SEVENTH FRAMEWORK PROGRAMME

THEME 6: Environment (including Climate Change)

Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems

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PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Abstract

As part of |REFRESH WP6 Task 6.3 (Scoping the solutions) a stakeholder workshop was held in Kauttua, southwest Finland on October 10 2011. The workshop explored the views of local stakeholders on both small scale and regional water protection measures and their adaptation under changing climate in the Lake Pyhäjärvi region. The participants represented major stakeholder groups from water protection, agriculture and fisheries sectors as well as municipalities.

Workshop discussions were held in three groups. One of the groups focused on agriculture water protection measures, one on fishing as a restoration measure and one on development trends in the region's economy.

The water protection group concluded that the various current water protection measures should be continued and further developed. Improvements are needed especially in targeting the measures to the most optimal locations. The group's discussion focused mostly on more strategic developments. It was felt that more attention should be given to soil structure and composition, to water management at field and catchment levels and to the development of organic production than is currently the case. Climate change will increase nutrient discharges, which will requires more attention to water protection.

Fishing as a lake restoration measure was discussed in the second group. The group perceived that this is effective and its continuance should be guaranteed. Restoration fishing is effective in removing nutrients from the lake system via food-web alterations and this has already resulted in clearer water and an increase in valuable fish species in Lake Pyhäjärvi. Profitability of restoration fishing is a challenge. Today it is dependent on funding and subsidies but in the long run restoration fishing should become self-sufficient. The region still has active commercial fishing, which is a prerequisite for continuance of the measure. Climate change can hamper restoration fishing as it is to large extent dependent on ice cover during winters. Technical development of fishing methods is a way to ensure adaptation.

The third group focused on factors that influence the region's socio-economic development now and in the future. The region has a strong, shared economic strategy is built upon agriculture and processing of food. The strategy is relying on locally and responsibly produced food, which brings agricultural water protection issues into the core of the strategy. In the future agriculture will be directed more towards production of special crops (root crops, vegetables and possibly oil plants). Lake Pyhäjärvi protection activities are an important asset for the region's economic strategy.

This is a publically available deliverable. The target audience includes members of the REFRESH consortium, stakeholders in the Lake Pyhäjärvi catchment, scientists and managers interested in adaptation measures for freshwaters and, more broadly, those involved in engagement activities between scientists, managers, land owners etc with freshwater interests.

REFRESH: Adaptive Strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems.
http://www.refresh.ucl.ac.uk/

REFRESH WP6 Task 6.3
Deliverables 6.6 - 6.10
Workshops - collaborative scoping of solutions

Report on

Stakeholder Workshop on 10th October 2011,

Kauttua, Finland

on mitigation measures to improve river and lake water quality and on the future scenarios in the region

Riina Pelkonen, Riku Varjopuro, Anna Tainio and Ahti Lepistö
21st December 2011

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Abstract

A REFRESH stakeholder workshop was held in Kauttua, southwest Finland on October 10 2011. The workshop explored the views of local stakeholders on both small scale and regional water protection measures and their adaptation under changing climate in the Lake Pyhäjärvi region. The participants represented major stakeholder groups from water protection, agriculture and fisheries sectors as well as municipalities.

Workshop discussions were held in three groups. One of the groups focused on agriculture water protection measures, one on fishing as a restoration measure and one on development trends in the region's economy.
The group that focused on water protection measures in agriculture concluded that the various current water protection measures should be continued and further developed. Improvements are needed especially in targeting the measures to the most optimal locations. The group's discussion focused mostly on more strategic developments. According to the group more attention should be given to soil structure and composition, to water management on field and catchment levels and to development of organic production than currently. Climate change will increase nutrient discharges, which requires more attention to water protection.

Fishing as a lake restoration measure was discussed in the second group. The group perceived that the measure is effective and its continuance should be guaranteed. Restoration fishing is effective in removing nutrients from the lake system but especially in causing beneficial food-web alterations that have already resulted in clearer water and an increase in valuable fish species in Lake Pyhäjärvi. Profitability of restoration fishing is a challenge. Today it is dependent on funding and subsidies but in the long run restoration fishing should become self-sufficient. The region still has active commercial fishers, which is a prerequisite for continuance of the measure. Climate change can hamper restoration fishing that is to large extent dependent on ice cover during winters. Technical development of fishing methods is a way to ensure adaptation.

The third group focused on factors that influence the region's socio-economic development now and in the future. The region has a strong, shared economic strategy that is built upon agriculture and processing of food. The strategy is relying on locally and responsibly produced food, which brings agriculture's water protection issues into the core of the strategy. In the future agriculture will be slightly direct towards production of special crops (root crops, vegetables and possibly oil plants). The Lake Pyhäjärvi protection activities are an important asset for the region's economic strategy.

1. Introduction

This report presents the results of a stakeholder workshop that was held in Kauttua, southwest Finland on 10 October 2011. The workshop was hosted by Pyhäjärvi Institute and organised together with the institute and SYKE. Participants of the workshop represented relevant actors involved in the region's water protection. The participants discussed water protection measures related to agricultural production, lake restoration and future socio-economic development trends in the region.

The workshop serves REFRESH Task 6.3 by exploring the views of local stakeholders on both small scale and regional water protection measures and their adaptation under changing climate in the Lake Pyhäjärvi region. The stakeholders already possess a vast amount of knowledge on the research on and implementation of water protection in the region but the

workshop was intended to not only produce information for the REFRESH team but also to provide the stakeholders on opportunity to discuss the feasibility of water protection measures and their expectations on the future development of water protection in the region.

The report first introduces the recent and current pressures to Lake Pyhäjärvi as well as the major water protection issues regarding the lake. It then presents the process of identifying relevant stakeholders in the region for water protection and preparations made for the workshop. The report proceeds to presenting the issues discussed during the workshop as well as the results of the workshop process. Finally, the stakeholder views on expected socio-economic development trends and the feasibility of water protection measures at present and under changing climate conditions are drawn together as conclusions on the key issues of concern for developing water protection and its efficiency at Lake Pyhäjärvi.

