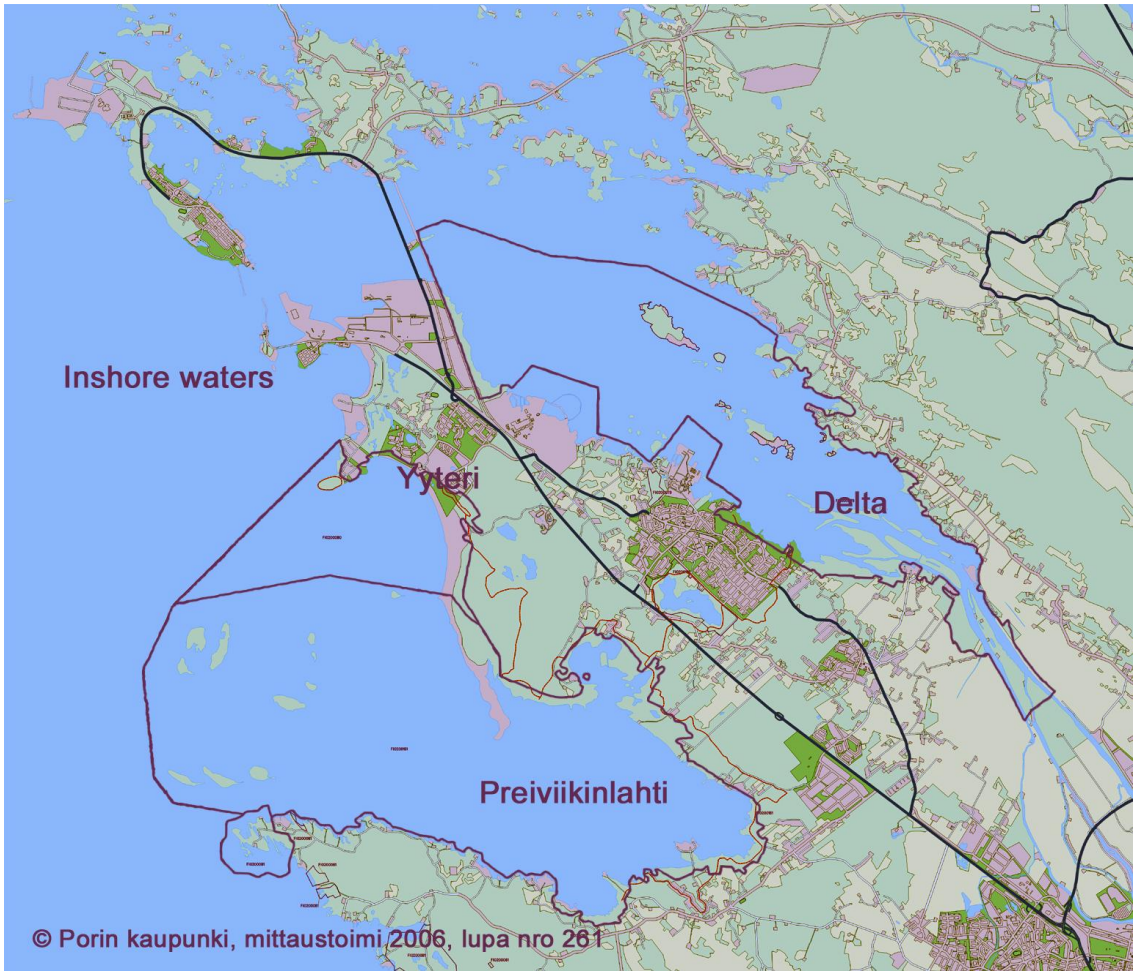
Multi-criteria methods in scenario analysis: The case of Meri-Pori, SW Finland



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1 Introduction

There is a growing interest in environmental decision-making for aids that combine future studies and multi-criteria decision-making with participatory processes. This paper describes the experience from the application of such a participatory process based on the approach of *Transactive Scenario Planning.*

Our case study is one of the case studies integrated into a collaborative European-wide Interreg III B project Watersketch – Strategies for a Sustainable River Basin Management (2004-2007). As it is, rivers and lakes have numerous different functions such as traffic routes, electricity supplies, habitats for animals and recreation areas for people. The Watersketch partners want to develop strategies for sustainable river basin management in order to do justice to different economic, ecological and social functions (Watersketch 2006).

