for product quality standards, preparation, storage and transport.
- Involvement of clustered local actors e.g. energy producers, sewage treatment plants, farmers, fertilizer producers, etc. Incentives provided by national governments that are tasked with reducing nutrient loading in catchments.

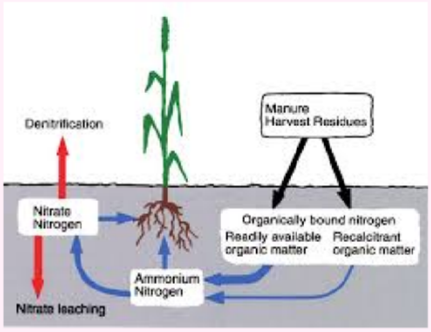
Expected effects

- Reduced use of imported chemical fertilizer. Increased use of recycled fertilizers. Higher quality standards on waste treatment from crop and animal farms and from sewage treatment plants.
- Reduction in overuse of fertilizers on croplands. Increased consumer interest in closed loop systems supporting environmental improvements.

#P2

£

Measure
Prohibition of post-harvest application of manure and other organic fertilizers



Gustafson (2012). Leaching Losses of Nitrogen from Agricultural Soils in the Baltic Sea Area

Stream: Flow

Type of intervention: Policy

Area of operation: Land -based

Problem description:

Timing of manure use is one of the most important aspects for ensuring a high utilization effect of manure and field trials document that leaching risk is highest for manures that are applied in autumn (Liu et al., 2018). All littoral states to the Baltic Sea (except RU) have a ban on manure application during winter beginning about November 1st and opening again in the beginning of the growing season. However, field trials document high leaching from manure applied in autumn. Hence, a ban on post-harvest application of manure will ensure that manures are stored and increasingly applied prior to the growing season of the main crop, which implies a higher utilization effect of N in the manure. Furthermore, a ban on post-harvest application will provide incentives for farmers to construct sufficient storage capacity for manure to ensure distribution when utilization is highest.

Actions required

- HELCOM to make further recommendations regarding post-harvest applying of manure during the autumn in all sensitive areas of the BSR.
- Recommendations would include safe storage of manure in order to prevent loss of ammonia and nitrate and to retain as high a content N/P ratio as possible prior to spreading in the spring.HELCOM signing parties to enforce these recommendations in national regulations.

Expected effects

- Elimination of post-harvest manure spreading during the autumn in sensitive areas where nutrient leaching and runoff occur. Reduction in N and P losses from farms during the autumn and winter period when main crop uptake is not occurring.

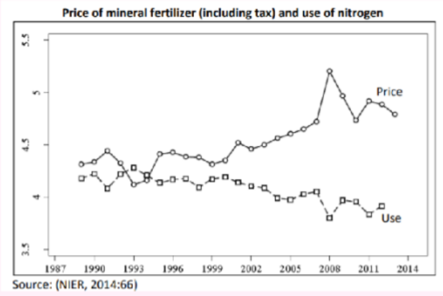
COOK

#P3

£

Measure

Tax on mineral fertilizers



Source: Skou Andersen (n.d)
https://ieep.eu/uploads/articles/attachments/cd57d2c2-6c74-4244-8201-10c8fff4b7f6/SE%20Fertilizer%20Tax%20final.pdf?v=63680923242

Stream: Flow

Type of measure: Policy

Area of operation: Land -based

Problem description:

The cost of transporting manure from animal farms to cropland areas where it is needed makes it unprofitable compared to buying mineral fertilizers. By taxing mineral fertilizers this difference can be evened out.

Actions required

- HELCOM provides a formula for a new volume-based sliding taxation system. This would then be taken on board by the signing parties and incorporated into the national regulations.
- Chemical fertilizer would be taxed based on volume consumed per hectare with low levels of use receiving lower taxes and higher users receiving higher taxes. At the same time there would need be tax relief measures made for recycled fertilizer products.

Expected effects

- Reduced use of chemical fertilizers on a per hectare basis. Increased use of recycled fertilizers as alternatives.

COOK

#P4

£

Measure

Reducing livestock densities and coupling livestock to the area of available farmland

https://www.organe.dk/docs/Synthesizing_best_practices_and_technologies_for_nutrient_recovery_and_circular_economy_in_the_Baltic_Sea_Region_Henning_Lyngs%C3%B8_FOGED.pdf

Stream: Flows

Type of measure: Policy

Area of operation: Land -based

Problem description:

Concerning agriculture in the Baltic Sea catchment area some regions are more dominated by livestock production, while others are more focused on crop production. The crop-livestock separation is an Important driving force for nutrient imbalances in agriculture (Nesme et al., 2015; Schipanski and Bennett, 2012).

Areas focusing on crop production often depend on imported mineral fertilizer to a large extent. Areas focusing on livestock production import a large proportion of feed for animals (Wang et al, 2018), while the manure usually is applied on fields close to the farm, often in excess of crop needs. Therefore, in areas with high livestock densities excessive nutrient inputs to surface waters are occurring. Transporting the manure to other regions would be a possible solution, but it is costly and therefore hardly practiced. A more sustainable solution would be to reduce livestock densities and couple them more closely to the area of available farmland so that sustainable fertilisation practices can be achieved.

The aim of the measure is that HELCOM Contracting Parties commit to a reduction of livestock densities in particular in areas with high livestock densities that are sensitive to nutrient losses. Current livestock densities vary between HELCOM Contracting Parties Baltic Sea catchment area (0.26 to 1.17 LSU/ha according to Svanbäck et al. 2019),

Actions required

HELCOM contracting partners sign to invoke limits to livestock density in order to limit nutrient overloading in the immediate cropland area. This is to be based on national guidelines for an allowable maximum surplus eg 10 kg P/ha/yr. This means farms are responsible to carry out nutrient balancing, by taking measurements of the soil nutrient levels, estimating nutrient offtake by the target crops, measuring the N/P ratio of the stored manure and applying manure based on the P crop requirements.

Alternative measures are to reduce the amount of manure produced by reducing the number of livestock units or to treat the slurry/manure/litter in order to make it transportable to neighboring cropland farms.

Expected effects

These measures will limit P overloading of cropland in animal farms, reduce the density of livestock units, create a need for investments in improved manure storage facilities (to ensure N losses are limited), and in manure treatment equipment such as dewatering and drying.

A negative impact would be reduction in the production of meat and eggs in certain BSR countries in order to protect the environment and the concomitant increase in imports from countries with less stringent regulations.

#P5

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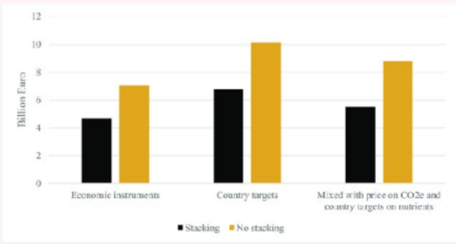
Measure

Allow coordination of abatement measures among HELCOM countries to ensure cost-effective nutrient abatement at the basin and Baltic scales



Source: Gren & Ang 2019 DOI: 10.1016/j.ecolecon.2019.106375

Stream: Flows and Stocks

Type of intervention: Policy

Area of operation: Land- and watershed-based

Problem description:

Rules specifying how nutrient abatement targets can be achieved have a substantial impact on total costs. The current Baltic Sea Action Plan (BSAP) sets rigid national abatement targets, rather than basin specific targets. If each country must reduce nutrient emissions by a certain amount to a certain basin, costs will be unconditionally higher than necessary. If more flexible abatement strategies were allowed, i.e., if BSR countries could cooperate to find the least-costly abatement measure for a particular basin, the same overall reduction could be achieved at substantially lower cost than implied by the current BSAP.

Actions required

HELCOM makes recommendations to set up management authorities for each river catchment area within the BSR. With the use of the EU Water Framework Directive nutrient budgets are then set up for each catchment and using SWAT modelling, limits are constructed regarding acceptable surplus levels of nitrogen and phosphorus. Signing parties for each catchment would then agree on emission limits and permits which would be tradable within the catchment area and also include transporting of excess manure from animal farms to croplands to achieve higher catchment-wide PUEs and NUEs. The same can be applied to treated sewage sludge.

Expected effects

By shifting from national emission targets, signing parties to HELCOM would work up nutrient emission limits within basin authorities. This would allow for more flexible arrangements for land use within countries and the sharing of nutrient abatement measures between neighboring countries sharing the same catchment. The ultimate effect would be a more efficient system for nutrient management in each catchment area integrating both farms and cities

COOK

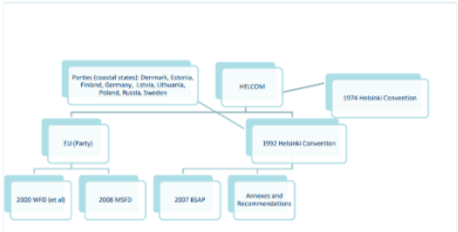
#P6

£

Measure

Improved integration of BSAP targets with WFD targets

Baltic Sea regulatory framework



Source: Bohman 2020 https://www.su.se/polopoly_fs/1.502063.1591048202!/menu/standard/file/Brita%20Bohman.%20Compliance%20in%20the%20Baltic%20Sea%20area.pdf

Stream: Flow

Type of measure: Policy

Area of operation: Watershed-based

Problem description:

The BSAP and Water Framework Directive (WFD) both carry targets for nutrient inputs, though the two approaches and the targets derived are not fully compatible. In general, the BSAP targets are more ambitious than those under the WFD and in addition there may be significant variation between the WFD targets of neighboring countries with adjoining waterbodies. The targets under the WFD should be better aligned with the more stringent BSAP targets to make coherent, harmonized and compatible targets that are ambitious and reflect the regional impacts and nature of nutrient discharges.

Actions required

- HELCOM makes recommendations to set up management authorities for each river catchment area within the BSR. With the use of the EU Water Framework Directive nutrient budgets are then set up for each catchment and using SWAT modelling, limits are constructed regarding acceptable surplus levels of nitrogen and phosphorus.
- Signing parties for each catchment would then agree on emission limits and permits which would be tradable within the catchment area and also include transporting of excess manure from animal farms to croplands to achieve higher catchment-wide PUEs and NUEs.

Expected effects

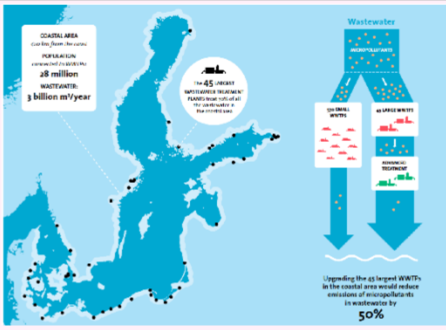
- By shifting from national emission targets, signing parties to HELCOM would work up nutrient emission limits within basin authorities. This would allow for more flexible arrangements for land use within countries and the sharing of nutrient abatement measures between neighboring countries sharing the same catchment.
- The ultimate effect would be a more efficient system for nutrient management in each catchment area integrating both farms and cities

#P7

£

Measure

Strengthening of HELCOM recommendation 28E/5 on municipal wastewater treatment



Source: Baltic Eye https://balticeye.org/en/pollutants/increased-need-for-advanced-waste-water-treatment/

Stream: Flows

Type of measure: Policy

Area of operation: Landbased

Problem description:

HELCOM Recommendation 28E/5 on municipal wastewater management was adopted in 2007 based on the then current level knowledge and available best practices at that time. Due to significant technological improvements the level of P removal that can be achieved has increased markedly.

Actions required

Strengthening of the recommendation by increasing the targeted removal of P to 95% or higher (exact value proposed to be concluded on, work ongoing) would have significant impacts on the P loadings to the Baltic Sea, essentially halving the current accepted inputs (at the 95% value proposed here).

Expected effects

The impact of such actions would be significant at the scale of the entire Baltic Sea, though the outcomes would likely manifest differently in different sub-basins due to underlying conditions.

COOK

#P8

£

Measure

Use CAP to support agreed measures

Stream: Flows

Type of measure: Policy

Area of operation: Landbased

Problem description:

Actions required

Expected effects

Appendix C. Details of the 5 interventions developed during the workshop

Intervention 1. Increasing incentives for valuing nutrients, resource recovery and circular nutrient economy

Cook Step

Measures were selected through a consensus-based approach. The measure that had been pre-selected by most people was selected as the main measure. For those who had not selected this measure, they agreed that this one was important and had in fact considered selecting it.