1.1. Purpose of the workshop

The objective of the workshop was to explore the feasibility of water protection measures and terms of their use in the catchment area of Lake Pyhäjärvi The workshop was intended to examine the views of stakeholders on future development of water protection as well of socio-economic trends in the region in order to determine the effects of changing climate conditions on water protection and its measures.

2. Identification of Pressures

Increased eutrophication of Lake Pyhäjärvi has been a major concern since the late 1980s. Lake Pyhäjärvi is classified as having a *good* ecological status (WFD classification) but spatial variability of water quality is high. In physical-chemical assessment the class was *satisfactory* but the application of WFD classification system in Finland does not follow the "one off, all off" principle. Therefore, an overall classification can be *good,* even if one criterion does not meet that status. River Yläneenjoki has a *satisfactory* status as both physical-chemical and biological indicators were *satisfactory*.

Total P concentrations in the lake noticeably increased in the 1980s and 1990s. During the 2000s, total P has been decreasing, probably partly because of lower external loading due to a dry period and water protection actions in the catchment, and partly because of efficient fish removal. Also, Chl-a concentrations have decreased during the 2000s due to lower phytoplankton biomasses. Secchi depth has varied from 2.4 to 3.9 m during the open water season of 1980–2005 (Ventelä et al, 2007)

Two major rivers, Yläneenjoki and Pyhäjoki, discharge into Lake Pyhäjärvi (see figure 1). Yläneenjoki river basin is considerably larger (233 km^2) than that of River Pyhäjoki (78 km^2). River Yläneenjoki is the main inflowing river to the lake at the lake's southern end. The Yläneenjoki catchment is responsible for over 60 % of the external nutrient loading into the Lake Pyhäjärvi (Ekholm et al. 1997). Until late 1960s, point sources (industrial and municipal) were significant for the lake, but these sources have been clearly decreased. Nowadays a sewage system takes industrial and municipal wastewaters to a waste water treatment plant that discharges the cleaned waste water to a river that is, in fact, flowing out from the lake. Intensive agriculture and housing in rural areas with no centralized sewerage system are the main sources from the region. In addition to these, changes in temperature and precipitation have contributed to the eutrophication of Pyhäjärvi particularly to the high variability between the years (Ventelä et al 2007).

Several management efforts have been applied to reduce non-point loading in the Pyhäjärvi catchment area since early 1991. Southwest Finland Regional Environment Centre and a Lake Pyhäjärvi Restoration Fund (established in 1995) have initiated several protection projects. Farmers in the region have taken part in water protection actively. In recent years, several various water protection measures have been taken in the catchment: up to 50 experimental sites have contributed to actions such as filtering ditches and sand filter fields, utilizing lime or other materials for binding of phosphorus, series of small dams, small chemical treatment units to treat waters from dairy and cattle farms, sewage water treatment of rural houses and village planning as a new method for promoting environmentally sound development of the rural areas.

Agriculture is the largest individual cause of nutrient loading and consequently is the area where the greatest water protection potential occurs. Several protection measures have been conducted in farming: e.g. buffer zones, reduced use of manure, vegetation cover during winter, and reduced tillage. EU agriculture policy is relevant for water protection because conditions for subsidies require following good environmental practices. After Finland became a member of EU, over 99 per cent of the farmers of the Pyhäjärvi area have committed themselves to the Finnish Agri-Environmental programme.

In the REFRESH project we focus especially on water protection measures in the River Yläneenjoki area. However, the lake and its protection are the main motivation for the region's water protection activities, and restoration of the lake by fishing is one of the main water protection measures. Therefore, we cannot limit the analyses only on the river catchment but the entire Lake Pyhäjärvi catchment has to be taken into account in addressing the feasibility of water protection measures and the future development of the region.