The coastal northwest corner of the city of Pori in SW Finland is well known for its nature, landscape and recreational use. Ecologically and geologically the area is nationally and internationally significant. There are several interrelated reasons for this: the land-up-lift, the widest wetland mosaic in Finland, diverse coastal meadows, sand dynes, and shallow inshore waters etc. Also a multitude of recreational activities, housing, and industrial activities are exercised on the area.

The Meri-Pori scenarios -case study deals with this area of land and water. The reason for the initiation of the case study is the persistent upheaval of conflicts and controversies between the stakeholders. On the area, the public and the private, the entrepreneurs and the public, the private and the private interests intertwine in complex ways.

The purpose of the Meri-Pori scenarios project is to construct a *watersketch* for the area. The purpose is to produce a collaborative and consensual land and water use scenarios for the area, which covers the delta of River Kokemäenjoki, the peninsula of Yyterinniemi and the bay of Preiviikinlahti. As for the

methodological purposes, we will integrate the approach known as Transactive Planning with Scenario Planning and Multi-Criteria Decision-Making (MCDM).

2 Background information

2.1 General characteristics of the River Kokemäenjoki

The Kokemäenjoki catchment area is located on the boreal zone of Fennoscandian eco-region in South-West Finland. The catchment area is the fourth largest in Finland and covers 8 per cent of Finnish surface (Table 1). The annual mean flow is 231 m^3/s during 1961 – 1990 (Oravainen 2004). The main part of the drainage basin is covered by forests. In the upstream soil is largely a formula for clay. In the downstream soil consists of gravel, sand and silt (Raunio 1992).

Area of drainage basin km^2	27 040
Area of lakes km^2 (%)	2950 (11%)
Area under cultivation km^2 (%)	4867 (18%)
Main channel length km	112
Descent of main channel m	57.5

Table 1. Basic information about the River Kokemäenjoki.

The River Kokemäenjoki is one of the most loaded river systems in Finland. The quality of water was weakest in 1970s (Oravainen 2005) and has been markedly improved since these days.

The loading of nutrients (nitrogen 29 131 kg d^{-1} and phosphorus 940 kg d^{-1} during 2004) are carried by stream and the nutrients influence strongly by eutrophication to the area of sea in front of Pori (Oravainen 2005). In addition, the discharge contains the toxic substances like organ chlorines, PCB, and heavy metals (Raunio 1992).

Especially, the contents of copper and mercury are higher in the River Kokemäenjoki than in the most Finnish river systems. The industrial waste-waters are the main origin of metals, but also the seed disinfectants and the fertilizers of agriculture have contained heavy metals (Häkkilä 1984). The metal loading grew up in the 1930s and the 1940s, being the highest in the 1960s and the 1970s (Häkkilä 1984). Nowadays the metal contents in the river Kokemäenjoki are much lower than in the earlier decades. The metals have sedimented in the bay of Pihlavanlahti and the archipelago of Ahlainen (Raunio 1992).

The city of Pori has suffered from the occasional floods. Especially, in winter, the dams of ice have caused some deleterious situations for the settlements, agriculture, and industries. The risk of floods is connected to the high river flow, sudden freezing of the river, and the high sea-water level. As a solution to the problem, the dredging of the mouth of the River Kokemäenjoki is thought. The previous

dredgings were done in the 1980s and the 1990s. As a precautionary measure, the riverbanks by the downtown of Pori have been embanked (Raunio 1992).

2.2 General characteristics of Meri-Pori

Meri-Pori is important from the vantage point of nature conservation (Figure 1). The delta of the River Kokemäenjoki is part of the Natura-2000 reserve network. The peninsula of Yyterinniemi is a significant area in many respects. The south of it -- Preiviikinlahti -- is a very important bay with significant ecological values (Manninen 1999).