Main measure - C1 Support and improve knowledge exchange between farmers, authorities and decision makers at national and international levels for all stakeholders

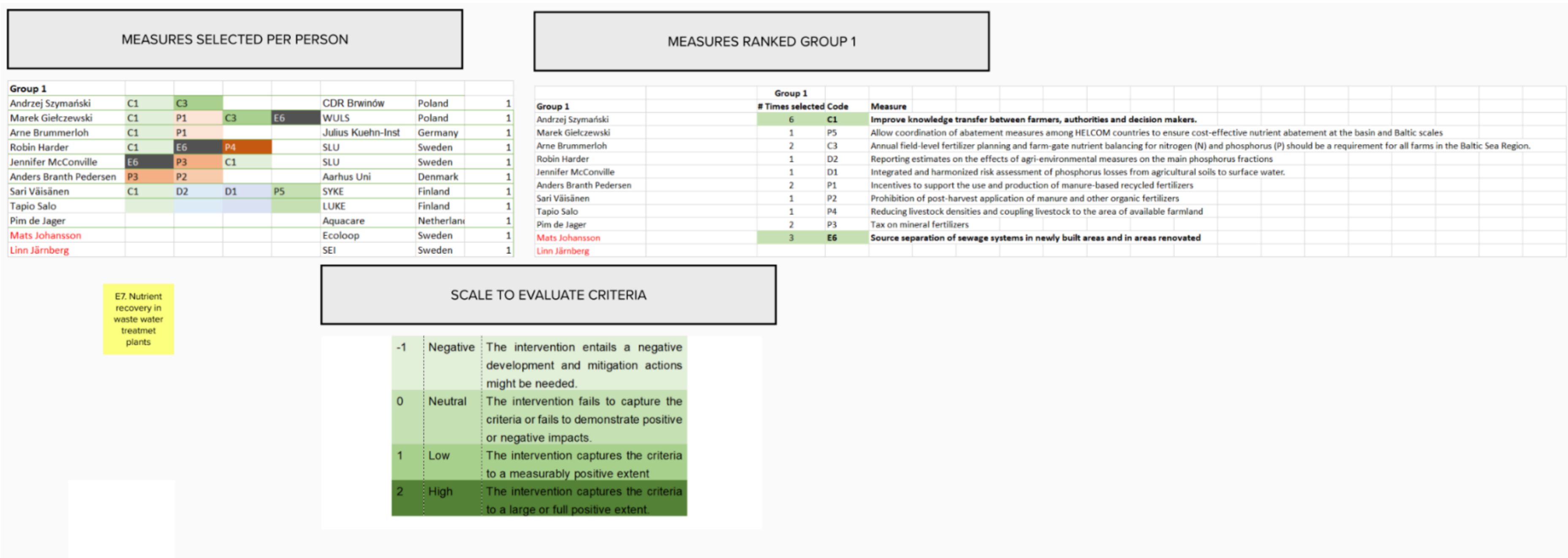
Supporting measures

- D1 Integrated and harmonized risk assessment of phosphorus losses from agricultural soils to surface water
- E6 Source separation of sewage systems in newly built and renovated areas
- C3 Annual field-level fertilizer planning and farm-gate nutrient balancing, including quotas for recycled fertilizers for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region

In the process of selecting the measures, some were reformulated to make sure everyone in the group agreed to include them. The changes were only made to the "title" of the measure without digging deeper or changing the content of the templates for each measure. In bold, are the changes made:

- C1 - **Support and** improve knowledge transfer between farmers, authorities and decision makers at national and international levels for all stakeholders" to emphasize that knowledge transfer does not happen automatically but requires support. Also lack of knowledge might not necessarily be the issue, but instead the (lack of) transfer of knowledge. The group agreed that knowledge sharing is indeed fundamental for increasing a circular nutrient economy in the Baltic Sea region. The problem is often not a lack of information, but there is a lack of a common understanding, and information doesn't always reach those who would need it the most for making decisions.

- C3 - Annual field-level fertilizer planning and farm-gate nutrient balancing, **including quotas for recycled fertilizers** for N and P should be a requirement for all farms in the BSR to emphasize that planning and nutrient balancing would not only include mineral fertilizers but the measure should also push for more circular solutions.



MEASURES SELECTED PER PERSON

Group 1							
Andrzej Szymański	C1	C3			CDR Brwinów	Poland	1
Marek Giełczewski	C1	P1	C3	E6	WULS	Poland	1
Arne Brummerloh	C1	P1			Julius Kuehn-Inst	Germany	1
Robin Harder	C1	E6	P4		SLU	Sweden	1
Jennifer McConville	E6	P3	C1		SLU	Sweden	1
Anders Branth Pedersen	P3	P2			Aarhus Uni	Denmark	1
Sari Väisänen	C1	D2	D1	P5	SYKE	Finland	1
Tapio Salo					LUKE	Finland	1
Pim de Jager					Aquacare	Netherlan	1
Mats Johansson					Ecoloop	Sweden	1
Linn Järnberg					SEI	Sweden	1

MEASURES RANKED GROUP 1

	Group 1		
Group 1	# Times selected	Code	Measure
Andrzej Szymański	6	**C1**	**Improve knowledge transfer between farmers, authorities and decision makers.**
Marek Giełczewski	1	P5	Allow coordination of abatement measures among HELCOM countries to ensure cost-effective nutrient abatement at the basin and Baltic scales
Arne Brummerloh	2	C3	Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region.
Robin Harder	1	D2	Reporting estimates on the effects of agri-environmental measures on the main phosphorus fractions
Jennifer McConville	1	D1	Integrated and harmonized risk assessment of phosphorus losses from agricultural soils to surface water.
Anders Branth Pedersen	2	P1	Incentives to support the use and production of manure-based recycled fertilizers
Sari Väisänen	1	P2	Prohibition of post-harvest application of manure and other organic fertilizers
Tapio Salo	1	P4	Reducing livestock densities and coupling livestock to the area of available farmland
Pim de Jager	2	P3	Tax on mineral fertilizers
Mats Johansson	3	**E6**	**Source separation of sewage systems in newly built areas and in areas renovated**
Linn Järnberg			

E7. Nutrient recovery in waste water treatmet plants

SCALE TO EVALUATE CRITERIA

-1	Negative	The intervention entails a negative development and mitigation actions might be needed.
0	Neutral	The intervention fails to capture the criteria or fails to demonstrate positive or negative impacts.
1	Low	The intervention captures the criteria to a measurably positive extent
2	High	The intervention captures the criteria to a large or full positive extent.

WG 1 Cook Step

Incubation Step

When working through the criteria of actors, processes, capabilities, and impacts, one challenge was that since the measures/combination of measures are very broad - particularly the main measure, basically everything and everyone could be included at some point. To address this, the group sorted the post-its in order of importance with the most important ones at the top. Though timing was pressed, for the sequencing (timing of events), it was agreed there was no point in waiting with any of the measures; rather, they should all ideally be started as soon as possible. However, one of the measures, E6 - source separation (in sewage systems), should probably be considered a longer-term transformational measure, in the sense that it could trigger a transition towards a different wastewater system altogether.

The following is a collection of the “post-it” notes produced on-line in the incubation template by the participants:

Actors

- National environmental/agri agencies
- agricultural advisors
- Farmers and farmer organisations
- politicians,
- entrepreneurs,
- housing and building developers,
- environmental organisations,
- young generation,
- scientists, researchers, R&D actors,
- general public, consumers

Processes

- Agriculture: agri-environmental subsidies, codes of good practice for fertilizer application
- EU frameworks: EU circular economy package, EU Farm to Fork Strategy, EU Regulation on Fertilisers
- National planning: national environmental planning and monitoring, national planning agendas housing development,
- Innovation: promotion of pilot projects
- Knowledge exchange: educational activities, mechanisms supporting cross-country exchange of knowledge to farmers, farmer visits to different countries

Existing Capacities

- Technical: Practical experience with test beds, technical solutions available
- Human: human capacity, topical expertise, field practical experience, networks, forums, knowledge exchange

Required capabilities

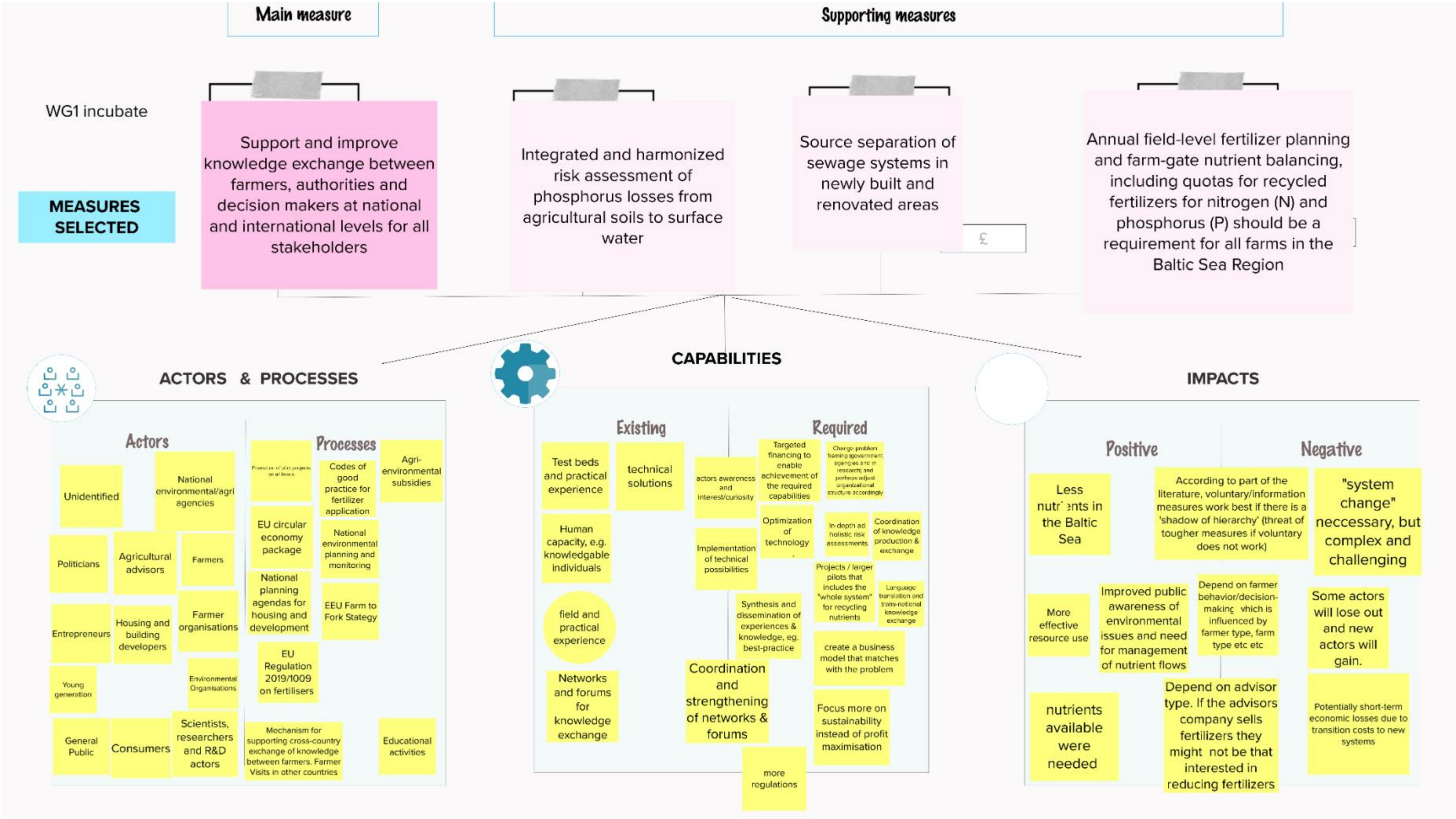
- Financial: Targeted financing to enable achievement of required capabilities, business models, not for profit maximisation
- Organizational: change problem framing, government agencies research organizational structure, more regulations
- Actor awareness and interest/curiosity
- Optimization of technology
- Knowledge transfer: coordination of knowledge production exchange, language translation, transnational knowledge exchange, synthesis, dissemination of experience, knowledge and best practice, coordination and strengthening of networks and forums.
- Analysis: in-depth holistic risk assessments, implementation technical possibilities, larger pilots projects "whole system" recycling nutrients, sustainability

Positive impacts

- Environmental: less nutrients in the Baltic Sea, management of nutrient flows, more effective resource use, nutrients available to where they are needed
- Awareness: improved public awareness on environmental issues
- Farmer behaviour and advisors' incentives steer whether positive impacts materialize

Negative impacts

- Voluntary information measures may only be effective if there is a "shadow of hierarchy", i.e. a threat of introducing tougher measures
- "System change" is necessary but is both complex and challenging
- Structural: some actors lose out and new actors will gain, transition to new systems (dependent on advisors and fertilizer companies interest in reducing use of fertilizers)
- Economic: potentially short-term economic losses



WG 1 Incubation Step

Evaluation Step

One of the main benefits of the suggested intervention is the increased focus on circularity. Despite the advantages of the intervention, to bring it forward as a measure in a policy context (e.g. BSAP) would require a greater degree of specificity and less generic statements. This would clarify the means of implementation and the potential for application. Furthermore, a reflection on whether the intervention reflects the group's willingness to compromise or whether it truly presents the best combination of measures would be necessary.

The following is a summary of the input for the different criteria provided by the participants during the evaluation step.