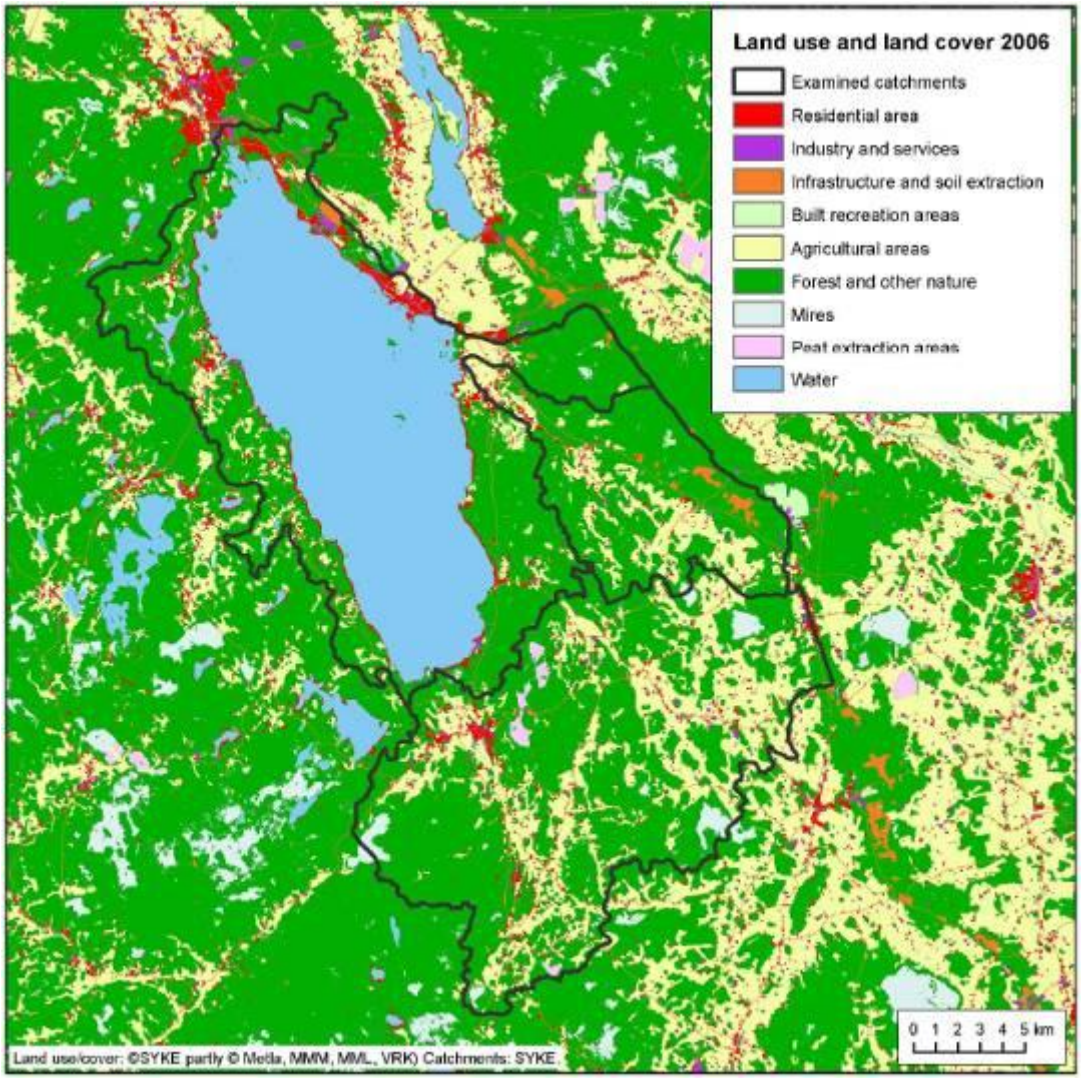

Figure 1. Land cover and land use in the Lake Pyhäjärvi catchment in 2006.

3. Stakeholder Identification

Stakeholders invited for the workshop were identified in cooperation with Pyhäjärvi Institute. Pyhäjärvi Institute has been active in water protection research and implementation of measures in the region for more than 20 years. For the REFRESH project, it has been agreed that stakeholders should include individuals, groups or organisations a) whose actions may threaten or enhance water quality or biodiversity in the study areas (can make a change), b) who we can conceive as knowledge brokers for mitigation/adaptation actions (can initiate actions) and c) who are influenced by a change of state of the aquatic environment or by the mitigation/adaptation measures (can win or lose). The Pyhäjärvi Institute itself is a major knowledge broker in the region. Furthermore, the main stakeholders from categories a) and b) are represented in the institute's steering group.

Altogether 22 persons were invited to the workshop including all members of the steering group for Pyhäjärvi Restoration Fund as well as their substitutes and "an emerita member". The steering group of the Pyhäjärvi Restoration Fund consists of representatives of the food and paper industry, agricultural producers, municipalities, regional environmental authorities, academics as well as fishing and water protection organisations with an interest in protecting Lake Pyhäjärvi. In addition to their positions in organisations some of the invitees are also

farmers in the Pyhäjärvi region. The steering group thus involves all the key actors with an impact on the state of or an ability to initiate water protection measures at Lake Pyhäjärvi.

The invitees were divided into three group sessions by forehand, according to their expertise. This was done to ensure that all groups would have enough participants as well as a range of perspectives on water protection and society.

3.1. Stakeholder relations

The Pyhäjärvi region has a long history in water protection activities. The Pyhäjärvi Institute and the Restoration Fund are forums for multiparty collaboration in water protection. The collaboration has brought together all the major public and private actors in the region for several years. The workshop participants were persons who have been involved in the collaboration for a long time. In this respect the relationships between the stakeholders are functioning well.

A proper stakeholder identification was not conducted, since the identification and invitation methods were based on the Pyhäjärvi Institute's existing network that covers all the major interest parties. Actors that might have opposition to the region's water protection activities were not search for in the process. However, there is no indication of any major opposition in the region.

3.2. Workshop participants

In the workshop ten participants from the Pyhäjärvi foundation attended the workshop together with seven SYKE representatives. The organisations represented by the actual participants in each group are presented below.

Group 1. Agricultural production, 7 participants: Agricultural producers' organisation, municipal environmental officer/a farmer, a farmer with an earlier expertise of water protection in the public sector, Pyhäjärvi Institute, 3 participants from SYKE

Group 2. Fishing as lake restoration, 6 participants: Regional environmental authority (ELY centre), Lake Pyhäjärvi fisheries organisation, University of Turku, Pyhäjärvi Institute, 2 participants from SYKE

Group 3. Socio-economic scenarios group, 4 participants: 2 municipal leaders, 2 participants from SYKE

Group	Institution or organisation	Impact on environmental state	Can initiate measures	Influenced by the environmental state
1	Agricultural Producers	X		
	Municipalities		X	X
	Farmers	X	X	
	Pyhäjärvi Institute		X	
	Water protection associations		(X)	
	(Regional environmental authority)		(X)	
2	Regional environmental authority		X	
	Fishing Area	X	X	X
	University of Turku		X	
	Pyhäjärvi Institute		X	
3	Municipalities		X	X
	(Industry)	(X)	(X)	

Table 1. The division of invited stakeholders according to REFRESH principles. Invitees who did not participate in the workshop are presented in brackets.

No participants outside the Pyhäjärvi foundation steering group were invited, except for a person who has a long experience in water protection administration and nowadays operates as an organic farmer. Not inviting people outside of the steering group was due to practical organisational demands and because the workshop was planned to also contribute to the planning of the Pyhäjärvi Institute's future activities. No representatives of the industry were present at the workshop though they were invited. The industry is highly relevant for the Pyhäjärvi region and to the water protection work implemented. This may have influenced the group discussion in the group on socioeconomic scenarios in particular as the local participants included only representatives of local municipalities.