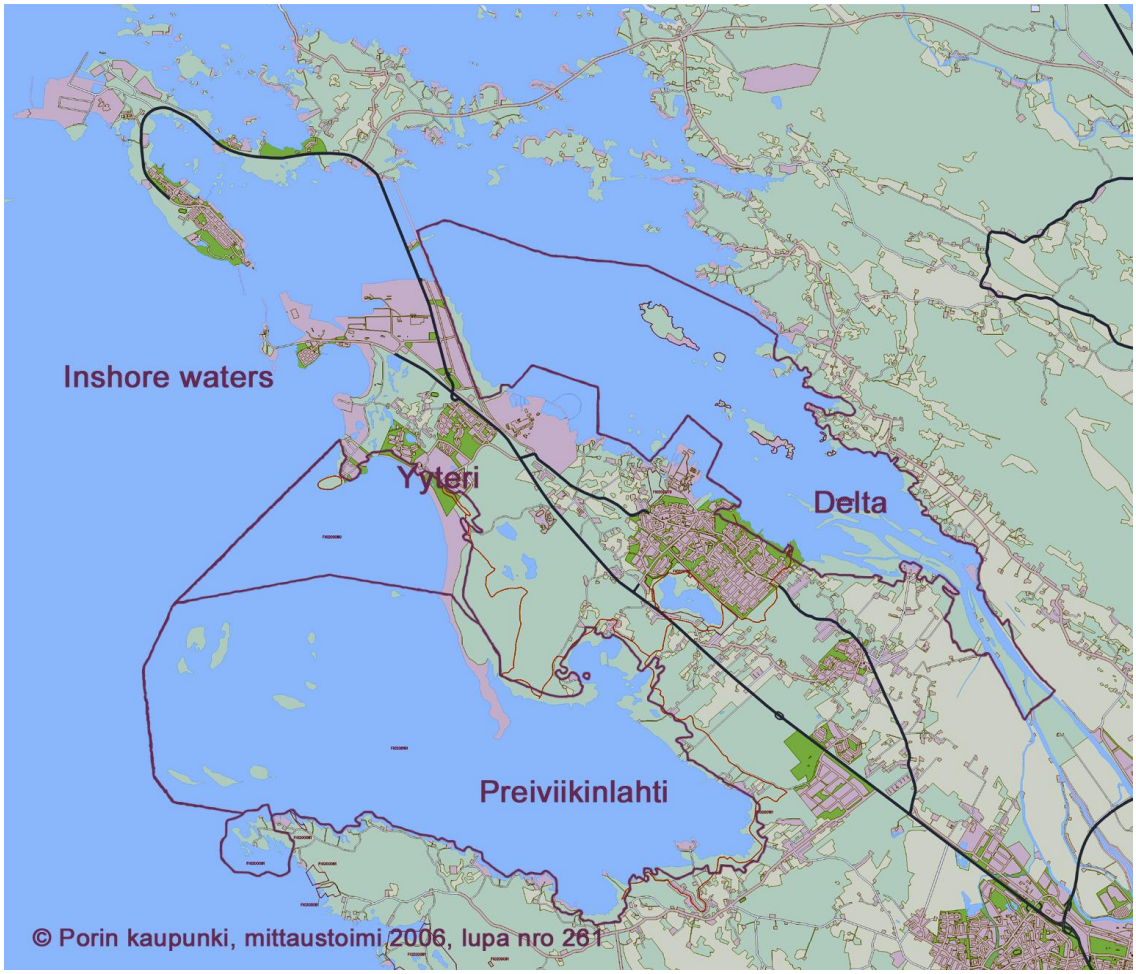

Figure 1. The area of Meri-Pori. The Natura 2000 -areas are marked on the map.

The area of the protected sites is altogether 8437 hectares; in the delta 2885 hectares (Ympäristöhallinto 2006a) and in the bay of Preiviikinlahti 5552 hectares (Ympäristöhallinto 2006b).

The delta of the River Kokemäenjoki is the largest in the Nordic countries (Raunio 1992) and its wetland habitats are the most representative in Finland. Open water communities, areas which predominate with scarce emergent macrophytes and large common alder groves can be found. The broad vegetation of macrophytes is one of its characteristic. (Ympäristöhallinto 2006a.) The traditional biotopes exist in the southern shore, e.g. reconstructed pasture-meadows (Ympäristöhallinto 2006a). Altogether 110 nesting bird species, of which 21 waterfowl, have been identified in the delta. The number of waterfowl pairs is about 700. In addition, there are plenty of waders, birds of prey and several rare passerines. The delta is an important moulting-site for the waterfowl and resting place of migrant birds. (Ympäristöhallinto 2006b.)

For centuries the delta has been utilized and manipulated by natural processes, these being very conspicuous, where the land-upheaval is outstanding. The delta shifts gradually seawards due to land-uplift and sedimentation, the rate being about 30 meters annually. During this process cigar-shaped rocks come into sight from the sea. The communities of vegetation move gradually with the delta. These rapid ecological processes are one of the most interesting issues in the conservation of these habitats. (Ympäristöhallinto 2006a.) Also human activities have shaped the delta-areas (e.g. Jutila 1999, Laitinen et al. 1999, Louekari 2002, Ojala & Louekari 2002).

