



Strategic Alliance for integrated Water management Actions



# SAWA Final Report

## Summary



High Tide Heels  
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## Abstract

SAWA strived to strengthen the member states for their current implementation of the EU Flood Directive. The aim was to adapt existing water management systems to the effects of extreme flood events due to climate change, focusing on sustainable development of society and regional economies. Despite of the initial intensive attempts to find one common implementation strategy for all pilot regions individual approaches have been developed instead. The reason is seen in high diversity of the national contexts in terms of institutional responsibilities and structures, scale of the problem, available data and resources. Six Flood Risk Management Plans and one river basin management plan have been developed by the partners for the SAWA pilot regions in four NSR states whereas synergies between flood risks and water quality aspects as well as an active involvement of interested parties became integral part of the planning cycle:

- ▶ FRMP Wandse, catchment of River Alster in Hamburg, GER, urban area
- ▶ RBMP catchment of River Illmenau in Lower-Saxony, GER; rural area
- ▶ FRMP water systems of Lake Värnen/Göta älv for the cities of Lindköping and Karlstad, SWE; urban area
- ▶ FRMP catchment of River Gaula, NOR, rural area
- ▶ FRMP catchment of River Tana, NOR, rural area (Cross border)
- ▶ FRMP region Hunze en Aa's, NL, rural area

Additional features like decision support tools, assessment methods and databases on adaptive measures and expertise as well as a great variety of capacity building measures have been developed in order to support the planning process as well as a better understanding of the ideas behind the directive's purposes. This great variety of capacity building measures gives preference to interactive ways of communication and education instead of traditional teaching approaches. SAWA established:

- ▶ a M.Sc. course on Flood Risk Management
- ▶ educational games, events and study tours for pupils, student and professionals
- ▶ different Sustainable Education Centers,
- ▶ different raising awareness measures like workshops, exhibitions and art impressions

SAWA results are presented in several SAWA reports (available via internet at <http://www.sawa-project.eu/index.php?page=documents>) and on the SAWA pages of iwa waterwiki (<http://www.iwawaterwiki.org/xwiki/bin/view/Organizations/SAWA>).

## SAWA Project – Basic Information

SAWA is the acronym for Strategic Alliance for Integrated Water Management Actions. Five countries from the North Sea Region, represented by 22 partners, have formed a long-term partnership of expertise in order to learn from each other on how to manage water and its risks. Together they develop measures not only for dealing with future flood risks, but also to enhance the quality of life for those who live in close proximity to water.

In May 2008 the application of the project SAWA submitted by the Agency of Roads, Bridges and Waters, Hamburg (LSBG) was approved for funding in the Interreg IVB Program of the North Sea Region. Now, in April 2012, SAWA is able to present the results from a more than four years collaboration.

Germany	The Netherlands	Norway	Sweden	United Kingdom
				
<ul style="list-style-type: none"> <li>• Ministry of Urban Development and Environment; Agency for Roads, Bridges and Waters (LSBG)</li> <li>• TU Hamburg-Harburg (TUHH)</li> <li>• HafenCity Universität Hamburg (HCU)</li> <li>• LEUPHANA Universität Lüneburg</li> <li>• Agriculture Chamber of Lower Saxony (LWK)</li> </ul>	<ul style="list-style-type: none"> <li>• Province of Flevoland</li> <li>• Waterschap Zuiderzeeland</li> <li>• Waterschap Hunze en Aa's</li> <li>• Waterschap Noorderzijlvest</li> <li>• Waterboard of Delfland</li> </ul>	<ul style="list-style-type: none"> <li>• Norwegian Water Resources and Energy Directorate (NVE)</li> <li>• Norwegian University of Science and Technology (NTNU)</li> <li>• Melhus Municipality</li> <li>• Norwegian Meteorological Institute (met.no)</li> </ul>	<ul style="list-style-type: none"> <li>• County Administrative Board of Värmland</li> <li>• Swedish Meteorological and Hydrological Institute (SMHI)</li> <li>• County Administrative Board of Västra Götaland</li> <li>• Karlstad University</li> <li>• Swedish Geotechnical Institute (SGI)</li> <li>• City of Karlstad</li> </ul>	<ul style="list-style-type: none"> <li>• Heriot-Watt University</li> <li>• University of Edinburgh</li> </ul>