Risk
Natural disasters like flooding or drought, risk of farmers not perceiving current fertilizer use as a problem, conflicting political or economic interests, interventions from the agriculture industry, conflicts between nations and regions, mistakes will blow up the project or concept, conflict between actors

Circularity

- Source separation leads to better nutrient recovery for reuse
- The intervention improves knowledge of how to more efficiently use nutrients in agriculture
- The intervention leads to nutrient recovery on small geographical level (less transport)

Efficiency

- It depends on farmer advisors. Are they interested in promoting reduced use of fertilizers?
- It depends on farmer type, farm type etc which have an influence on farmer behavior
- The intervention targets knowledge that can effectively control both point and nonpoint sources of nutrients to the Baltic Sea
- It depends on whether farmers can see a business model

Feasibility

- Research funders can support knowledge development around risks
- National and EU agencies promoting Circular Economy and Environmental issues can provide seed money for pilot scale demonstrations
- Feasibility is important, but having said that it is hard to estimate financial feasibility on the current more holistic level

- Basically, information measures can be cost-effective, if they work

Co-benefits

- jobs and businesses
- Stimulus to local economy / production
- Better understanding of nutrient cycles by (more) general public and/or farmers

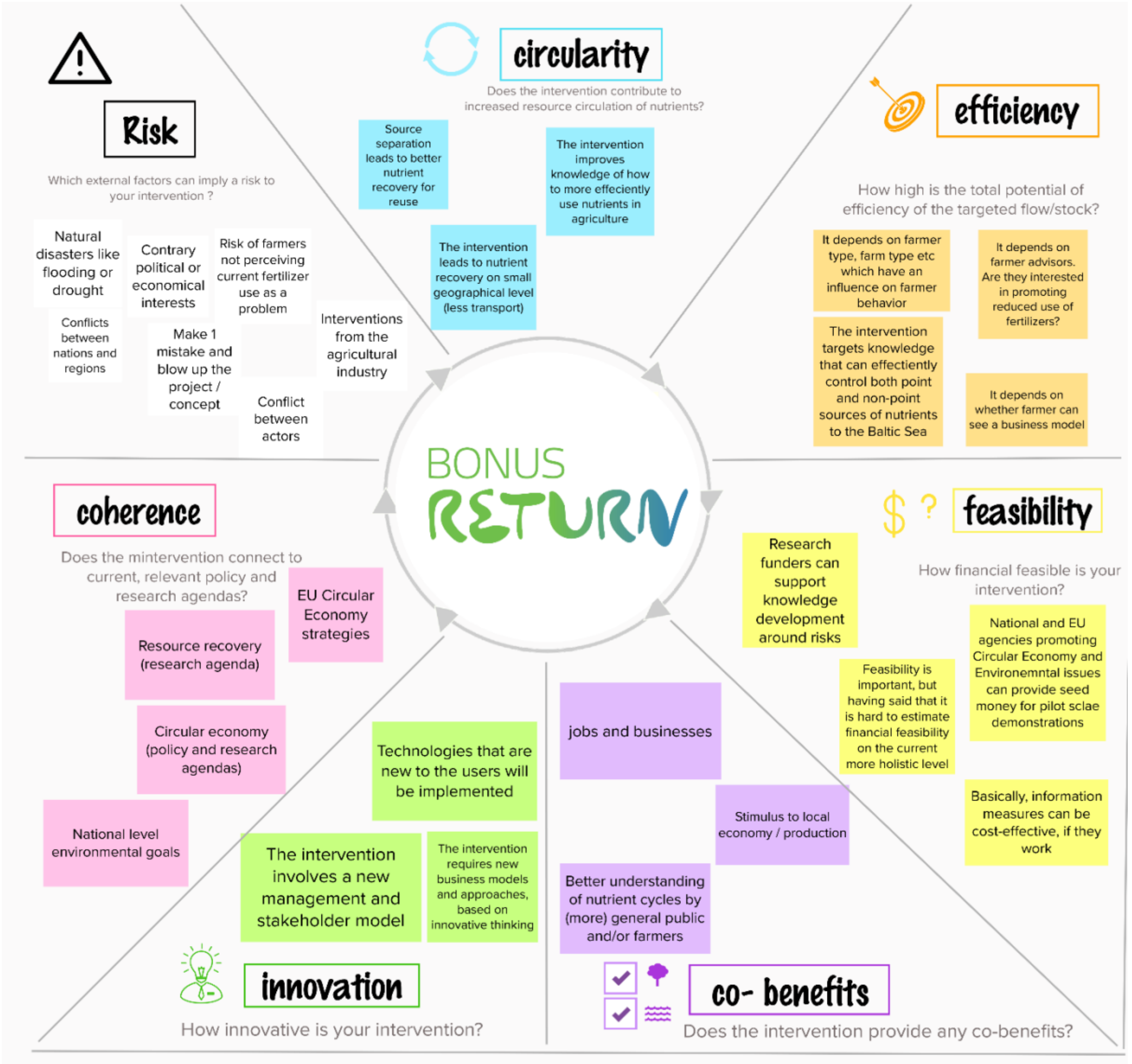
Innovation

- Technologies that are new to the users will be implemented
- The intervention requires new business models and approaches, based on innovative thinking
- The intervention involves a new management and stakeholder model

Coherence

- EU Circular Economy strategies
- Resource recovery (research agenda)
- Circular economy (policy and research agendas)
- National level environmental goals

WG1 Evaluation Step



Intervention 2 - Improving the integration of farming practices with required nutrient reductions across the Baltic Sea Region

Cook Step

The discussion on what measures to choose and combine was a difficult part to start off with. Lack of consensus coupled with the fact that not all participants knew each other, and that not everyone felt comfortable with the software being used, made this first part of the workshop a complex task. Some participants felt they were cornered into choosing the pre-selected measures and would have liked to take part in more in-depth discussion on the measures themselves and reasons behind choosing them.

Using the software Mural and adding sticky notes with comments went smoothly. The discussions were a bit reserved at the start, but picked up as the workshop proceeded. The digital environment did not allow for an even exchange of views. Instead, a few loud voices dominated, while others silently spectated. While the moderator directly and indirectly referred to all participants, by for instance inviting specific persons to contribute, the dynamics of the discussion remained stiff.

The group chose measures based on how the members voted in the pre-selection process. This resulted in four measures:

Main measure
P4 Reducing livestock densities and coupling livestock to the area of available farmland

Supporting measures

- E7 Nutrient recovery in wastewater treatment plants
- C3 Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region.
- C1 Improve knowledge transfer between farmers, authorities and decision makers.

Some additional comments from the participants:

- Important to incorporate research in C1 Knowledge brokering. C1 could include transfer of research knowledge to inform decisions of farmers, authorities and other decision makers (just a clarification).
- C1, C3 and P4 integrate well as a group of strategies involving farmer engagement, knowledge transfer and economics. Would be good to consider these 3 as a unit.
- Widen the scope in E7, measures should be targeted local conditions, acknowledge that different countries, and even regions within a country, will need different things to meet big goals because the causes of issues are different. Good point about regional differences. Scale and coordination then become very important
- Cannot forget issues of equity and livelihoods in the way we address nutrients.
- To reduce losses to the sea we have to rethink livestock production, there is only so much we can do with business as usual, efficiency and incentives. The international trade part of course is important as the Baltic interacts with other systems that drive actions.

WG 2 Cook Step

MEASURES SELECTED PER PERSON

Group 2						
Søren Pedersen					Copenhagen Uni	Denmark
Zanda Melnalksne	C1	E1	P4		Farmers Parliament	Latvia
Genevieve Metson	C1	P4	P1	P7	Linköpings Uni	Sweden
Biljana Macura	P3	C1	D3	E7	SEI	Sweden
Mikael Skou Andersen	P3	P4	C3		Aarhus Uni	Denmark
Erik Kärrman	E6	E7	E1		RISE	Sweden
Niels van Helmond	E7	E1	P4		Utrecht Uni	Netherlan
Mark Rasmussen	C3				SEI	Sweden
Kari Ylivainio	C3	P1	D1	E7	LUKE	Finland
Petra Wallberg					Formas	Sweden
Somya Joshi					SEI	Sweden
Elin Leander					SEI	Sweden

MEASURES RANKED GROUP 2

Group sum		
# Times selected	**Code**	**Measure**
3	**C1**	**Improve knowledge transfer between farmers, authorities and decision makers.**
3	**C3**	**Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region.**
1	D1.	Integrated and harmonized risk assessment of phosphorus losses from agricultural soils to surface water.
1	D3	Definition of "New Hot Spots" of nutrient input into the Baltic and subsequent targeted measures to reduce the source
2	P1	Incentives to support the use and production of manure-based recycled fertilizers
2	P3	Tax on mineral fertilizers
4	**P4**	**Reducing livestock densities and coupling livestock to the area of available farmland**
1	P7	Strengthening of HELCOM recommendation 28E/5 on municipal wastewater treatment
3	E1	Recycling of nutrients and carbon in agricultural residues by use of anaerobic digestion
1	E6	Source separation of sewage systems in newly built areas and in areas renovated
4	**E7**	**Nutrient recovery in wastewater treatment plants**

Systemic change really needed to the farming system in reduce livestock, while we can't reduce human waste so then its about recovery.

C1, C3 and P4 integrate well as a group of strategies involving farmer engagement, knowledge transfer and economics. Would be good to consider these 3 as a unit.

enhance feeding practices in pig production to reduce P surplus

Knowledge brokering: C1 could include transfer of research knowledge to inform decisions of farmers, authorities and other decision makers (just a clarification)

I feel like C1 should not aim just for a transfer but also co-creation or is that a separate thing?

The C measures got less votes but maybe they are tools in achieving P4 and E7? We need coordination and data in order to know when, where, and how to increase recovery and reduce densities

Make sure to find cost effective solutions at crop root zone and water recipient

improve darinage management and damaged pipes

Direct communication between farmers and scientists should be strengthened, to develop measures with real implementation and impact/efficiency potential.

We have to tackle the root of the problem, i.e. limit the input of nutrients into rivers and eventually the Baltic Sea itself.

Production strategically should be planned and regulated according to available resources in particular region and population density. Priority - to shorten supply chains.

When designing intervention should think of alternative pathways and negative feedback loops

good point about regional differences. Scale and coordination then become very important

Cannot for get issues of equity and livelihoods in the way we address nutrients

To reduce losses to the sea we have to rethink livestock production, there is only so much we can do with business as usual efficiency and incentives

Any measure recomended, firstly has to be evaluated, through all implementation algorythm, to see real implementation feasibility.

Need to think of changing norms and attitudes/"mental lock-ins"

The international trade part of course is important as the baltic interacts with other systems that drive actions

Would a focus on refunding and prioritising extension agencies be of interest to this group as part of the face to face exchange between scientists and farmers? Maybe something not only focused on agronomy, but more multi disciplinary. I think this would be a great way to test different things, share knowledge but also ensure good monitoring and evaluation along the road.

Knowledge brokering tool between many different actors

If we decrease livestock and reuse manure very locally, then human excreta becomes a more important source of nutrients for a full nutrient recovery and reduced pollution. Maybe in our measure we could thus bring in E7 in that way to match with P4?

Cannot forget food waste and other circular nutrient flows

SCALE TO EVALUATE CRITERIA

-1	Negative	The intervention entails a negative development and mitigation actions might be needed.
0	Neutral	The intervention fails to capture the criteria or fails to demonstrate positive or negative impacts.
1	Low	The intervention captures the criteria to a measurably positive extent
2	High	The intervention captures the criteria to a large or full positive extent.

Quality of quantity. Farmer centered support to decrease livestock and nutrient losses while increasing the reuse of organic waste resources and liveslihood security

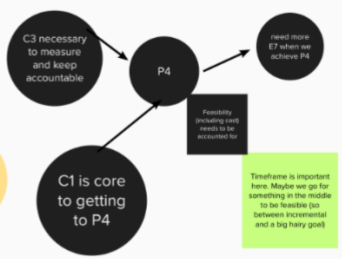
EU CAP policy change

multi decciplinary extension teams responsible for local farm clusters

higher prices for crops and animals that do not exceed N P K application and prefer recycled materials

This does mean protectionist policies though :(because of the global market place

Lots of campaigns to the public about needing nutrient recycling and support Baltic farmers



Incubation Step

In order to succeed with the intervention the group identified a number of actors which need to be involved. Since it is an intervention very much based on the success of knowledge co-production and translation, all actors need to be involved, from food retailers to land planners.

Actors

- Local governments,
- Land planners,
- Helcom commission,
- Farmers organizations,
- EU CAP,
- specialists able to link information from different systems and sectors,
- educators,
- farmers collecting farm gate data and applying measures,
- extension agents,
- food retailers to make purchasing decisions that reflect this goal,
- background information providers eg scientists, laboratories, data and information owners,
- sanitation authorities to recover human waste.

The process to implement the intervention cut across sectors, from the support of citizens as consumers of sustainable products to technical development needed to succeed.

Process

- Tech development for monitoring at the field level,
- realistic evaluation of people decision making fundamentals,
- lawmakers in different countries to set guidelines,
- policy recommendation elaborators with the mandate to purchase and only sustainable products,
- consumers and citizens need to support the producers and the measures,
- need also ground examples and experimental learning, not just policy recommendations.