The area of Yyteri is located in the peninsula of Yyterinniemi. The area of Yyteri is a valuable dune area and it incorporates camping areas, hotels, various eco- and recreational businesses. Free-time activities include sunbathing, swimming also in hotel's pool, surfing, stick-walking etc. Local user groups are constantly developing their activities, which creates tension between the governmental agencies and the user groups.

The bay of Preiviikinlahti is extensive and shallow. It belongs totally to the Natura-2000 network. The area is protected by the Birds and Habitats Directives. The bay of Preiviikinlahti belongs (partly) to the significant esker area. There are plenty of representative beachfronts, sandbanks and combinations of both of these. This area is one of the rare places where the whole process of dyne development can be seen. The bay of Preiviikinlahti is the very important resting place for migratory waterfowl and waders. In Preiviikinlahti the number of the nesting waterfowl is also very significant. There nest over 350 pairs of waterfowl from c. 20 different species. The lake Enäjärvi has plenty of pondweeds. The surface of the lake Enäjärvi is about 100 hectares. The nesting waterfowl of Enäjärvi is rich and diverse and the area is a significant resting place for the migratory and moulting waterfowl. The vegetation is variable and covers also a number of rare species. (Ympäristöhallinto 2006b.)

2.3 The Impact Matrix

The water quality of the River Kokemäenjoki affects the delta-area. For this reason, the impact matrix is for the whole River Kokemäenjoki (Table 2). The river Kokemäenjoki has modified human activities. The opposite is true as well: Human activities have modified the river Kokemäenjoki. There are several hydroelectric power plants along the River Kokemäenjoki triggering both hydrological and morphological pressures. Agriculture and forestry leak their nutrient and suspend matter into the river. In addition, there are also a lot of settlement and industry on the drainage basin. The impact matrix demonstrates to the total effects of various pressures.