Figure 1: Sawa representatives

## 1.1 SAWA Motivation

There are three major driving forces which make regions attractive for people to life, work and invest in. It is a well balanced combination of thriving local economies, healthy natural environment and self-sustaining well established social communities. Over the past decades the North Sea Region (NSR) has been successful in building a prospering setting for this. Nevertheless current threats like unemployment, urban and rural inequalities, environmental pollution and finally fluvial and pluvial floods due to climate change (CC) put extensive stress on this intricate system. Innovative strategies and business solutions in the NSR are needed to deal with and mitigate the negative effects to ensure an ongoing and stable development in the future. Large parts of the NSR are low lying areas. Hence in many of these areas the risk of fluvial flooding caused by more frequent heavy rainfall is putting pressure onto regional decision makers and stake holders.

Looking at CC as a driver for a very likely increase in regional risk of flooding, it will be one of the major challenges for future Flood Risk Management tasks in this century. It is widely believed, that adaptation will be one of the key strategies to cope with this threat.

In October 2007 the directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood risks (FD) has been established. The purpose of this Directive is to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community.

SAWA picked out some very relevant aspects of this directive. These are:

- The development of Flood Risk Management Plans as pilot concepts
- The integration of flood risks and water quality aspects (2000/60/EG / WFD)
- The active involvement of interested parties in the flood risk management planning cycle
- The cost-conscious usage of resources
- The call for raising awareness and integration (capacity building activities)

When SAWA was initiated, early in 2008, there was only a rough idea of what flood risk management plans really are. Nevertheless SAWA formulated the ambitious aim to develop a common planning strategy and create flood risk management plans for five pilot areas in four member states whereas synergies between flood risks and water quality aspects as well as an active involvement of interested parties should become integral part of the planning cycle.

Additional features like DSS tools, assessment methods and databases on adaptive measures and expertise and a great variety of capacity building measures have been developed in order to support the planning process as well as a better understanding of the ideas behind the directive's purposes.



## **1.2 SAWA Approach**

The project aimed to adapt existing water management systems to the effects of extreme flood events due to CC, focusing on sustainable development of society and regional economies. The original plan was to achieve this by compiling a common adaptive implementation strategy within the SAWA partnership for the FD which is closely linked with the WFD.

The real case experiences have taught us an alternative procedure. However, to test this strategy different pilot flood risk management plans (FRMP) have been developed in a transnational partnership context, using new adaptive structural and non-structural measures. When working out these plans, communication and education have been two of the key tools for sustainable implementation of the adaptive management system and played an important role in the very much needed capacity building process. Looking at relevant target groups, SAWA aimed to increase the CC and water management awareness in the NSR.

The hands on experience during the implementation phase of the pilot FRMP and the adaption strategies on regional and local scale fed back to the EU-CIS Process group and possibly triggered the implementation of FD on national levels.

Other EU member states, also outside NSR, are kindly invited to benefit from SAWA results for the implementation of the FD.

## 1.3 SAWA Structure

### 1.3.1 The overview

The described approach is structured by the objectives of SAWAs three key areas, so called Work Packages (WP 1-3). These are Adaptive Flood Risk Management, Adaptive Measures and Capacity Building.

These key areas are being fed by a great number of projects on national level. A close collaboration and intensive knowledge exchange of our SAWA partners on transnational level allows to elaborate super-ordinated results and recommendations. In accordance with the three key areas the findings are structured logically and well linked in our SAWA final report.