4. Workshop Preparation

4.1. Methods

Selected water protection measures

Seven water protection measures were chosen in advance to be discussed by the stakeholders in the workshop. These included:

- Vegetation cover in winter (grass or tilling of the stubble field)
- Manure-fertilising (in addition to artificial fertilisation)
- Reduced artificial fertilisation
- Reduced soil tillage, Direct seeding
- Buffer zones
- Wetlands
- Restoration fishing

The measures were chosen due to their relevance as current water protection measures implemented by Pyhäjärvi Institute in different projects. SYKE modellers in WP5 were consulted during the selection process in relation to the extent to which the measures may be modelled in REFRESH.

Invitations and material provided for the stakeholders

The relevant stakeholders were identified as the members of the Pyhäjärvi foundation steering group and they were invited in cooperation with the Pyhäjärvi Institute. At the workshop the participants in each group session were presented with tables for evaluating the feasibility of the water protection measures. The tables are presented in appendices 1-3.

4.2. Workshop Programme

10:00 Welcome / Anne-Mari Ventelä, Pyhäjärvi Institute
10:10 Introduction: Objectives, structure and research area / Riku Varjopuro, SYKE
10:15 REFRESH project: background and objectives / Ahti Lepistö, SYKE
10:25 Climate change and water protection in the Pyhäjärvi region / Teija Kirkkala, Pyhäjärvi Institute
10:40 Socio-economic scenarios / Riku Varjopuro
11:00 Introduction to group sessions / Riku Varjopuro
11:10 Group sessions
- Agriculture and adaptation to climate change
- Economy and society
- Restoration fishing under changing climate

11:45 Lunch
12:30 Group sessions continue
13:30 Summary of and discussion on group sessions
14:00 End of workshop

4.3. Plenary session

The plenary session was divided in two parts. The first part was conducted before the group sessions as an introductory to the issue and the REFRESH project. The second part included the presentation of the discussed issues in each group and the conclusions by the groups on feasibility of the measures in the region. The results were then discussed among all participants.

Plenary session: Part I

As an introduction to the workshop the objectives and structure of the session were presented to the participants. They were then introduced to background and objectives of the REFRESH project and its linkage to the workshop results. A representative of the Pyhäjärvi Institute briefed the participants on key issues in climate change and water protection in the Pyhäjärvi region including past patterns of and expected future changes in nutrient loading, precipitation and lake ice cover periods. Finally the concept and use of socio-economic scenarios in REFRESH were introduced to all participants.

Plenary session: Part II

- Outcomes of each group discussion
- Discussion on the outcome of the workshop

5. Results

Here we present the main contents of the discussions held in the three groups: agricultural production (5.1.), fishing as lake restoration (5.2.) and socio-economic scenarios (5.3.). The chapter 6 will present the conclusions and lessons learnt.

5.1. Agricultural production

The aim of the 'agricultural production' group session was to discuss the feasibility of current water protection measures (or alternatively other innovative measures) and their effectiveness under and sensitivity to changing climate and weather conditions. The group was provided with a list of locally used water protection measures, which included vegetation cover during winter, changes in fertilisation levels, reduced tillage of soil, buffer zones, wetlands and other innovative measures.

The group had a strong view that the currently practiced measures (listed above) should be continued and even practiced more broadly but the actual discussion on agricultural production focused rather on strategic approaches with future importance than on addressing individual water protection measures in detail. The strategic approaches seen as the most significant for the region included a stronger focus on *water management and soil structure* as well as developing *organic farming*.

Water management and soil structure are inherently linked and the expected more *extreme weather conditions* (incidents of high precipitation / dry periods) induced by climate change will require preparation for and adaptation measures. Paying attention to water management and soil structure would also *increase the profitability of agricultural production*. All in all, the group was adamant on paying attention to the *maintenance and further development of existing water protection measures* instead of the development of new measures. Particularly *the proper allocation of measures* was seen important.

5.1.1 Maintaining good soil structure

Increasing farmer's awareness on the importance of good soil structure was perceived challenging as there are conflicting issues of intensity demands and environmental aspects related to soil structure. As the size of farming equipment continues to increase and farming schedules become more restricted in the future *preventing soil compaction* was viewed as a significant economic factor and a genuine threat for agricultural productivity. *Direct seeding* method reduces the need to use heavy equipment on the fields, but it requires good soil structure and drainage. Direct seeding is relatively commonly used in the region but its use has not increased in the recent years. One challenge pertaining to climate change is that *ploughing* is necessary after growing periods of high precipitation levels.

5.1.2 Soil composition information

It was suggested that *the chemical composition of soil* such as soil pH and nutrient levels should be addressed more comprehensively. More analyses and guidance to farmers on soil acidity and nutrient levels is needed on a plot level. This would allow for the use of *precise fertilisation for each plot* with both economic and water protection benefits. However, the technique was not perceived as a relevant measure in the region. Farmers may still lack plot-specific information on harvests and conditions within the plots may also vary significantly.

5.1.3 Water management on a farm level: Drainage

Developing water management on a farm level may entail for instance *developments for controlled drainage*. Controlled drainage is applicable only in levelled/flat fields, which are not highly common in the Pyhäjärvi region. As controlled drainage requires a lot of financial resources and specific soil types in the region the measure was seen to be profitable in farming of certain products only (especially of special crops such as potato) but not in grain farming.

Field drainage during the spring and harvest season is vital to field farming in Finland and it will have a particular importance under climate change. However, field drainage increases water runoff to the lake, which may have negative impacts on water protection. With the changing climate *the availability of irrigation water* during dry growth periods must be secured for special crop (vegetable) cultivation in the future. Special crop cultivation has a specific importance for the Pyhäjärvi region and minor irrigation measures have been undertaken for example for cabbage and cucumber farming in the proximity of Lake Pyhäjärvi. Farm level water management is seen to have a significant role in the future.