The group identified already existing capabilities such as existing networks of different actors. Funding in different ways was identified as capabilities required to enable this intervention.

Capabilities existing

- networks of different actors,
- monitoring scheme,
- data and knowledge,
- reporting through CAP and national regulatory agencies,
- use of EU rural development funds for training and knowledge dissemination,
- acknowledge that different countries and even regions within a country will need different things to meet big goals because the causes of issues are different

Capabilities required

- funding to keep competitiveness of the regions' products after implementation of all environmental recommendations,
- funding for multi-disciplinary regional extension teams to support farmer decisions,
- funding to compensate farmers

Positive impacts

- this intervention could help achieve nutrient security
- this intervention could reduce pollution through focussing on circularity, less meat consumption

Negative impacts

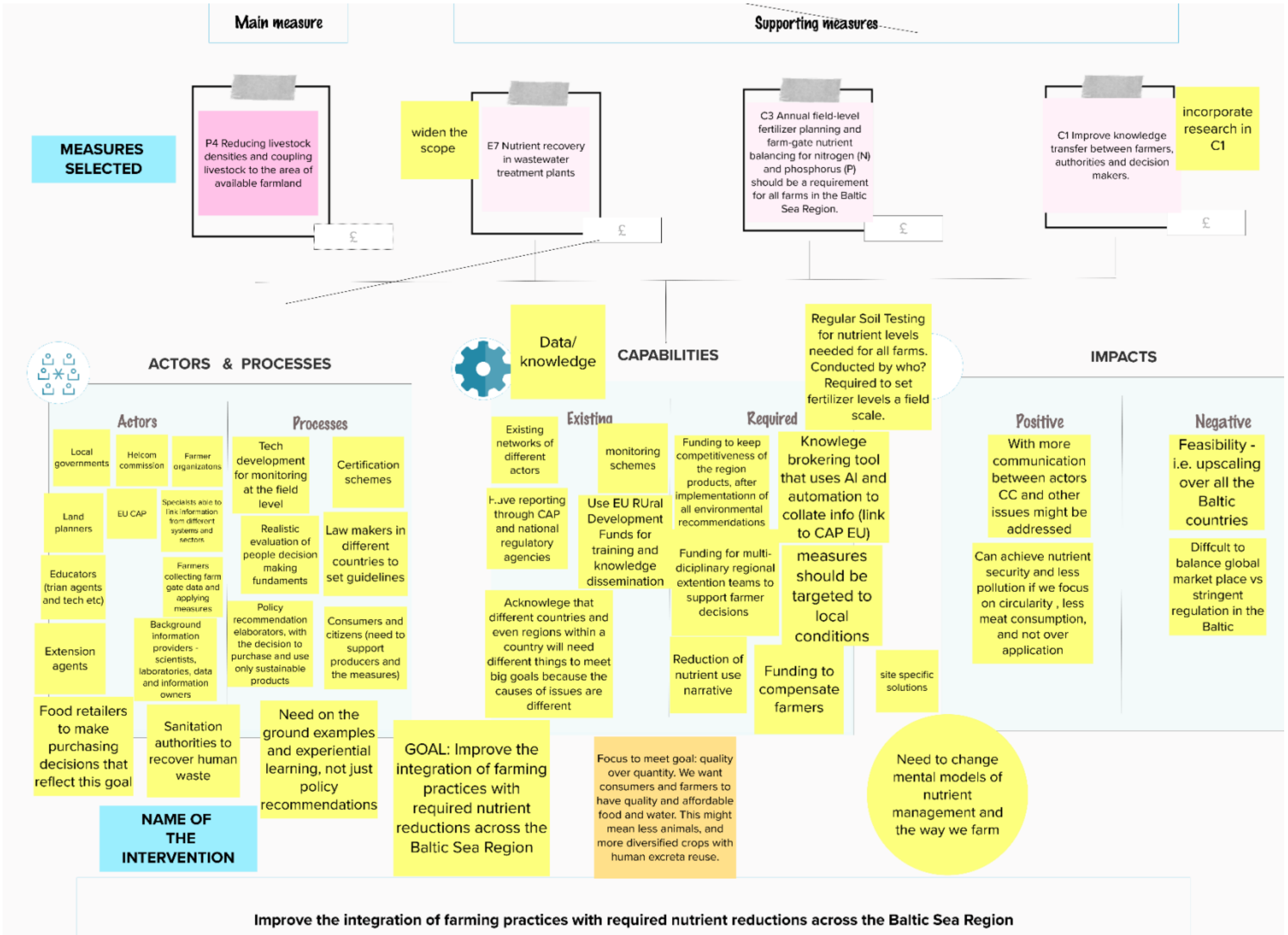
- difficulties in feasibility of upscaling across all the Baltic countries,
- difficult to balance the global marketplace vs stringent regulation in the Baltic.

Comments from participants during the process of building the intervention:

- "GOAL: Improve the integration of farming practices with required nutrient reductions across the Baltic Sea Region". "Focus to meet goal: quality over quantity. We want consumers and farmers to have quality and affordable food and water. This might mean less animals, and more diversified crops with human excreta reuse."

- some of the criteria had already been covered in the first session. In this session there was a time stress and the discussion was still a bit slow, the participants wrote on sticky notes more than actually discussed with each other. But the group decided on which measures were the main ones and which one was more of a supporting overarching measure (C1)
- some further clarity was needed on what an intervention would look like to identify challenges/measures. Not all agreed – that the interventions cooked up, would address all points. They struggled to find a good illustrative case that would encapsulate the interventions.
- need to change mental models of nutrient management and the way we farm
- Need to create a balance between tech and computing power on the one hand and the element of 'human touch' in coordination, collaboration, info sharing and evaluation
- the group carried out a discussion on knowledge transfer, translation, co-production together with technical solutions

WG 2 Incubation Step



Evaluation Step

Risk

- lack of regulatory authority to compel action/compliance by farmers
- Insufficient funding/staffing to finance field-scale monitoring and interventions
- Differences between existing systems in different countries.

Circularity

- focus in this intervention is integration both wastewater and farm flows are involved

Efficiency

- if combined with P4 and E7

Feasibility

- depends on the timescale
- Build on existing capacities for harmonization and data collection like CAP, HELCOM, and national agencies

Co-benefits

- Increasing communication lines can facilitate addressing other issues like CC, pest control, equity, etc.
- Not allowing end of pipe solutions.
- The planning is at the land use and infrastructure level but facilitated by clear lines of communication

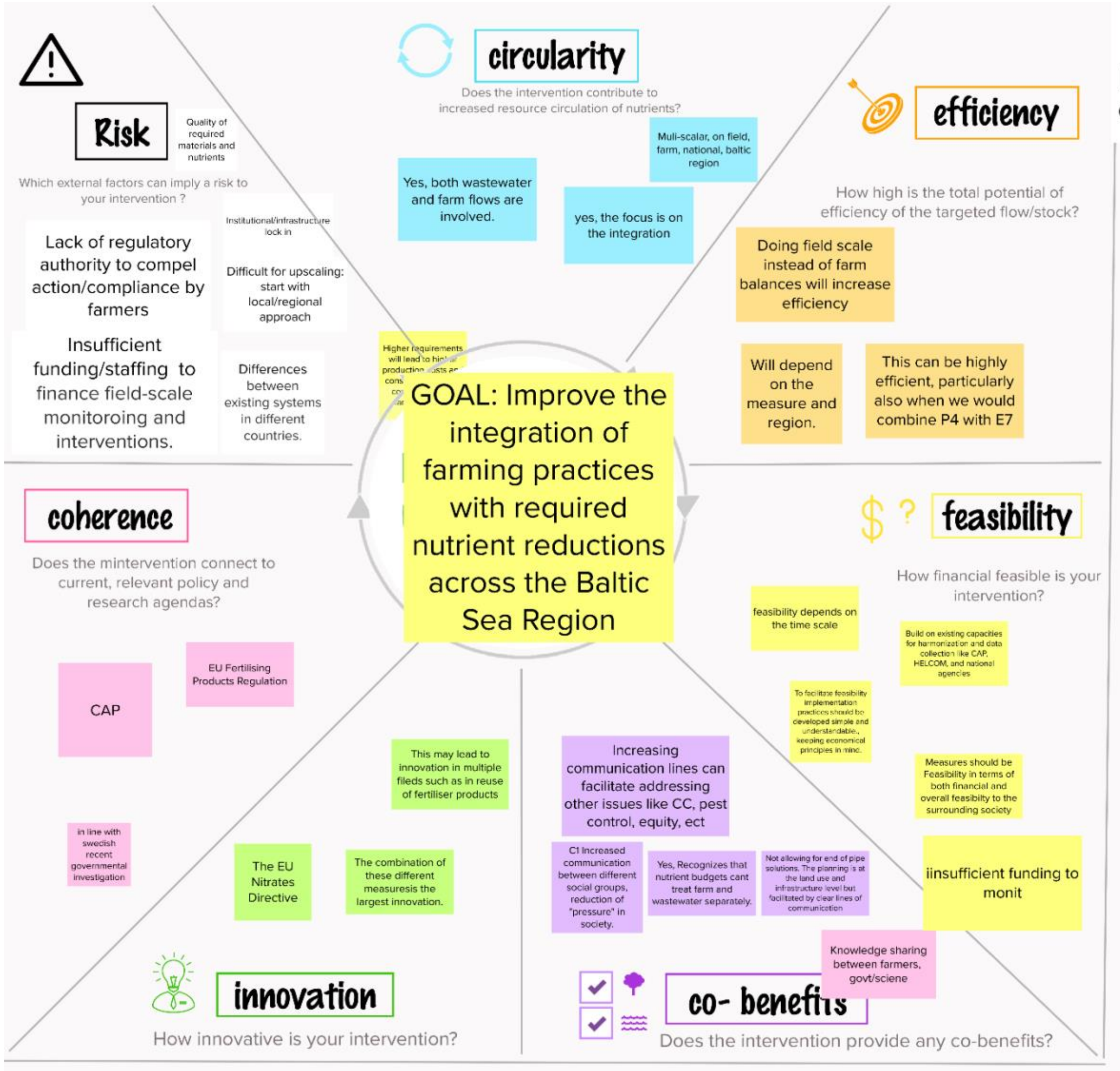
Innovation

- The combination of these measures is the largest innovation, it may lead to reuse of fertiliser products

Coherence

- With the EU nitrates directive, CAP, EU Fertilising products regulation

WG2 Evaluation Step



How realistic was the chosen intervention and could it be tabled at a BSAP meeting of HELCOM?

Comments from participants:

- this is more of an intermediate step where we address the intervention bridge between land and water.
- the large goals that are above that intervention need consideration: e.g. the need to deal with nutrients before they get to the sea; the need for systemic change in the food system (farm to fork) which could mean very different livestock management as well as organic waste management strategies
- Need for a knowledge-brokering tool that uses AI and automation to collate info (eg linking to CAP EU policies and subsidies).
- The group emphasized the need for site-specificity which perhaps makes this intervention less of a success in this mission-oriented format.
- A risk identified is insufficient funding and the issue of upscaling since there are differences between existing systems in different countries and even between regions within countries.

Intervention 3 - Surf and turf nutrient capture and reuse

Cook Step

The group decided to choose the three measures that got the most first place votes and then create the intervention based on these. These were: E4 - Reducing nutrient loading by farming and harvesting blue mussels, D3 - Definition of “New Hot Spots” of nutrient input into the Baltic and subsequent targeted measures to reduce the source, and C1 - Improve knowledge transfer between farmers, authorities and decision makers. We could not decide on a fourth so none was chosen. The main measure was not taken from the provided selection but was created by the group emphasising integration between land and sea activities.

Main measure - (new) Integrated approach between sea-based and land-based measures.