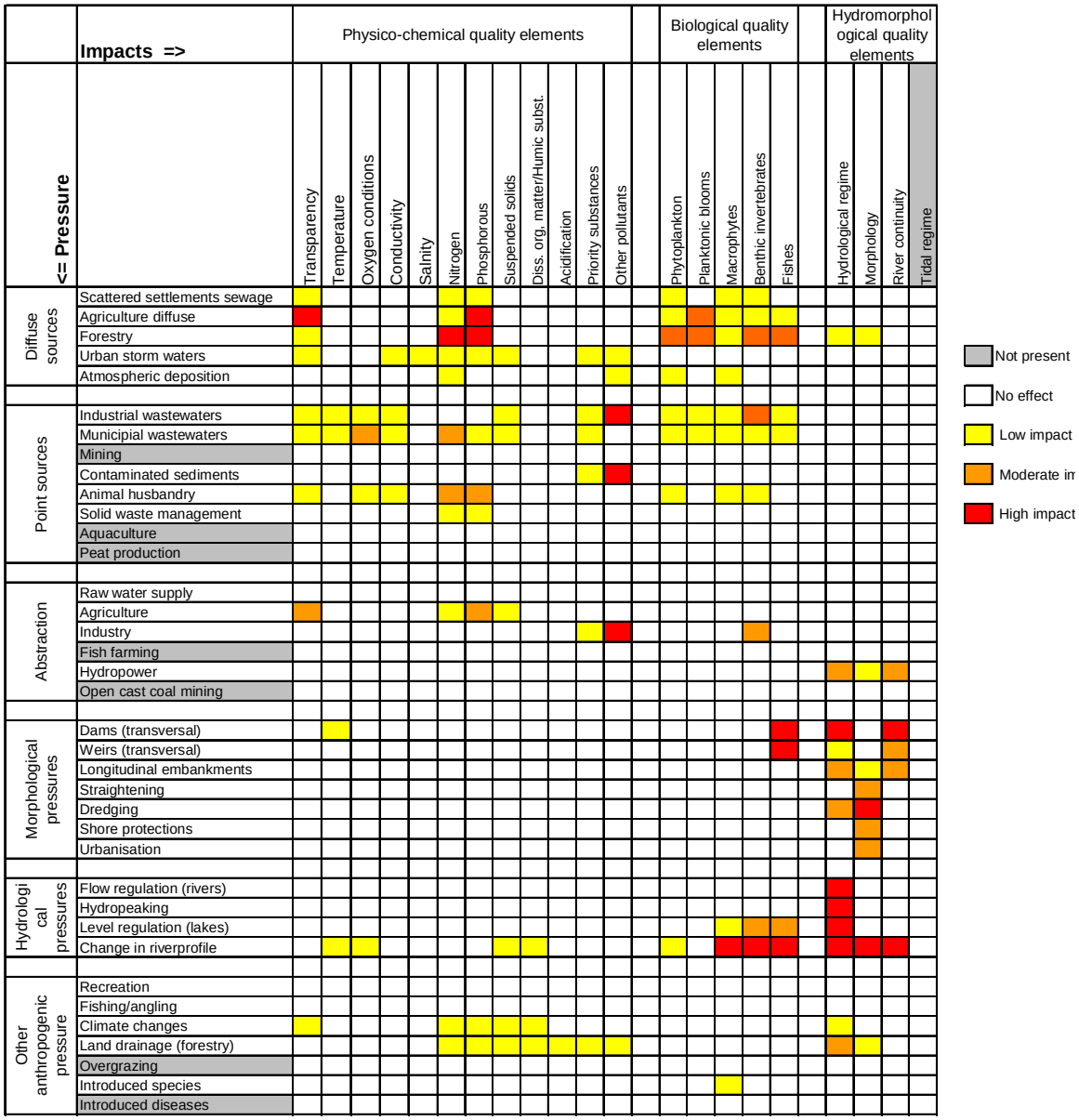

Table 2. The impact Matrix of the River Kokemäenjoki.

3. Transactive Scenario Planning

Transactive scenario planning consists of seven overlapping stages that a relatively small group of researchers, managers, policymakers, and other stakeholders explore through a series of workshops. Our approach differs somewhat from that of Peterson et al. (2003; see also Bromley 2006; Hiedanpää 2002; 2005). The phases are 1) purpose, 2) hotspots, 3) context, 4) attractors, 5)

alternatives and scenarios, 6) assessment and signification, 7) policy screening and policy formulation.

3.1 Purpose

The purpose of the first phase of transactive scenario planning is to identify the main characteristics of the situation and to focus the collective will into the future. The task is to create a mission statement – a purpose for the scenario process.

In our case study, the first meeting was held at the Satakunta Environmental Research Institute (SERI) (University of Turku) on December 3, 2004. The institute is located on the island of Reposaari, which is part of the study area as well. All together 11 persons representing 7 stakeholders and regional authorities were present. In this meeting, the Watersketch project and the preliminary purpose of the Meri-Pori Scenario process was introduced.

As result of workshop, the participants agreed on the purpose, rules and procedures of this joint activity. The participants also pointed out the omissions in the current list of participants.

3.2 Hotspots

The purpose of the second phase of the scenario process is to identify those areas that are the objects of multitude of interests. We called these areas hotspots.

The second meeting was held on February 15, 2005. Also this time, the meeting was held at the SERI. The list invitation was extended according to the suggestions given in earlier workshop. All together, 23 groups were invited. A pre-task was sent to the participants before the meeting. The pre-task was: "The aim of the meeting is to identify areas of multiple interests in Meri-Pori. We hope that you could come up with 5 areas that are the most relevant from the point of view of organization or group you are representing. Please, give reasons for your choice." On the basis of this pre-task, the participants (14 persons from 10 different groups of interest) marked the areas on the map and showed them on an overhead screen while giving reasons for their preferences. As a consequence,

the hotspots started to emerge on the overhead screen. The meeting was recorded using the digital videotape equipment.

As the result of workshop, we identified three hotspots: a) The delta of River Kokemäenjoki, b) The Bay of Preiviikinlahti and Yyteri Penisular, and c) Inshore waters.

3.3 Contexts

The purpose of the third phase of the scenario process is to identify the institutional, social and ecological contexts of each hotspot.

The method was to work desk-based and examine the existing research materials, documents, plans etc. The period took place, primarily, in January – April 2005.

As a result of work, a GIS map of spatial institutions, ecosystems and social practices was created.

3.4 Attractors

The purpose of the fourth phase of the scenario process is to identify the most powerful attractors of development. For the sake of emphasizing the real-life interconnectedness of volitional and spontaneous powers in development, we used the term attractor.

We organized three workshops, one for each hotspot. The meetings were held in April and May 2005. The list of invited groups was again expanded, e.g. with the delegates of residential associations. Again, a pre-task was delivered to the invited participants. This time we had three interrelated questions: (i) which 5 of following 14 activities will *in actual fact* become the most important constituents of development, and (ii) from the point of view of your group, which *ought to become* and (iii) which administrative or managerial actions would guarantee that future would become as you prefer. This period took place in April – May 2005.