5.1.4 Catchment level water management: Flood plains

As heavy rains are to become more common it may be critical to plan *flood plains for regulating transitory flood peaks* on a catchment level. The development and siting of flood plains still requires more work and modelling. In general it was regarded important to develop a common regional strategy for flood management. This would require wider regional perspective instead of farm level planning. The implementation of flood plains would also require new and flexible economic compensation measures for compensating farmers for inundated farm land as well as changes in regulations related to the flexible use of flood plains in varying circumstances.

5.1.5 Crop varieties and crop rotation

In the Pyhäjärvi region the majority of agricultural land is used for traditional crop and animal fodder farming. The total area of agricultural land will remain on a similar level in terms of land use in the region, but the range of crop varieties may be changed. In the future, changes in agriculture are largely related to modifications in crop varieties and particularly to the *growth of special crop production* such as root crop and vegetable cultivation. *Oil crops* have potential for both farming and processing industry in the region. Feed production may decrease in the area. The production of *energy crops* has not provoked interest among the local farmers and therefore its production volumes are unlikely to increase in the region.

5.1.6 Organic production

Organic production was perceived as the other important strategic development trend for the region. In order to develop organic production it would be necessary to set apart the subsidies for organic production from the general development of the agri-environmental subsidy scheme. The group's conclusion was that organic farming should not be addressed as a specific measure but primarily as an overall production strategy (alternative to intensive farming).

In terms of water protection, organic production and traditional production methods do not necessarily differ in their nutrient loading. Organic animal production often requires significant investments and the availability of organic feed is commonly low. This is particularly true for pig and poultry production due to the low availability of organic barley.

5.2. Fishing as a lake restoration method

The group focused on lake restoration and particularly on fishing as a single water protection measure. The objective was to discuss the development and impact of restoration fishing as well as the terms for its implementation and continuation so far and in the future. The session was also to cover the impacts of increased nutrient loading and climate change on fish populations, fishing and aquatic ecosystems and how the changes should be addressed in the region. The expected outcome for the group discussion was to define the terms of reference in restoration fishing under the changing climate and environmental conditions.

Fishing is *an effective lake restoration method*. It helps to reduce phosphorus levels but its most significant effect on the state of Lake Pyhäjärvi results from its *impact on the food chain*. Particularly the fishing of vendace has clear effects on water quality and the aquatic ecosystem. The efficiency of restoration fishing is indicated by increased water clarity and the recent increase in levels of perch relative to the levels of roach in the lake.

Factors encouraging restoration fishing

In previous years, restoration fishing in Lake Pyhäjärvi has mainly taken place as seine-fishing during winter time that has been conducted by local commercial fishers. Recently *new open water methods* have been developed with the advantage of selective fishing.

The continuity of funding for restoration fishing in terms of both volume of funding and its allocation is a great challenge as restoration fishing will only be effective as a long-term measure. In order for restoration fishing to continue, professional fishing must remain profitable. Financial self-sufficiency without the need for subsidies is a long-term goal also for lake restoration in the region, but has not been met yet. Profitability could potentially be improved by developing the marketing and processing methods for lower-value fish species as well as with the price of natural fish continuing its growth. Producing bioenergy from fish was seen as a very unlikely option for improving the profitability of restoration fishing.

The large number of professional fishers in the region allows for maintaining restoration fishing at Lake Pyhäjärvi for the time being. Restoration fishing has a positive image in the area and the impacts of restoration fishing are well known. Continuous monitoring is important for providing information on fish population modifications and for the correct allocation of restoration fishing measures. It is vital that the involved fishermen and funding organisations react rapidly to the changes in fish populations as well as to changes in the global market.

Factors discouraging restoration fishing

The continuity of funding is directly associated with the effectiveness of restoration fishing as the measure requires long-term implementation in order to achieve effective results. Currently restoration fishing is not profitable without external funding with the exception of large vendace catches. Although external funding is still required in the long run restoration fishing should be made profitable without subsidies in the region. The slight increase in the market price of natural fish was regarded as promising. A higher price encourages fishing but the best way to profit from high fish prices is to increase the selectivity of fishing as assorting of a mixed catch increases the costs of fishing.

Climate change may complicate restoration fishing in its existing form. It is unclear how the decrease in the length of ice cover period will affect restoration fishing. Some changes in species populations are expected to occur. For vendace fishing the main method has been seining during an ice cover period. Vendace fishing is essential to the desired food chain impacts and thus a shorter period of ice cover may have impacts on the effectiveness of restoration fishing. The worst scenario for restoration fishing is if , as a result of climate change, there would be long periods of a *thick snow cover on a thin layer of ice*, which will inhibit both fishing on the ice and open water fishing. The group was confident that by developing techniques used in fishing it is, however, possible to adapt to the challenges climate change poses for restoration fishing.

The retirement of current fishermen was mentioned as a genuine threat for fishing. However, if the *financial conditions* for restoration fishing were secured a new generation of fishermen would surely be willing to take on restoration fishing in the region.

A limited access to some fishing grounds at Lake Pyhäjärvi have hindered restoration fishing and reduced its effectiveness. Ownership of fishing rights and permit procedures are thus a factor that can slow down the implementation of restoration fishing measures. In addition, collaboration between fishermen should be improved in order to utilise the whole potential of restoration fishing in the region.

5.3. Socio-economic development trends

The session focused on discussing the future development of regional economy and land use as well as future scenarios on factors affecting these in the Pyhäjärvi region. Funding for the Pyhäjärvi Restoration Fund and other protection measures were also to be addressed in terms of previous funding interests and future development of funding opportunities. The expected outcome of the group session was to develop the presented scenarios (see Figure 2) as well as provide answers on the future of funding for the Pyhäjärvi foundation. This group contributes thus also to REFRESH land-use scenario activities.

Pyhäjärvi region is a significant region for agricultural production and food processing in the country. In terms of agriculture the regional economic development strategy is founded on market-led intensive agricultural production with products aimed largely to the domestic market. Agricultural production was seen to remain strong in the region and *agricultural environmental protection* will be emphasised in the region also in the future. This is supported by the economic development strategy, which is based on the production of *authentic and "pure" domestic food* in the region. Agricultural environmental protection was viewed to be strongly associated with the *trends of the EU agricultural policy* and the level of agri-environmental subsidies.