Supporting measures

- E4 Reducing nutrient loading by farming and harvesting blue mussels

- D3 Definition of “New Hot Spots” of nutrient input into the Baltic and subsequent targeted measures to reduce the sources
- C1 Improve knowledge transfer between farmers, authorities and decision makers

MEASURES SELECTED PER PERSON

Group 3							
Angela Schultz-Zehden	E4	P5	C1		Submariner Network	Germany	3
Sirkka Tattari	D3	E2	C1		SYKE	Finland	3
Julia Tanzer	E4	P5	D1	P7	Proman	Austria	3
Filippa Ek	E4	E7	D3	P1	SEI	Sweden	3
Emilija Žilinskaitė	E4	P6	C3	P1	SLU	Sweden	3
Neil Powell	C1	P5			Uppsala Uni	Sweden	3
Sten Stenbeck	P5	D3	C1	E4	RISE	Sweden	3
Kaj Granholm					BSAG	Finland	3
Georgia (Gia) Destouni					Stockholm Uni	Sweden	3
Erik Sindhöj					RISE	Sweden	3

MEASURES RANKED GROUP 3

Group 3	# Times selected	Code	Measure
Filippa Ek	4	**C1**	**Improve knowledge transfer between farmers, authorities and decision makers.**
Angela Schultz-Zehden	1	C3	Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region.
Sirkka Tattari	1	D1.	Integrated and harmonized risk assessment of phosphorus losses from agricultural soils to surface water.
Julia Tanzer	3	**D3**	**Definition of "New Hot Spots" of nutrient input into the Baltic and subsequent targeted measures to reduce the source**
Emilija Žilinskaitė	1	P1	Incentives to support the use and production of manure-based recycled fertilizers
Neil Powell	4	P5	Allow coordination of abatement measures among HELCOM countries to ensure cost-effective nutrient abatement at the basin and Baltic scales
Sten Stenbeck	1	P6	Improved integration of BSAP targets with WFD targets
Kaj Granholm	1	P7	Strengthening of HELCOM recommendation 28E/5 on municipal wastewater treatment
Georgia (Gia) Destouni	1	E2	Use of gypsum to reduce phosphorus loads from agricultural land
Erik Sindhöj	5	**E4**	**Reducing nutrient loading by farming and harvesting blue mussels**
	1	E7	Nutrient recovery in wastewater treatment plants

SCALE TO EVALUATE CRITERIA

-1	Negative	The intervention entails a negative development and mitigation actions might be needed.
0	Neutral	The intervention fails to capture the criteria or fails to demonstrate positive or negative impacts.
1	Low	The intervention captures the criteria to a measurably positive extent
2	High	The intervention captures the criteria to a large or full positive extent.

WG3 Cook Step

Incubation Step

Actors

- Feed Industry sea-based products
- farmer organizations
- National / regional authorities
- Water protection associations
- Society

- coastal communities, operations businesses mussel farms
- Industry / agriculture sectors
- Entrepreneurs, NGOs, academia, government, researchers
- Consumers Inhabitants - understanding positive effects blue mussels

Processes

- Establish funding opportunities mussel farming sea-based nutrient removal
- Main target areas overlapping areas high nutrient loading areas high nutrient input
- Establish funding system encourages cooperation among stakeholders and sectors and supports sea-based products
- Define most cost-efficient effective measures land-based sea-based region
- blue circular economy objectives policies processes
- Creating platform different stakeholders collaborate
- Introduce new nature-based measures hotspot areas
- hot spots areas with high nutrient loading

Capacities existing

- Data coastal areas suffering land-based nutrient inputs internal loading
- Nutrient hotspots potential nutrient recycling
- Farmers resourceful innovators generate value added opportunities
- Assessment of hotspot nutrient flows
- Maintenance of mussel beds
- Estimates of nutrient uptake in mussels
- Increased knowledge re. suitable technologies exploiting nutrient uptake by mussel and algal farming

Capabilities required

- Financial incentives regarding reduction of nutrients surpluses in the Baltic Sea area
- Incentives initiate measures, nutrient removal compensation
- Time, resources incentives farmers interacting with other actors
- Identification of optimal sites in the Baltic Sea are for mussel farming
- Environmental risk assessment of scaled-up mussel farms

- Cooperation between mussel farmers including joint data monitoring
- Mussels nutrient removal policy measure
- Determination of the market potential value of harvested mussels
- Cooperation between mussel farmers re product development eg mussel based fertiliser products
- Cooperation between stakeholder groups including dialogue and action
- Payment for environmental services
- Integrated assessment framework in order to determine the highest marginal impacts

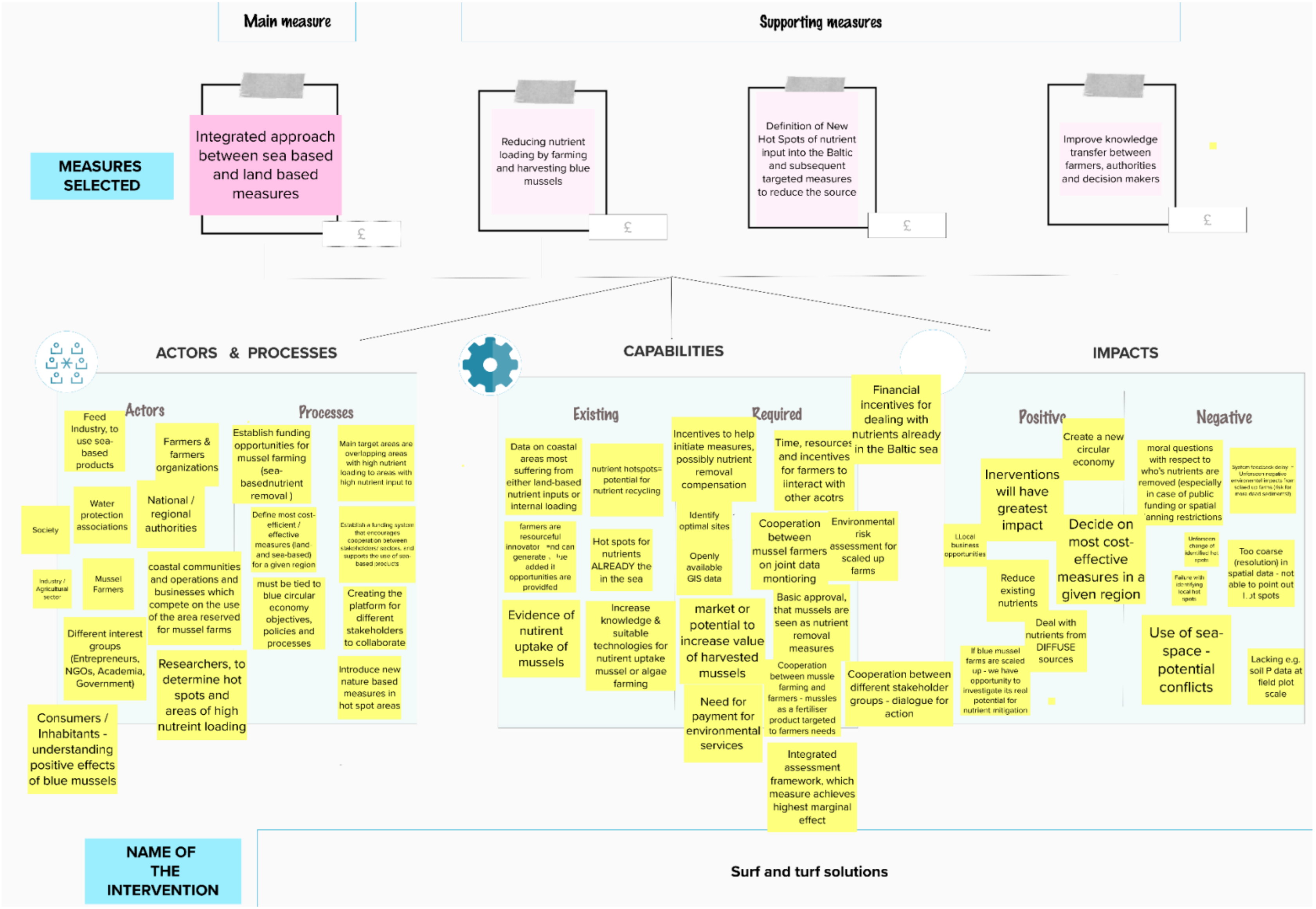
Positive impacts

- Financial incentives dealing nutrients Baltic Sea
- Incentives initiate measures nutrient removal compensation
- Time, resources incentives farmers interact actors
- Identify optimal sites
- Environmental risk assessment scaled up farms
- Cooperation mussel farmers joint data monitoring
- mussels nutrient removal measures
- market potential increase value harvested mussels
- Cooperation mussel farming fertiliser product targeted farmers needs
- Cooperation stakeholder groups - dialogue action
- payment environmental services
- Integrated assessment framework, marginal effect

Negative impacts

- Moral questions whose nutrients removed public funding spatial planning restrictions
- System feedback delay unforeseen negative environmental impacts from scaled up farms dead sediments
- Unforeseen change identified hotspots
- Too coarse resolution spatial data - point out hotspots. Lack soil phosphorus data field plot scale
- Failure to identify local hotspots
- Sea-space - user potential conflicts

WG3 Incubation Step



Building the intervention was challenging but it came into form during the evaluation step. This was mainly because the measures we ended up with were so widespread and yet specific (E7 was a specific sea-based ecotech measure, D3 was a specific land-based data driven measure, and C1 was a general communication measure). The discussion tended to be widespread from sea-based scenarios to land-based approaches without deciding on a plausible action plan.

The group could not agree on a main measure, and although the 3 supporting measures were all seen as important there lacked something to pull them together. Toward the end of the session, the need for linking the sea and land based measures became more obvious. This is when the group came up with the name “Surf and Turf”, suggesting the combination of sea-based and land-based food production. Time limitation prevented developing the intrinsic details further.

Since the group was quite cross-sectoral, this forced the participants to think creatively, which eventually ended up in describing needed links between sea- and land-based measures. The negative was that everyone had a different focus which took time to voice and was difficult to link to others.

Evaluation Step

Risk

- Harvest loss of mussels due to natural event, birds, etc. (not so relevant if large number of mussel farms
- Hotspot inflow areas not always best spots for mussel farming - then other measures needed
- Technology has to be tested at demonstration level
- Different interest groups / stakeholders have different preferences for mitigation
- Legal barriers

Circularity

- Reuse of nutrient through marketing mussels (eg. as feed)
- Nutrient harvesting & recycling - mussels used again in Baltic FEED
- Reuse nutrients from the hot spot areas

Efficiency

- Spatially targeted measures are more efficient than general measures

- Blue mussels can only be an add on i.e. part of a strategic set of measures
- Potential depends on success in identifying hotspots

Feasibility

- IIncentives have to be created to PICK up nutrients - not to avoid nutrients
- For the moment -lack of economic incentives o make it feasible
- Mussels is cost-effective - esp. in areas where marginal costs of land-based measures too high
- Mussel Cultivation has to reach a CRITICAL mass as to become cost-efficient

Co-benefits

- Yes - improved water quality; biodiversity increase, blue economy
- production of alternative protein sources for animal feed, reduced dependence on imported soy
- Once cooperation is established it can also be used to solve other regional problems

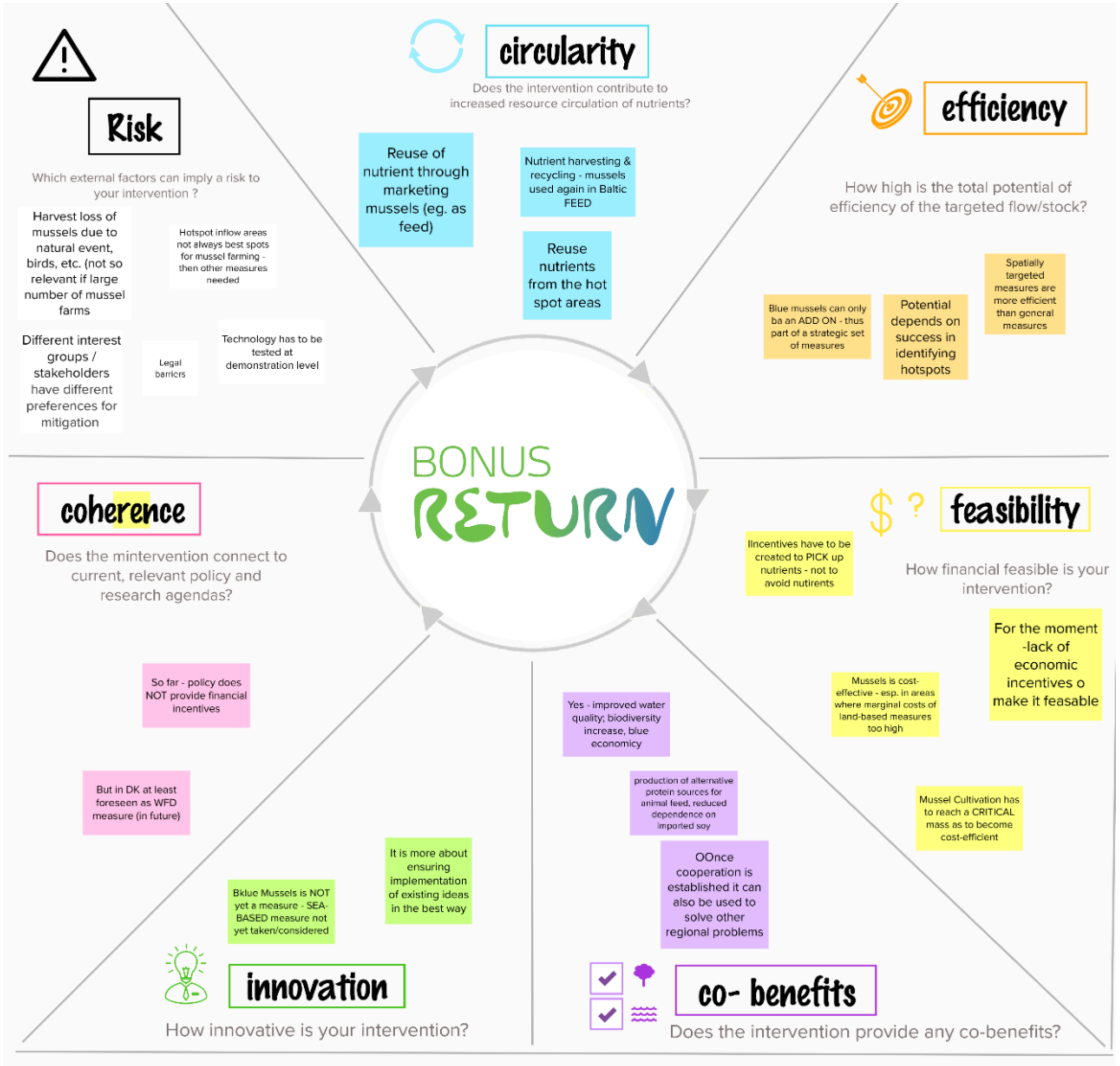
Innovation

- It is more about ensuring implementation of existing ideas in the best way
- Blue Mussels is NOT yet a measure - SEA-BASED measure not yet taken/considered

Coherence

- So far - policy does NOT provide financial incentives
- But in DK at least foreseen as WFD measure (in future)

WG3 Evaluation Step



This step provided the intervention with more focus. The group started moving away from the specifics of the individual measures and looked instead at the larger picture, seeing the measures more as possible examples. Then we could start to look at and formulate what needs to be done on land in order to successfully implement a measure at sea, and how the success of one is dependent on the success of the other. A central question was how a surplus resulting in runoff losses from agriculture activities (i.e. a hotspot) could be turned into a productive marine aquaculture activity such as mussel farming. Circularity was a big point here, focusing on local hot-spot areas to create sea and land linked measures to increase circularity of nutrients from the Baltic Sea back into agricultural production.