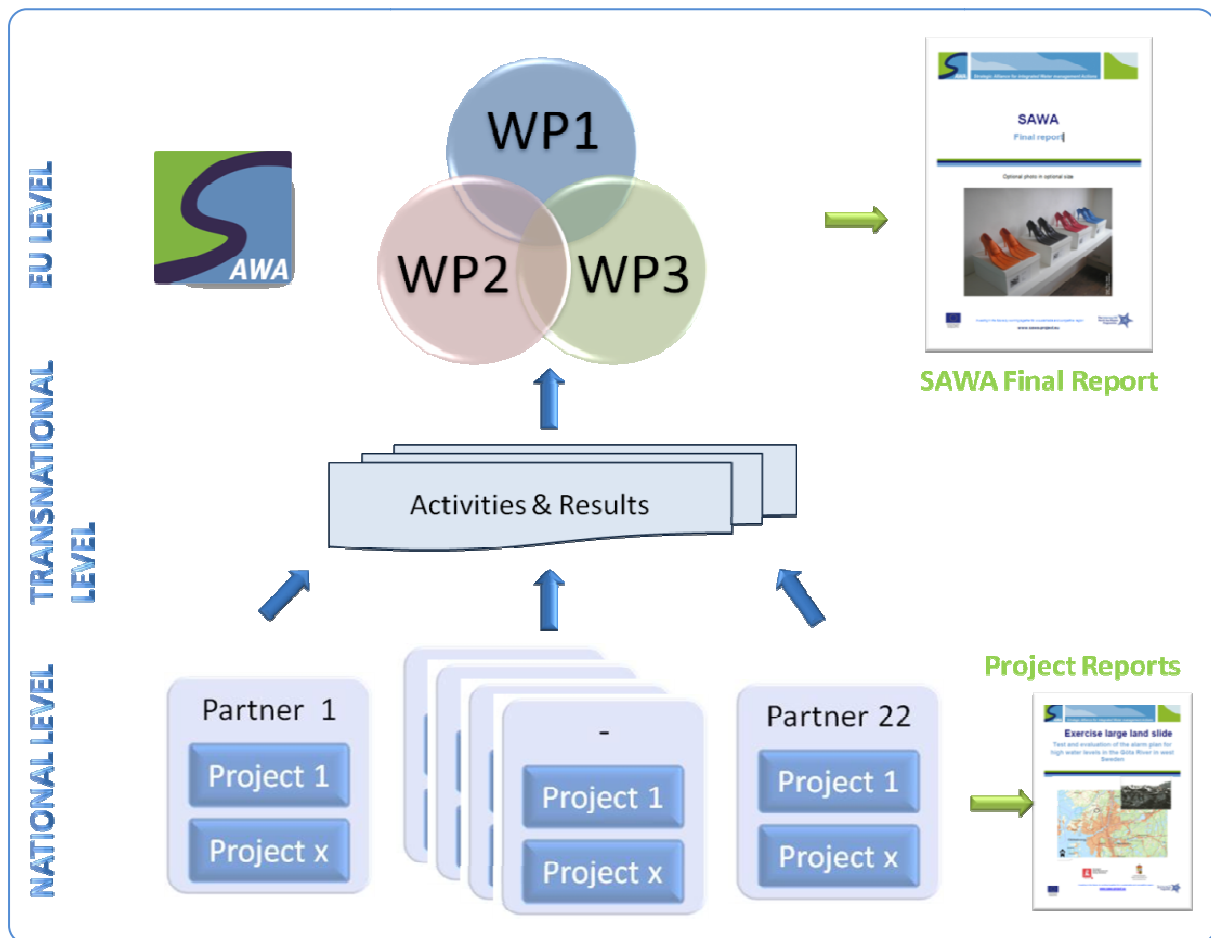


Figure 2: Schema of SAWA structure

### 1.3.2 Project Structure in Detail

As already mentioned SAWA is working by separating the respective aims into three interlocking work areas (WP1-3):

#### A) Adaptive Flood Risk Management

Key area A has mainly three objectives. More detailed these are to:

- (1) Identify potential conflicts and synergies in the implementation of Flood Risk Management Plans (FRMP) coordinated with River Basin Management Plans (RBMP) (link C1, input to C3)
- (2) Apply and test adaptive planning strategies to optimize the implementation of FRMPs and RBMPs, following a holistic risk based approach, incl. CC impacts on hydrology and demonstrating how the FRMPs for river basins can efficiently be made operational on local level (Input to C1, B3)
- (3) Involve stakeholders and key individuals on a river basin level to develop an integrated framework for assessing and communicating the effects of CC and associated uncertainties on regional hydrology, integrated in the preparation process of FRMPs. (links C1-C3)