Cooperation between different actors is a significant factor in both food production and water protection in the Pyhäjärvi area. The work of Pyhäjärvi Institute is strongly associated with food industry development and environmental management and in is located in the core of the regions economic strategies. Municipalities are committed to continuing the funding of protection measures in the future. The group members who represented municipalities were convinced that also the companies in food and paper industry that are presently co-funders of the Pyhäjärvi Restoration Fund are interested in the activity also in the future. However, in the future the challenge is to preserve the interest of the companies' international owners and shareholders in the protection activities in the Pyhäjärvi region. However, as the locally and responsibly produced food is a core strategy of the companies a rapid removal of funding from the companies is not expected.

Economic activity in the region is and will include intensive agriculture and that will remain as a strain for the environment. It was suggested that this could be compensated by directing land use to a more water protection friendly direction outside farm land that is in forest and bog areas. No substantial changes were expected to the regional land use pattern. The common economic development strategy for the region is seen as a strong and adaptable and it is reflected on land use in the area.

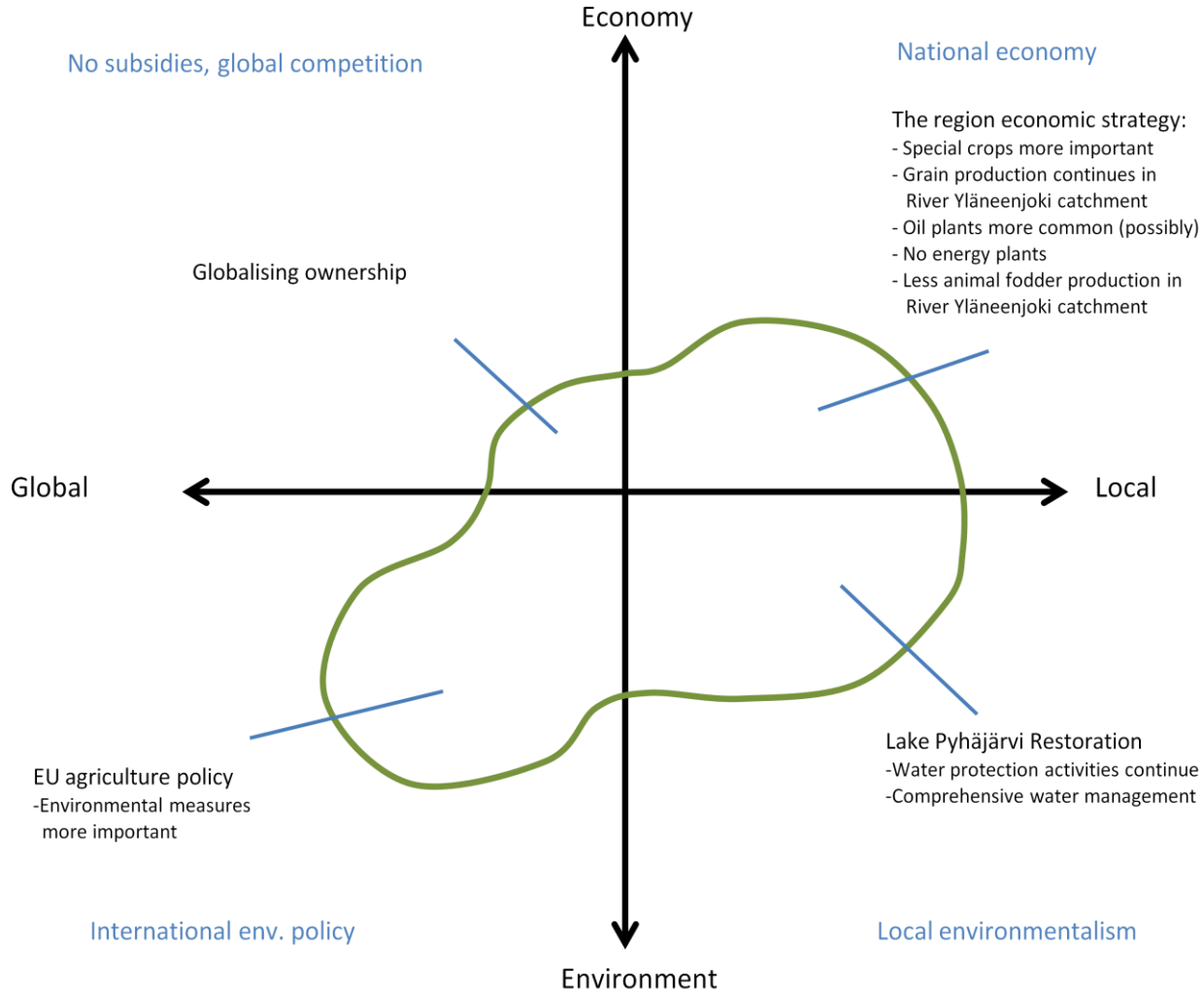

Figure 2. Land-use scenarios in the region

6. Discussion and Conclusions

6.1. Stakeholder feedback on the REFRESH Stakeholder Engagement Process

Stakeholder feedback on the workshop was not collected. Draft reports of each group was sent for the participants for commenting, but only very few of them commented the drafts.

6.2. Lessons learnt

In the agricultural production group the discussion was rather different to the expected outcome of the group session. This was due to both the history of research activities and implementing water protection activities in the Pyhäjärvi region as well as to the vast knowledge of the participants on the subject: they felt that discussing the details of water protection measures once again would not be as valuable as discussing new strategic developments for agriculture management. Furthermore, a presence of a dominant character

in the discussion also had a significant effect on the course of the discussion within the group. In the next workshop the issue needs to be addressed by planning the compositions of potential groups and further clarify their tasks in terms of discussed issues. An option to be considered is to conduct a few individual interviews for assessing the feasibility of water protection measures. This would guarantee a clear focus on the topic though a chance of stakeholder communication and mutual learning would be lost in this option.