The strategy here is one of targeting efficient nutrient management measures to identified pollution zones which would lead to greater impact than generalized measures applied everywhere. The feasibility of such interventions will require some degree of incentives to get started and these should equally address the sea and land related issues linked to the measures. The co-benefits include a range of local environmental improvements and decreased reliance on external protein and industrial nutrient sources. Innovation is needed to find technological solutions that actually work at harvesting nutrients from the Baltic and putting them back into circular solutions. Innovative business models need to be developed to drive the intervention.

Coherence will initially be an issue, since there are no incentives to help prompt such solutions, and this will generally require coordination and collaboration between various governmental agencies that have authority over different areas that do not normally work together.

There also risks that the chosen hotspots for surplus nutrients might not be amenable to implementation of specific chosen measures. Large-scale offshore mussel farming is not yet validated or fully developed and other persistent pollutants in the Baltic Sea (e.g. chlorinated hydrocarbons and heavy metals) could affect the safety of recycling of the protein and nutrients derived from these systems when returned to land.

How realistic was the chosen intervention and could it be tabled at a BSAP meeting of HELCOM? The premise of linking certain types of sea-based measures with specific land-based measures/actions is probably highly relevant due to potential synergies and provision of options in managing land-based hotspots/surpluses and closing of nutrient cycles in sea-based activities. This has potential but first requires further development prior to scaling up.

Intervention 4 - Reducing nutrient surpluses and increasing efficiencies in agriculture

Cook Step

The group reviewed the various suggested measures and took into account those that could be given a broader key role also even defining the intervention. The number of votes for each measure was an important element in choosing. It was found important that the various measures could be linked with each other.

Main measure - D1 Integrated and harmonized risk assessment of phosphorus losses from agricultural soils to surface water including the use of P indices

Supporting measures

- C3 Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region.
- E1 Recycling of nutrients and carbon in agricultural residues by use of anaerobic digestion
- C1 Improve knowledge transfer between farmers, authorities and decision makers

MEASURES SELECTED PER PERSON

Group 4						
Mikolaj Piniewski	D3	E1	D1	P4	WULS	Poland
Marcus Ahlström	E6	D3	P4	C1	RISE	Sweden
Mateusz Sekowski					CDR Brwinów	Poland
Minna Sarvi	C3	P1	E1		LUKE	Finland
Katrin Kuka	C3	C1	P1	P4	Julius Kuehn-Inst	Germany
Thao Do	C1				Uppsala Uni	Sweden
Henning Lyngsø FOGED	C3	D1	E1		Organe Institute	Denmark
Maria Kämäri	E1	C3	D2		SYKE	Finland
Tord Söderberg					A2T	Sweden
Arno Rosemarin					SEI	Sweden
Jon Wessling					LRF	Sweden

MEASURES RANKED GROUP 4

Group sum		
# Times selected	**Code**	**Measures**
4	**C1**	**Improve knowledge transfer between farmers, authorities and decision makers.**
4	**C3**	**Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region.**
2	D1.	Integrated and harmonized risk assessment of phosphorus losses from agricultural soils to surface water.
1	D2	Reporting estimates on the effects of agri-environmental measures on the main phosphorus fractions
2	D3	Definition of "New Hot Spots" of nutrient input into the Baltic and subsequent targeted measures to reduce the source
3	P1	Incentives to support the use and production of manure-based recycled fertilizers
3	P4	Reducing livestock densities and coupling livestock to the area of available farmland
5	**E1**	**Recycling of nutrients and carbon in agricultural residues by use of anaerobic digestion**
1	E6	Source separation of sewage systems in newly built areas and in areas renovated

SCALE TO EVALUATE CRITERIA

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WG4 Cook Step

Incubation Step

Once the actors were named and the processes brainstormed and recorded it was straightforward to determine which ones were already existing or which still required developing. The negative and positive impacts were then made obvious and the group rolled these out. That the measures were well interwoven and that the intervention was mainly dealing with agriculture nutrient surpluses made this exercise relatively straightforward. The jury member from LRF (Jon Wessling) was very helpful and filled in knowledge gaps as necessary. The intervention dealing with surpluses and efficiencies is key to solving the problem of nutrient losses to the Baltic drainage basin and was found to be sufficiently complex requiring technical, policy, financial and communication efforts.

Actors

- Farmers
- Consultants
- Researchers
- Authorities
- BFFE
- HELCOM
- industry
- EU parliament

Processes

- Policies encourage environmentally sustainable management practices
- legislation nutrient balancing
- subsidies farmers manure-based fertilizer products anaerobic digestion
- Training management-practices learning-exchanges
- financing incentives capital investments anaerobic digester, dewatering, dryer
- training extension nutrient balancing
- certification-programme sustainable-fertilizers
- tax economic incentives organic fertilizers REVAQ-type sludge
- increase efficiency biogas production
- nutrient balancing indices organic certified fertilizer
- Reduction nutrient surpluses increasing efficiencies BSR agriculture

Capacities existing

- Training management practices learning exchanges
- Training extension nutrient balancing
- BFFE agenda Baltic eutrophication
- research knowledge mechanisms nutrient management

Capabilities required

- Introduction legislation nutrient balancing, harmonization across BSR calculation Phosphorus surpluses losses

- Tax economic incentives organic fertilizers REVAQ sludge
- Financing incentives capital investments anaerobic digester, dewatering, dryer
- BFFE discussions phosphorus losses nutrient balancing
- Subsidies farmers manure-based fertilizer products anaerobic digestion
- Certification programme sustainable fertilizers
- Implement efficient manure storage practices

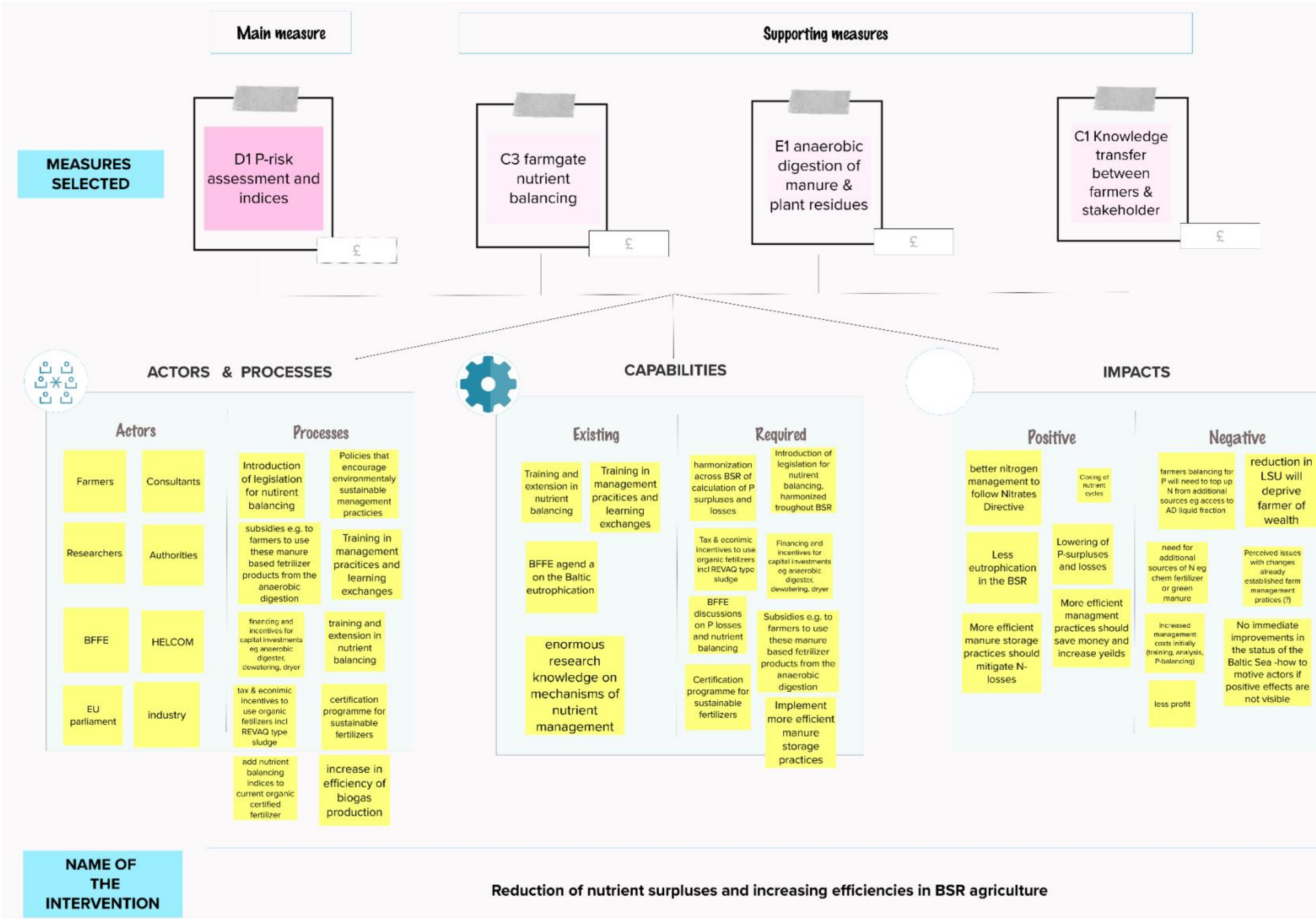
Positive impacts

- better nitrogen management to follow Nitrates Directive
- Closing of nutrient cycles
- Lowering of Phosphorus surpluses losses
- Less eutrophication BSR
- efficient management practices save money increase yields
- More efficient manure storage practices mitigate Nitrogen losses

Negative impacts

- farmers balancing Phosphorus additional sources nitrogen access anaerobic liquid fraction
- reduction LSU reduce farmer wealth
- need additional sources of nitrogen chemical fertilizer green manure
- Perceived issues changes already established farm management practices
- Increased management costs training, analysis, Phosphorus balancing)
- no immediate improvements status Baltic Sea motivate actors positive effects not visible
- less profit

WG 4
Incubation
Step



Evaluation Step

The evaluation brought up several key points indicating that there are some challenges that need to be addressed such as policy, incentives, finance and communications. At the same time the co-benefits and improvements in abatement of nutrient losses were seen as major net benefits that would pay for themselves assuming that Baltic Sea improvements are valued sufficiently by society.