As a result of workshops, we identified actual and potential drivers and needs, and hopes and fears concerning the future of each hotspot.

3.5 Alternatives and Scenarios

The purpose of the fifth phase of the scenario process is to construct alternatives or scenarios for each hotspot. The difference is that the alternatives are specific while the scenarios are general.

This phase was again a deskwork based on the audio and video materials recorded on the workshops. The work was done between June – November 2005.

As a result: a) The challenges in the *delta* of the river Kokemäenjoki are specific enough in order to create alternatives concerning the future of the area. First we (three researchers from SERI) drafted a decision tree. Then three reference persons selected from the participants of the delta workshop commented on the constructed decision tree. We finished the tree according to comments. The decision three consists of alternatives, impacts (criteria 2), goals (criteria 1) and the purpose of analysis (goal). See below.

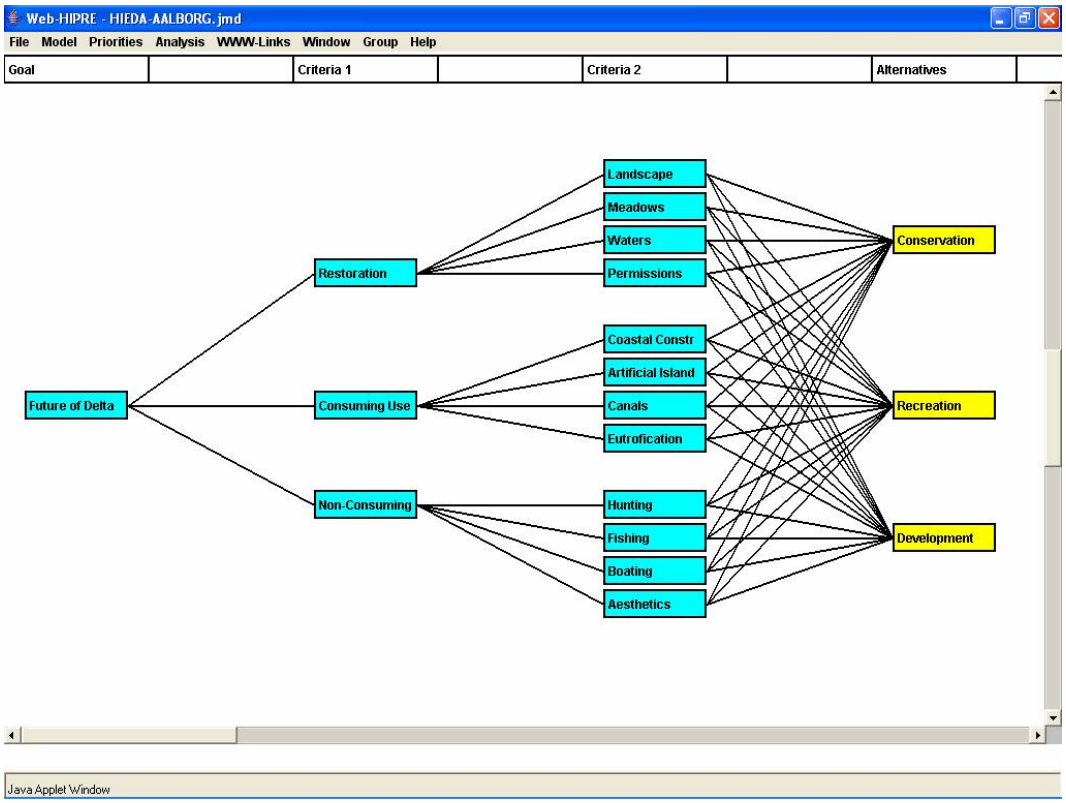

Figure 2. The decision tree concerning the future of the delta of the river of Kokemäenjoki

b) The challenges on *the bay of PreiviikinIahti and Yyteri Peninsular* are controversial, but focused. Perhaps for this reason, the participants of the workshop saw the best way to proceed. They came up with the idea of "governance committee" for the area. The committee would look over the planning processes as a sovereign body assigned with a sufficient power to influence the rules and principles of the future processes, resourceful enough to facilitate the stakeholder cooperation, and capable of mediating emerging conflicts and disputes. The idea is currently under consideration.

c) The future of the *inshore waters* unfolds in concrete but complex ways. The major attractors of development are (i) the extraction of sea-bed gravel, (ii) the suggested wind-mill farms, (iii) the expansion of the population of *gormorant*, and (iv) the planning of the Selkämeri National Park, which will partly cover the area. All of them are under planning and assessement simultaneously, but separately. For this reason, we have applied so called the APPI-analysis Hiedanpää 2003). The purpose of APPI-analysis is to facilitate a reasonable stakeholder discussion on the Actual, Potential, Possible and Impossible results, side-effects and unintended consequences of the plans. Reasonableness refers to value-plurality, ethical sensitivity, and scientific robustness (Hiedanpää 2004).