The invited participants were all members of the Pyhäjärvi foundation steering group due to both the co-operative nature of the workshop as well as their interest and knowledge on water protection in the region. However, other stakeholders outside the Pyhäjärvi foundation steering group could have potentially provided other perspectives to the issue particularly in the group discussing agricultural production.

The stakeholders were eager to discuss the issues and time was somewhat limited in the workshop. Particularly the discussion on agricultural water protection measures could have potentially been more structured and the topics perhaps more limited such as in the case of restoration fishing group. The group focused on one measure only, which resulted in a thorough analysis of factors influencing the applicability of the measure.

6.3. Conclusions

The significant role of the strong economic development strategy developed in the region was emphasised in the discussions. The strategy was found to have potential to remain strong and sustainable in the future and even to be capable of to some extent benefiting from climate change. The economic development strategy is based on effective cultivation incorporating environmental aspects. Sustainable and viable environment is an important competitive factor for the region. The sustainability of the economic development strategy comprises the sustainability of effective agricultural production, which also includes continuous efforts on restricting agricultural nutrient loading.

It was seen that nutrient loading pattern to Lake Pyhäjärvi would be likely to experience modifications as a result of changing climate conditions. Participants referred to agriculture scenarios developed in a recent research project on effects of climate change in the region (in a broader area than Lake Pyhäjärvi catchment) by Agrifood Research Finland (MTT). The scenarios indicate that generally *the total loading to Lake Pyhäjärvi would increase with climate change*. Loading would increase particularly due to the increased length of growing season. Moreover, the seasonal distribution of nutrient loading is likely to change more significantly due to climate change than the amount of total annual loading. In the future a higher proportion of loading will be induced during the autumn and winter seasons.

In order to maximise the benefits from a longer growing season, also fertilisation levels need to be increased. This would lead to increased harvests and to the possible introduction of potential new crop varieties with higher yields that would be able to uptake more nutrients from the soil and thus increase the amount of nutrients bound to the growing harvest. However, as temperatures increase the decomposition of organic matter in agricultural and forest soils is increasing leading to potentially higher nutrient leaching levels.

If climate change will increase the length of the growing season and winter temperatures, the use of autumn seeding crops will become more common. This would increase the length of vegetation cover period, which may reduce nutrient loading to the lake. However, mild

winters with heavy rainfalls may considerably increase loading simultaneously. As plant pathogens are likely to proliferate also soil tillage techniques would be modified in the future. This might suppress the need for ploughing, which currently is vital for instance for the production of malting barley.

Ultimately the future increases and decreases of loading are not related only to climate change but are largely dependent also on the directions to which agriculture is developing. The impacts of climate change on water bodies are thus indirect and subtle and associated with both agricultural and human activities.

The water protection measures discussed by the stakeholders are presented in table 2. In the agricultural production group the stakeholders did not necessarily argued for or against all measures but their terms of feasibility were discussed in more general terms. Under changing climate conditions and socio-economic development the stakeholders saw the most desired adaptation measures to be large scale efforts such as developing regional flood plain management and organic production. From Pyhäjärvi Institute's perspective special crop production and organic farming will increase their regional significance as production sectors and more resources should be invested in them. *The maintenance and development of existing water protection measures as well as their implementation* is a key issue for water protection work.

Restoration fishing of vendace in particular was seen as an important water protection measure but it is largely affected by the winter weather and ice conditions. The feasibility of restoration fishing of other fish species will depend largely on the development of the fish product market and funding opportunities.

	Water protection measures and related farming practices	Terms of feasibility	Specifics
Agriculture	Direct seeding	Soil structure; Drainage	
Agriculture	Ploughing	High precipitation	Farming practices
Agriculture	Preventing soil compaction	Demand for heavy machinery; Farming schedules	Soil chemical composition
Agriculture	Controlled drainage	Soil type; Topography; Financial investments	Special crops
Agriculture	Regulating field drainage and irrigation	High winter/spring precipitation vs. dry growth periods	Special crops
Agriculture	Crop rotation; crop varieties	Food market; Climate conditions	Special crops; Oil crops; Feed; Farming practices
Agriculture	Organic production	Subsidy schemes; Regional effort and cooperation; Financial investments	Organic feed
Agriculture	Guidance on e.g. soil composition	Plot-specific knowledge	Precise fertilisation
Agriculture	Flood plains	Flexible regulation on the use of flood plain areas; Compensation system; Research on siting (modelling etc)	
Lake restoration	Restoration fishing	Profitability (e.g. roach); Continuity of funding; Food market (e.g. roach); Ice cover (vendace); Fishing selectivity and fishing techniques; Monitoring	Water quality (vendace); Food chain (vendace); Water temperature (perch);

Table 2. The key water protection measures and farming practices that have relevance for water protection and terms for their feasibility in the Pyhäjärvi region.

The work of Pyhäjärvi Institute is focused on developing food production and environmental protection in the region and these will remain as their focal activities in the future. The institute's focuses are in the core of the region's food production and economic development strategies. In the region the unique cooperation between agricultural producers, food industry, environmental authorities and scientists has been a major success for the development of water protection and it has influenced the regional economic development strategy.

The precise measures and future scenarios which will be modelled in WP5/WP6 will be chosen i) based on their relevance as current water protection measures, ii) based on the outcomes of the workshop and iii) based on consultation by modellers and re-iteration of all the information available. Details on the feasibility of the measures can be checked by individual interviews with the experts (incl. farmers) in the study region.

6.4. Policy Recommendations

The most significant improvement required for the *development of the agri-environmental subsidy scheme* was found to be *a more precise allocation of subsidies*. Currently many subsidy measures are not directed to the most critical locations. Furthermore, the allocation of subsidies is assessed on a farm level and that may not always result in an optimal allocation of measures. The *continuance of agri-environmental subsidies* was also viewed significant as many fields are rented on short-term contracts and this impedes long-term planning and developments.