Risk

- finance and implementation capacity may be limited
- Can be hard to get all the relevant actors aboard

Circularity

- will be increasing circularity of nutrient flows and soil stocks

Efficiency

- will be the most important way of reducing surpluses and optimize nutrient efficiency

Feasibility

- nutrient balancing will pay for itself if value of a clean Baltic Sea is included in the calculation
- OPEX increase feasible
- decreasing LSUs may be feasible by decreasing exports of meat and eggs

Co-benefits

- positive benefits re climate warming, energy supply, mineral fertilizer imports
- increase biodiversity
- increase farm efficiency

Innovation

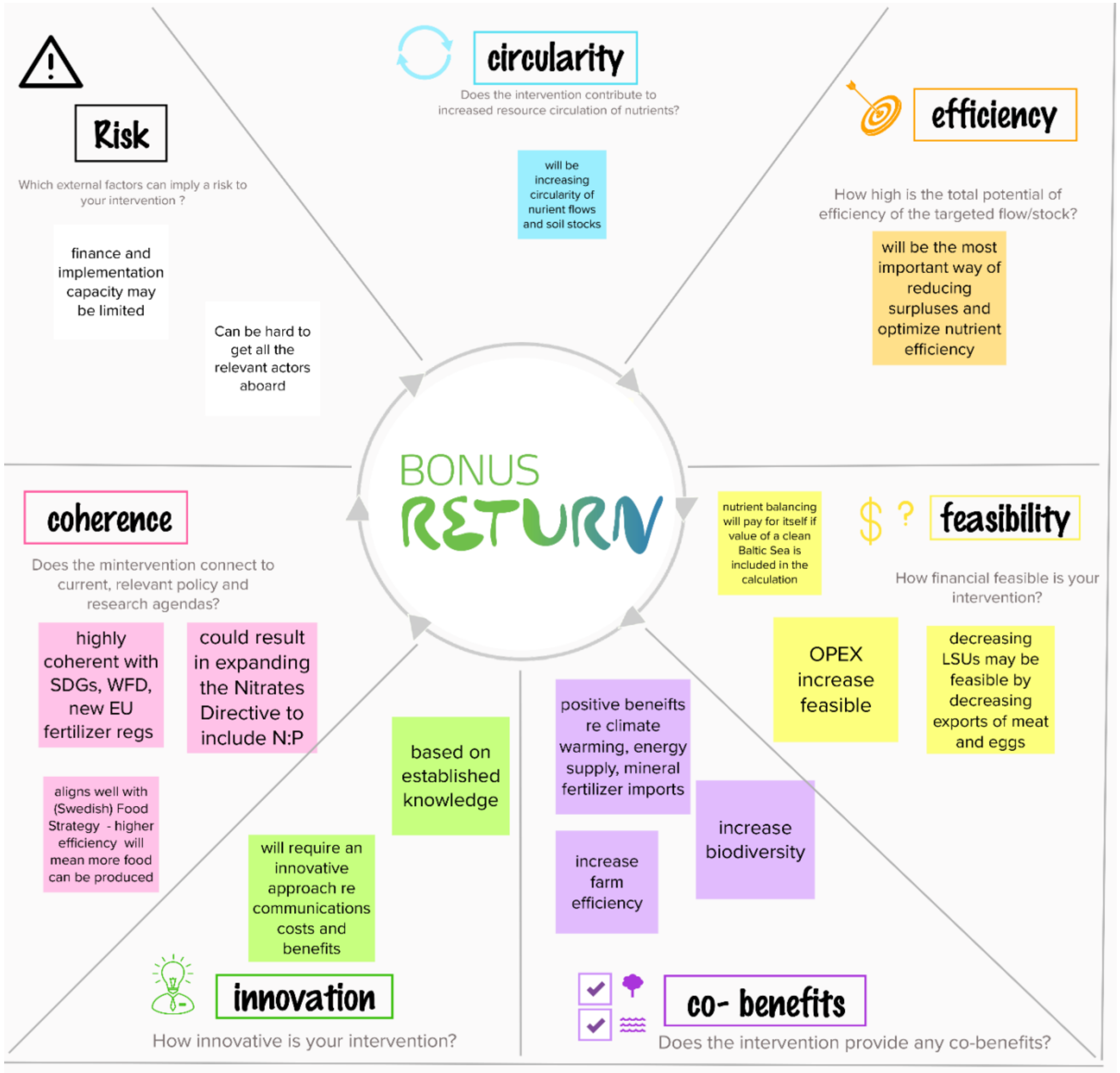
- based on established knowledge

- will require an innovative approach re communications costs and benefits

Coherence

- highly coherent with SDGs, WFD, new EU fertilizer regs
- could result in expanding the Nitrates Directive to include N:P
- aligns well with (Swedish) Food Strategy - higher efficiency will mean more food can be produced

WG 4 Evaluation Step



Intervention 5 - Rebalancing hotspots - Cost-efficient routes from fork to farm to fork...

Cook Step

The group had an open discussion about each person's favourite measures and the rationale behind each one. Most of the discussion circled around agricultural measures (gypsum) but we also wanted to get the issue of metal bonding in there somehow. We went back and forth a bit trying to find a broad measure that could serve as the overarching target and with others supporting and the hotspot theme worked nicely.

The cook phase was clearly the most difficult, especially trying to coalesce around a reasonably specific overall objective. Here I think there would have been value in setting a more narrowly focused topic area for each group. After we had settled on this I felt everything was pretty smooth sailing.

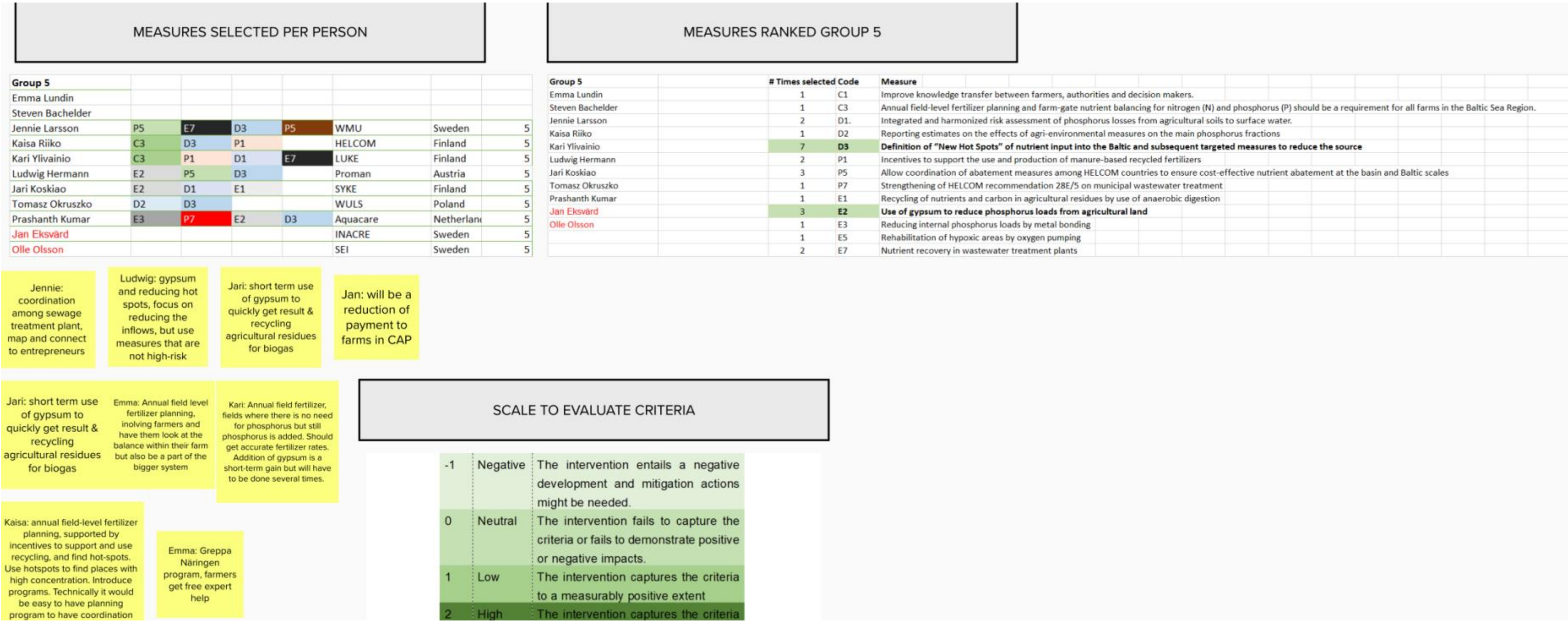
It became quite technical for a while which meant that some non-technical participants seemed to drop off a bit.

The following main and supporting measures were settled on by the group:

Main measure - D3 Definition of "New Hot Spots" of nutrient input into the Baltic and subsequent targeted measures to reduce the sources

Supporting measures

- E2 Use of gypsum to reduce phosphorus loads from agricultural land and E3 Reducing internal phosphorus loads by metal bonding
- C1 Improve knowledge transfer and co-ordination between farmers, authorities and decision makers
- C3 Annual field-level fertilizer planning and farm-gate nutrient balancing for nitrogen (N) and phosphorus (P) should be a requirement for all farms in the Baltic Sea Region



WG5 Cook Step

Incubation Step

Actors

- WWTPs
- Innovators technology services IT crop rotation systems varieties
- Farmers
- National agriculture agencies
- Resource suppliers
- Investors incubator programs
- National environmental agencies

- HELCOM
- Extension services

Processes

- CAP act now
- Information support programs
- Farm to Fork
- Fork to Farm circular economy action plan

Capacities existing

- research collaborative projects knowledge transfer
- Biosphere areas holistic connecting farmers others reduce emissions
- Technologies recover phosphorus concentrated form
- Technologies target high low phosphorus concentrations
- Swedish test bed nutrient recovery WWTPs
- "Catch the Nutrients" – Swedish Government Programme on Nutrient Management in agriculture
- Swedish Nutrient Platform

Capabilities required

- dialogue farmers, extension services regulators
- Business plan for nutrient management strategy, entrepreneurs, innovators
- costs measures at the farm level basis, payments to farmers, reductive measures
- Highlight beneficiaries and communicate positive impacts
- Wastewater plants with more stringent phosphorus discharge regulations
- common nutrient management strategy at the national level and the BSR level
- Clearer incentives to capture and recover nutrients
- broader perspective interventions e.g., pesticide management
- source to sea implementation manual

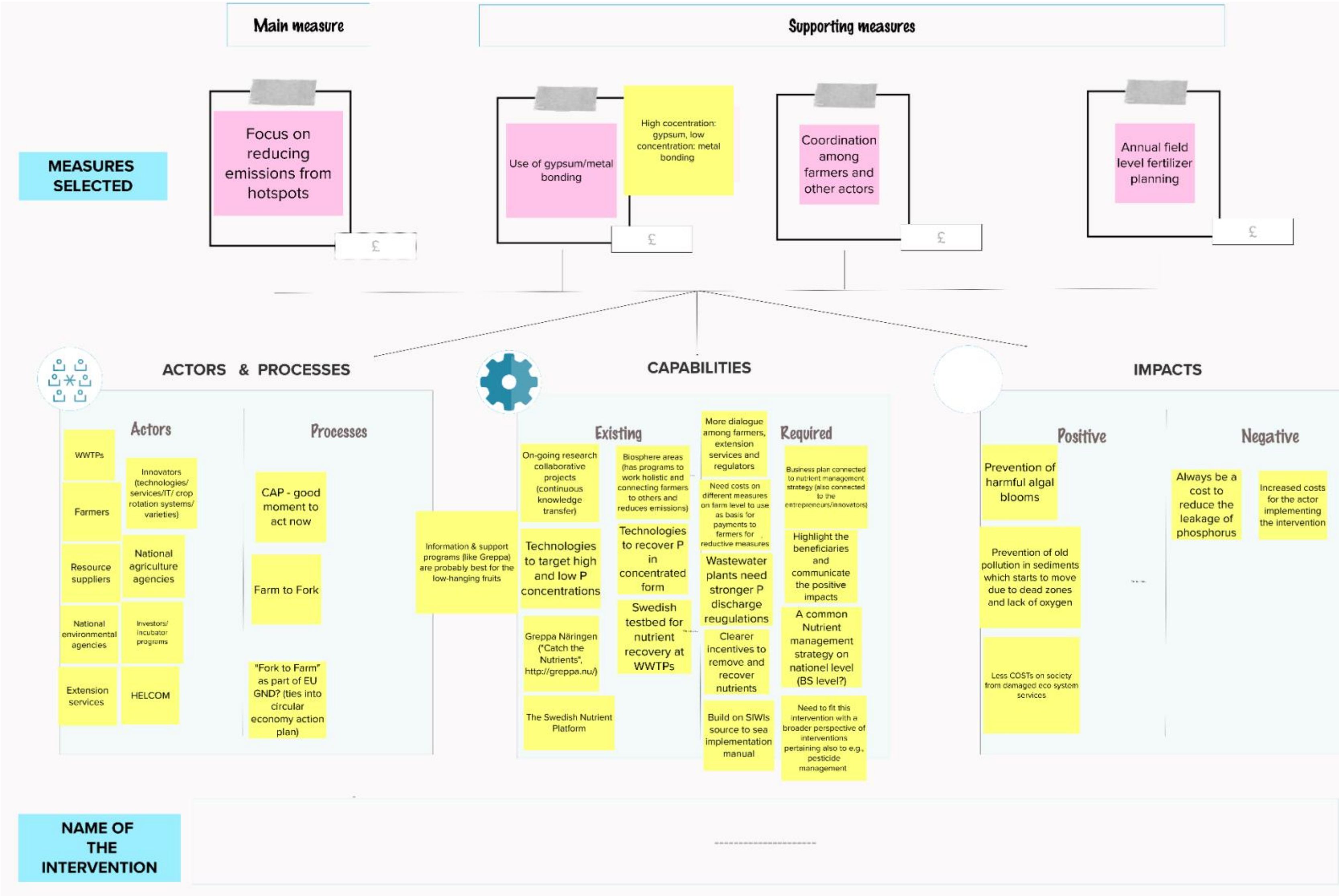
WG5 Impacts Positive

- Prevent harmful algal blooms
- Prevent old polluted sediments dead zones anoxic
- Less cost society damaged ecosystem services