3.6 Assessment and Signification

The purpose of the sixth phase of the scenario process is to assess the alternatives and scenarios.

Only in one hotspot the problems were specific enough so that the alternative courses of action had emerged, namely on the delta of the river Kokemäenjoki. We applied multi-criteria decision making tool (MCDM-method) called WEB-HIPRE in assessing and weighing the existing alternatives and their impacts. This software has already been successfully used in some complex river flow control cases (Mustajoki et al. 2004). We worked on this phase from October 2005 – February 2006.

We conducted the computer-aided interviews with 20 stakeholders. The analysis of the material is still underway.

As a result, we weighed and rank ordered alternatives from various perspectives. We found out that the diversity of *functional groups* may play an important role in how the future is appreciated or loathed and how the impacts valued, tolerated or resisted.

3.7 Policy Screening and Policy Formulation

The purpose of the seventh phase of the scenario process is to help the policy makers to compare the old policies with the new ones and to create means to redirect the policies.

For this purpose, we will organize the concluding workshop in the Fall of 2006.

As a final result, we will publish a consensual and voluntarily binding *Watersketch* for the hotspots in Meri-Pori by the end of 2006.

4 Results

Identification of the parties: We managed to identify the relevant parties concerning the future development of the Meri-Pori. Those local governmental parties, local actors and NGO-parties that we asked to participate, a large part of these participated very actively. This proved good for the scenario process. Also participant's suggestions of additional representatives to be taken into the process point to successful attitude into the process.

Mission statement: In the second meeting the parties agreed the proposition of the consensual Watersketch-process. On the one hand, they agreed upon the end-product of the process, and, on the other, they also agreed upon the working methods by which the end-product will be produced. Thinking about the tense relations between the stakeholders, this was an achievement in itself.

Activation of the parties: We managed in activation of the parties. Participation in the meetings was rather good. This was mostly due to the practical fact that the process was concrete and problem-oriented. The participants made during the rather long process their share in constructing the future scenarios and alternatives on each individual hot-spots. During the process, the participants

started to show commitment to the process, which is a sign of emergence of social capital.

Identification of the hotspots: The sites selected as hot-spots were presented by the participants. On the early stage of the process, the participants articulated their visions concerning desired future and expressed their anxiousness concerning the threats the future might bring to the fore. During the process, it became obvious that the hotspots act as nodes on the relational network of interest parties. The hotspots are not only spots on which different economic interest face, but also the field of ethical, aesthetic and epistemic interaction. For this reason, the desired future of each hotspot was articulated from the multitude of fine-tuned perspectives.

Creating alternatives and scenarios: Throughout the history, each official development plan for each of the hotspot has faced a serious amount of resistance. Our scenario process tried to make a change to this by initiating a collaborative bottom-up process for drafting the alternatives and scenarios for Meri-Pori. In our case the partners presented the future scenarios, discussed over possible pros and cons. To our knowledge, the scenario process succeeded with the task: namely, in a seminar in which the results were inseminated for the wider audience, the participants of the scenario process agreed upon our discussion and drawn conclusions and suggestions concerning the future collaborative activities in directing and managing the development of this sensitive and conflictual area. For example, in the delta of the river Kokemäenjoki the true alternatives concerning the future of it are under discussion. On the other hand, the inshore area of Meri-Pori is much too complex for specific alternatives, therefore the open-ended collaborative scenario process should continue. The Preiviikinlahti –Yyteri area is different. There the problems are so tangible and serious enough that the new sovereign body for the governance of the area was introduced.

Practical arrangement of the workshops: We were aware that all the representativeness of the participants, the consensual mission statement, the activation of the participants, and the identification of the hotspots brought forth requirements concerning the actual collaboration during the scenario process. We think we managed to face the challenge. By the snowball-technique, we managed to cover all the interested parties. By arranging the workshops in late afternoon, near the end of office-closing time, we managed to attract both governmental and non-governmental actors. Perhaps the most important fact in activating the

participants was the problem-oriented work throughout the scenario process and the participants 'confidence in workability of the end-product of the process.