In order to develop flood plains for regulating water flow during flood peaks *more flexible regulation on the appropriate use of areas designated as flood plains* is demanded. *An effective compensation system* was also seen as a vital prerequisite for land owners to agree on setting aside areas as flood plains.

For restoration fishing the *continuity of public funding* was also seen as a key condition for succeeding in reducing nutrients and improving water quality in Lake Pyhäjärvi.

Most relevant funding opportunities such as EU funding require innovative water protection measures though the maintenance of existing measures would locally be seen as more important and effective in the catchment. The price of agricultural products as well as food industry’s potential requirements for the use of specific measures may influence the feasibility of water protection measures. Farmers are considerably more motivated to receive their income from product prices than from subsidy schemes. This has already been successful in organic farming e.g. in the case of organic wheat.

Appendix 1. Evaluation tables for the feasibility of water protection measures in agricultural production group

1. Water protection measure
The measure *A short definition of the measure.*
2. Which factors have made the measure and its implementation appealing **for the producer**? Which factors have made the measure and its implementation unappealing?
3. Which factors have made the measure and its implementation appealing **for the Pyhäjärvi foundation**? Which factors have made the measure and its implementation unappealing?
4. Development trends for the measure
- *Recently the amount of land surface on which the measure is implemented has been on the increase/decrease.* - *In the long run the amount of land surface on which the measure is implemented will be on the increase/decrease. Why is this?*

5. In the long run agriculture will change in terms of the demand for agricultural products, agricultural policy and climate change. Which of the listed water protection measures are sensitive to the changes in agriculture and climate? Will the measures remain as feasible and relevant despite the changes?		
	The measure is/is not sensitive to the changes in precipitation and temperature (mild winters, length of growing season).	The measure will be particularly sensitive if the agricultural production sectors and methods (crop types, also energy crops; fertilisation levels, ploughing methods, etc) will change.
Vegetation cover during winter	*Yes/No, please define.*	*Please define which type of change will impact the feasibility and relevance of the measure.*
Manure-fertilising (in addition to artificial fertilisation)		
Reduced artificial fertilisation		
Reduced tillage/ Direct seeding		
Buffer zones		
Wetland areas		
Other measure		
Other measure		

6. Conclusions on all measures, outcome of group session
- *Which are the terms of implementation and feasibility for the measures?* - *How will the terms change with the changes in climate and agriculture (including agricultural policy) ?*

Appendix 2. Evaluation tables for the feasibility of restoration fishing

Water protection measure
Restoration fishing at Lake Pyhäjärvi *(Definitions according to e.g. fish types)*
1. Which factors have made the measure and its implementation appealing **for the fishermen**? Which factors have made the measure and its implementation unappealing?
From the perspective of fishing please list of the most significant factors allowing for the implementation of the measure. Please explain briefly. - *Factor 1, e.g. feasible to implement with or in addition to other fishing* - *Factor 2, e.g. economic subsidies* - *Factor n* *From the perspective of fishing please list of the most significant factors hindering the implementation of the measure.* - *Factor 1* - *Factor 2* - *Factor n*
2. Which factors have made the measure and its implementation appealing **for the Pyhäjärvi foundation**? Which factors have made the measure and its implementation unappealing?
Positive factors. Please explain briefly. - *Factor 1, e.g. known to be an effective restoration method* - *Factor 2, e.g. funding opportunities* - *Factor n* *From the perspective of fishing please list of the most significant factors hindering the implementation of the measure.* - *Factor 1* - *Factor 2* - *Factor n*
3. The effectiveness of the measure for water protection
- *Does restoration fishing efficiently remove nutrients from the lake? Which nutrients?* - *Is there enough knowledge on the impacts available?*
4. In the long run fishing at Lake Pyhäjärvi will change due to changes in e.g. the demand for fish products and subsidies for restoration fishing. What other societal and economic factors are there and how will they affect the continuity of restoration fishing?
- Change in the demand for fish products. *Please explain briefly the likely development trend of the change and its impact on restoration fishing.* - Change in economic subsidies. *Please explain briefly the likely development trend of the change and its impact on restoration fishing.* - Other factor. *Please explain briefly the likely development trend of the change and its impact on restoration fishing.*
5. Climate change will potentially change fishing at Lake Pyhäjärvi e.g. due to decrease in ice cover or increase in water temperature. Also the amount of nutrient loading to the lake may be modified.
Climate warming will change the fish populations and reduce ice cover in Lake Pyhäjärvi - What will happen to restoration fishing?

- How fast can the change in restoration fishing occur?

- Will climate change add to the loading in to the lake? Should this be addressed with restoration fishing?

6. Conclusions on restoration fishing and outcome of session
- *Which are the terms of implementation and feasibility for restoration fishing?* - *How will the terms change with the changes in climate and agriculture (including agricultural* - *policy)?*

Appendix 3. Evaluation tables for land-use scenarios

Land-use in River Yläneenjoki catchment (for background information)

Type of land-use	Present, ha (2006)	Present, % (2006)	Trend 2000-2006
Built	1246	6	growth
Agriculture	6684	34	stable +
Forests and nature	11048	56	stable
Mires	595	3	decrease
Peat production	231	1	strong growth
Else, what?			
Inhabitants (2009)	2 343		stable –
Jobs(2007)	548		stable

Land-use scenarios

Strong decrease, decrease, stable, growt, strong growth

Type of land-use	Present, ha (2008)	Present, % (2008)	Trend 2000-2006	Trend in a scenario: NAME OF THE SCENARIO	
				2012-2025	2025-2050
Grain	4800	77			
Root crops	193	3			
Vegetables					
Cattle feed	1255	20			
Oil plants					
Energy plants					
Sugar beet					
Intensive agriculture: strong fertilization and ploughing					
Reforesting of agriculture land					
Intensive forestry: fertilisation, drainage					
Wood energy					
Peat production					
Other?					

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