WG5 Impacts Negative

- financial cost to reduce leakage of phosphorus
- Increased costs actor implementing intervention

WG 5
Incubation
Step



Evaluation Step

Risk

- Lack of willingness to pay from a societal perspective
- Risk of soil acidification from gypsum? No problems discovered so far though.
- Even if there are incentives, people are unwilling to change

Circularity

- Farmgate Nutrient management contributes to enhanced circularity in the smaller system
- Indirectly
- If there is a willingness to reuse nutrients, then this would certainly enable circularity, hinges upon this

Efficiency

- Can almost go to zero% discharge with both metal bonding and gypsum
- Focus on hotspots is a way to make emission reductions as cost-efficient possible
- 50% reduction in leaching from fields with gypsum

Feasibility

- Identifying the beneficiaries and distributing the costs
- income via recovering the product
- Reusing the metal adsorbents,

Co-benefits

- Increased revenues for industries currently negatively affected by eutrophication
- Optimizing the use of nutrients by farmers
- Create new jobs & business opportunities
- Improved stewardship of global finite phosphorus resources

Innovation

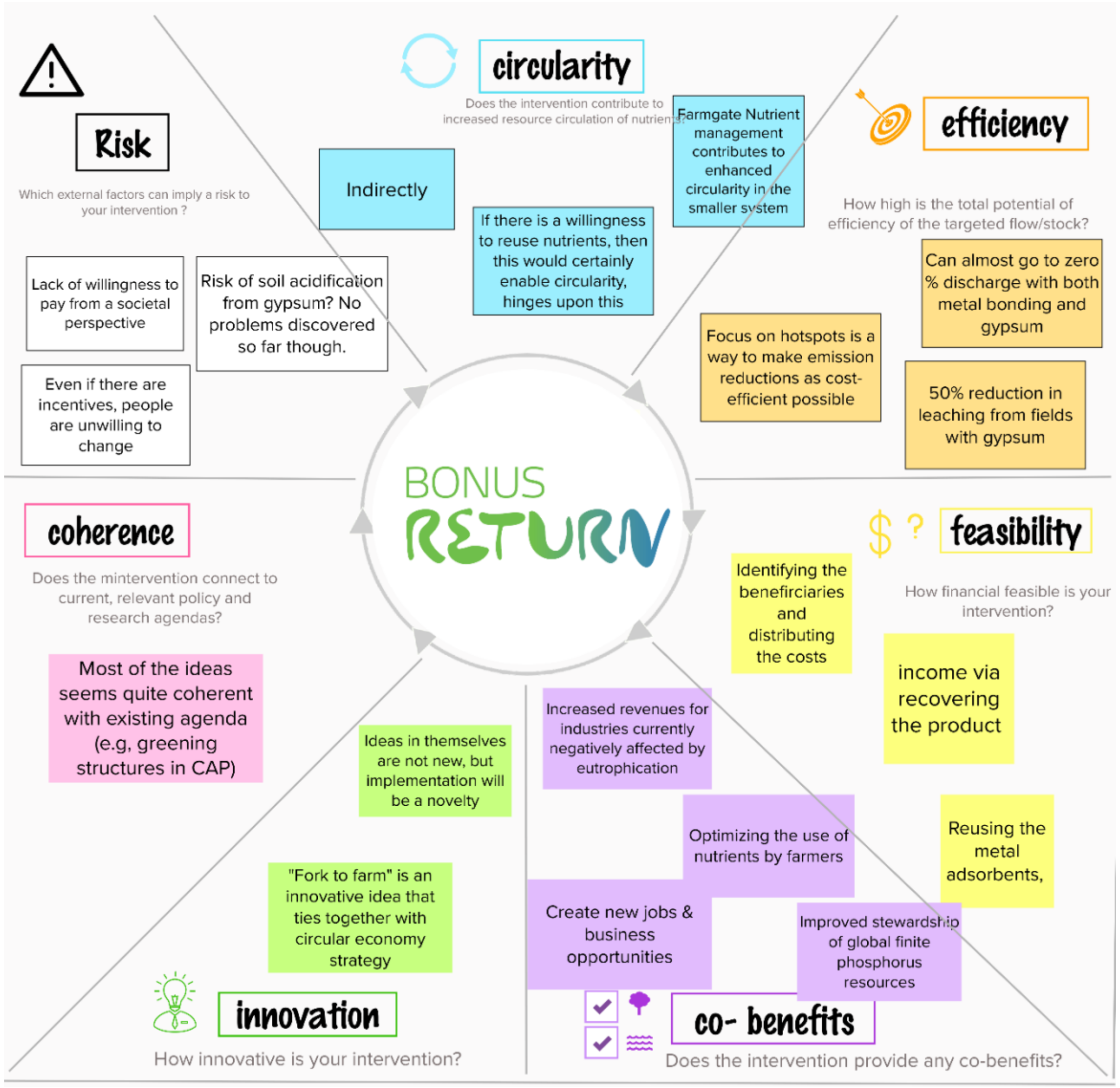
- Ideas in themselves are not new, but implementation will be a novelty

- "Fork to farm" is an innovative idea that ties together with circular economy strategy

Coherence
- Most of the ideas seems quite coherent with existing agenda (e.g, greening structures in CAP)

There was a discussion on whether a stronger focus on hotspots would mean that smaller/more dispersed emitters are let off the hook (i.e. ignored), this is a discussion worth tackling in the future. **The intervention suggested was realistic but requires further development.**

WG5 Evaluation Step



Appendix D. Agenda

Mission Blue Baltic – Healthy oceans, coasts and inland waters

10 June 2020
10:00 - 15:00 CEST
ONLINE – Zoom + Mural

Welcome!
You have been selected to participate in BONUS RETURN's final learning and exchange online workshop. The focus will be on leaving a legacy for future partnerships in the Baltic Sea Region. Together with you, we will identify interventions in policy, markets and research, that could significantly improve the status of our inland waters, coasts and the Baltic Sea and put us on track towards "Mission Blue". We look forward to your participation!

This information pack contains all the information you need to participate in the workshop as follows:

- The program
- Workshop structure
- Practical tips on how to use Zoom and Mural.

Before the workshop:
All participants have received this information package which introduces the concepts, approach, and tasks for the workshop. It is important to read through it, as explanations during the online meeting will be kept to a minimum.

Important points to note

1. Measures: Further instructions as well as the different measures to choose from are accessible through this Google Doc link. Apart from providing an overview of the measures, the Google Doc is a common and open document which all participants are invited to

contribute by suggesting changes in the descriptions of the measures or suggesting new measures. An example of a finalized measure is also included.

2. Selection of measures: Once you have read through the measures provided in the above link, fill in this short survey to indicate your preferred measures. The selected measures will be used to form breakout groups; therefore, your choice will determine your working group.

A few days prior to the workshop, you will receive a link to Zoom – our virtual meeting venue, and a link to your working group in Mural – our digital workspace. We kindly ask you to sign up to Mural in advance and download the zoom app to ensure a better experience and minimize technical issues during the meeting.

PROGRAM

10:00 - 10:30	Welcome in Plenary
10:30 - 11:10	Breakout groups session 1: "Cook" your measures
11:10 - 11:20	Coffee Break
11:20 - 12:30	Breakout groups session 2: "Incubate" your intervention
12:30 - 13:00	Lunch
13:00 – 13:20	Self-evaluation
13:20 – 13:30	Prepare pitch
13:30 – 14:05	Pitch your interventions (groups: 1, 2)
14:05 - 14:10	Coffee break
14:10 - 14:55	Pitch your interventions (groups: 3, 4, 5)
14:55 – 15:00	Wrap up, next steps
15:00	End of day

WORKSHOP STRUCTURE

Aim

We know that the Baltic Sea is one of the planet's most vulnerable ecosystems. It is an almost entirely enclosed system surrounded by a huge drainage area four times as large as the sea itself. It is inhabited by 90 million people in a highly industrialized landscape dominated by intense agriculture and forestry.

Despite the wealth of knowledge produced throughout the region and the actions taken to abate pollution; eutrophication of the Baltic Sea by wastewater, agriculture, industry and atmospheric deposits remains a challenge. A combination of technical and policy innovation as well as financial and economic incentives are needed to transform ocean-related sectors in land, watersheds, coastal areas and the open sea.

The workshop aims at producing tangible cross-sectoral prototype interventions that can be taken forward and further developed as impact projects within the broader umbrella of "Missions" for oceans.

The mission: "A Baltic Sea unaffected by pollution"

In line with HELCOM's goal for the region, the mission addressed in this workshop is of a Baltic Sea unaffected by pollution to respond to the grand challenge as formulated by the EU on "healthy oceans, coasts and inland waters". We start from the conviction that to achieve the mission, linear models of "use and dispose of" are insufficient. Instead, interventions that reduce-reuse-recycle-recover are crucial for closing the loop, limit the total input of nutrients and pollutants into watersheds and the ocean, and at the same time address emissions from the extraction of raw materials.

Approach

The starting point of the workshop is the integration of existing scientific and policy knowledge from the Baltic Sea region to respond to calls within the EU to work towards mission-oriented innovation policy.

Mission-oriented thinking requires understanding the difference between industrial sectors, broad challenges, and concrete problems that different sectors can address in order to tackle a challenge (Mazzucato 2018). This demands a shift in focus from ad hoc investments, for example in single-purpose infrastructure (e.g. roads), towards policies that are steered towards transformational changes—such as the development of new general-purpose technologies that cut across sectors (Mazzucato and Penna 2015). Missions are a promising framework due to the systemic approach to innovation; the ambition to transform the economy away from mere growth and towards a more sustainable, inclusive and smart system; and the renewed interest in the public sector as an agent of transformation.

The Challenge

The challenges underpinning the Blue Baltic missions are complex, multidimensional, dynamic and uncertain, especially in the long run. A reflection is needed about what kinds of innovation, and what 'innovation mixes' or 'innovation portfolios', have the highest potential to achieve transformative impact to accomplish missions that contribute to sustainable development. Innovation mixes for missions will need to include a wide variety of often interconnected technological, socio-economic and environmental innovations. Missions can benefit from tested solutions to respond to urgent problems in the short term, but they also need ambitious innovations that challenge the mainstream business models, redesign socio-technical systems, change urban and rural landscapes, and experiment with new governance, policy and economic frameworks.

The Task

The workshop will pilot-test a mission-oriented architecture underpinned by a co-creation approach that integrates gaming elements. During the workshop, you will be tasked with finding solutions that bring us closer to achieving the overarching mission and reduce the pressure on the Baltic Sea. You will be divided into working groups with around six participants who together will design concrete interventions for the Baltic Sea Region.

Interventions are concrete, time-bound, and measurable.

The starting point is measures which have been previously gathered by HELCOM amongst stakeholders from throughout the Baltic Sea Region. These have been adjusted for the purpose of the workshop and include information on:

- **Problem description:** The issue which the measure is trying to address.
- **Required actions:** processes, investments, or decisions required to implement the measure.
- **Expected effects** from implementing the measure.
- **Type of measure** can be either collaboration, data, ecotechnologies, or policy.
- **Area of operation** refers to whether the measure is land-based, catchment-based, or coastal zone/offshore-based.
- **Stream:** Refers to flows or stocks of nutrients. Flows refer to the movement of nutrients and carbon from one place to another. Stocks refer to legacies – of nutrients and carbon e.g. in soil and sediment.

The work will be structured within working groups. Each working group will follow a three-step approach, as illustrated in the image below, to shape interventions built around mixes of individual measures. For each measure, groups will be asked to identify the actors and processes, existing and required capabilities, and negative and positive impacts. Cost and time estimates will help contextualize the intervention. Pre-selected criteria will be used to guide the design of the interventions.

Expected outcomes and impact

- Tangible roadmaps to take forward and develop into full-fledged impact projects aimed at achieving SDG 14 and the grand challenge of attaining "healthy oceans, coasts and inland waters".
- Operationalization of a mission-oriented process that can be replicated for other missions.
- Feedback and peer review from an expert panel of funders and policy makers, industry and civil society on critical flows and pathways.

- Fostering of a dedicated network of decision makers, designers and scientists who can steer the mission forward and secure resources to realize the designs.

SUPPORTED BY

BONUS

BONUS RETURN HAS RECEIVED FUNDING FROM BONUS (ART 185), FUNDED JOINTLY BY THE EU AND FORMAS, A SWEDISH RESEARCH COUNCIL FOR SUSTAINABLE DEVELOPMENT; SWEDEN'S INNOVATION AGENCY, VINNOVA; ACADEMY OF FINLAND; AND THE NATIONAL CENTRE FOR RESEARCH AND DEVELOPMENT IN POLAND.

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