5 References

Bromley, D. (2006) *Sufficient Reason*. Princeton University Press, Oxford

Hiedanpää, J. (2005) The Edges of Conflict and Consensus. Ecological Economics 55(3): 485-498.

Hiedanpää, J. (2004) An Institutionalist Approach to Environmental Valuation: The Regional Forest Programme of Southwest Finland as an Example. Environmental Values 13(3): 243-260.

Hiedanpää, J. (2003) Työpajat transaktiivisessa ympäristö- ja kehityssuunnittelussa. In Hiedanpää, J. & Jussila, I. (eds.) *Ympäristölaadun instituutiot*. Satakunnan ympäristöntutkimuslaitos, Pori.

Hiedanpää, J. (2002) European-Wide Conservation vs. Local Well-being: The Reception of the Natura 2000 Reserve Network in Karvia, SW Finland. Landscape and Urban Planning, 61(3-4): 113-123.

Häkkilä, K. (1984) Pohjasedimentin ja jokisimpukan raskasmetallipitoisuudet Kokemäenjoessa. Vesihallituksen monistesarja 303. Vesihallitus, Helsinki.

Jutila, H.M. (1999) Vegetation and Seed Bank of Grazed and Ungrazed Meadows in SW Finland. Ann. Univ. turkuensis, 115. University of Turku, Turku.

Kivinen, E. & Hiedanpää, J. (2003) Meri-Porin Luontoarvot Matkailun ja Ympäristönsuojelun Ristipaineessa –Toimijoiden Näkökulma Virkistyspalveluiden Kehittämiseen Kokemäenjoen Suistossa ja Yyterinniemellä. Satakunnan ympäristöntutkimuslaitoksen tutkimusraportti 1/2003. Turun yliopisto, Turku.

Laitinen K, Louekari, S., Ojala, E., Hiedanpää, J. (1999) Historialliset, ekologiset ja yhteiskunnalliset tekijät Kokemäenjoen suiston kestävän käytön perustana. In Hiedanpää, J. (ed.) (1999) Yyterinniemen Natura-2000-alueiden biodiversiteetin hallinta. SYKEsarja A9, pp. 14-120. Turun yliopisto. Turku.

Louekari, S. (2002) Suo Siellä, Vetelä Täällä – Näkökulmia Ihmisen ja Luonnon Vuorovaikutukseen Kokemäenjoen Suistossa. Lisensiaatin tutkimus, Turun yliopisto, Turku.

Manninen, J. (1999) Yyterinniemen LIFE-projekti ja sen taustat. In Salonen, S. (ed.) (1999) Yyterinniemen Natura-2000-alueiden biodiversiteetin hallinta. SYKEsarja A9, pp. 7-13. Turun yliopisto. Turku.

Mustajoki, J; Hämäläinen, R. & Marttunen, M. (2004) Participatory Multicriteria Decision Analysis with Web-HIPRE: a Case of Lake Regulation Policy. Environmental Modelling and Software, 19, 537-547.

Ojala, E., Louekari S. (2002) The merging of human activity and natural change: temporal and spatial scales of ecological change in the Kokemäenjoki river delta. In Journal of SW Finland Landscape and Urban Planning 61: 83 – 98.

Oravainen, R., (2005) Vuosiyhteenveto Kokemäenjoen ja Porin Edustan Merialueen Yhteistarkkailusta 2004. Kokemäenjoen vesistön vesiensuojeluyhdistys ry, Tampere.

Peterson, G.D.; Cumming, G.S. & Carpenter, S.R. (2003) Scenario Planning: a Tool for Conservation in an Uncertain World. Conservation Biology 17(2): 358-366.

Raunio, A., (1992) Ympäristötietoa Kokemäenjoesta. Satakunnan Luonnonsuojelupiiri, Satakuntaliitto, Pori.

Riikonen S., Kankaanrinta S., Hiedanpää J. (2004) Kävijätutkimus Yyterinniemen ja Kokemäenjoen Suiston Luontoarvoista ja Alueen Kehittämisestä. Satakunnan ympäristöntutkimuslaitos, Turun yliopisto, Turku.

SAL (2006) www.sal.hut.fi / Publications / ppt-files / WebHIPRE / index.htm.

Watersketch (2006) Newsletter 01/2005. Online: www.watersketch.net , p. 2.

Ympäristöhallinto (2006a) www.ymparisto.fi / default.asp?contentid=14046&lan=FI.

Ympäristöhallinto (2006b): www.ymparisto.fi / default.asp?contentid=14041&lan=FI.