## **B) Adaptive Measures**

The main objectives of key area B are to:

- (1) Compile a transnational inventory of currently available strategies and experiences on implemented local scale non-structural and structural measures based on case studies (input to C1+C3)
- (2) Develop hybrid (FRM/WFD) adaptive non-structural measures to be implemented into FRMPs. Assessed, optimized and prioritized using a cost benefit approach (input to A2, C2, C3)
- (3) Design a decision support database
  - holding new adaptive and state of the art measures for all SAWA partners, accessible via internet (input to C2+C3)
  - offering a great variety of DSS tools
  - presenting examples of FRMP (input from A2)
  - offering an expert database, accessible via internet

## **C) Capacity Building (CB)**

Key area C has formulated as well three main objectives. These are to:

- (1) Derive a basic concept on CB, from local and individual experience, commonly used strategies, leading research in the field and pedagogic philosophy, as basis for SAWA (Input from A1, A2, B1, links A3)
- (2) Establish an educational exchange, based on the CB-Theory (C1), establish a network of international educational exchange and cooperation with respect to sustainable floodplain management (sfm). (SAWA Master Course) (link to A3+C3)
- (3) Establish so called Sustainability Educations Centres (SEC) for information, education and stakeholder integration, applying the CB-theory to provide hands-on educational activities, tools and information for sfm/FRM

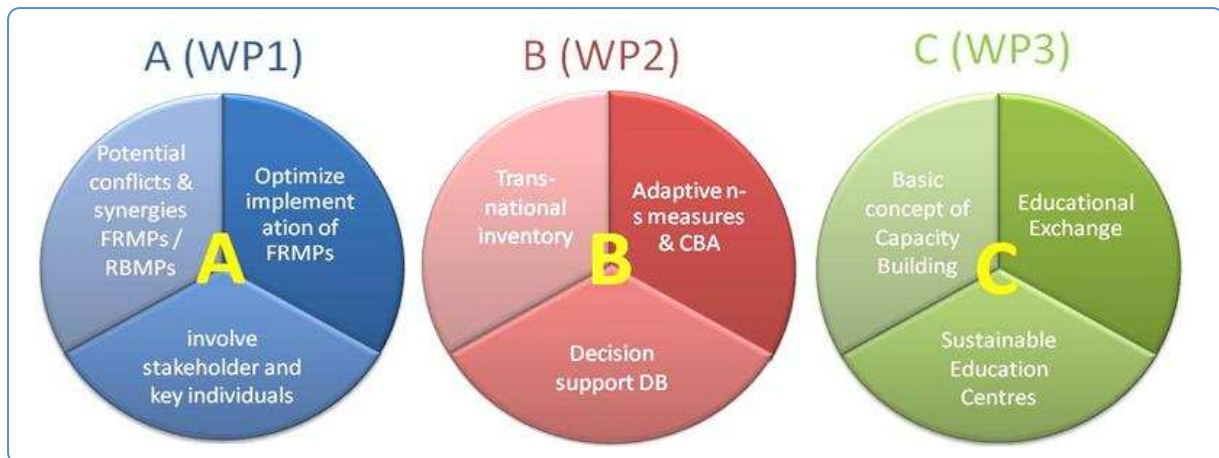


Figure 3: Overview on Key Area Activities

Beside the work package structure, which is focused on key topics, SAWA structure can also be visualized in terms of time. In principle SAWA structure should have looked like depicted on

Figure 4. The key activities of each phase are dealt with priority within one key area as highlighted in green. Due to several reasons SAWA did not strictly follow this time schedule. Phase 5-7 were independent from the progress of the phases before so SAWA started working on that much earlier. SAWA updated its results as well as its recommendations continuously due to a progressing treasury of experiences, know-how and information exchange. Finally, this sometimes led to delay but to even better results.

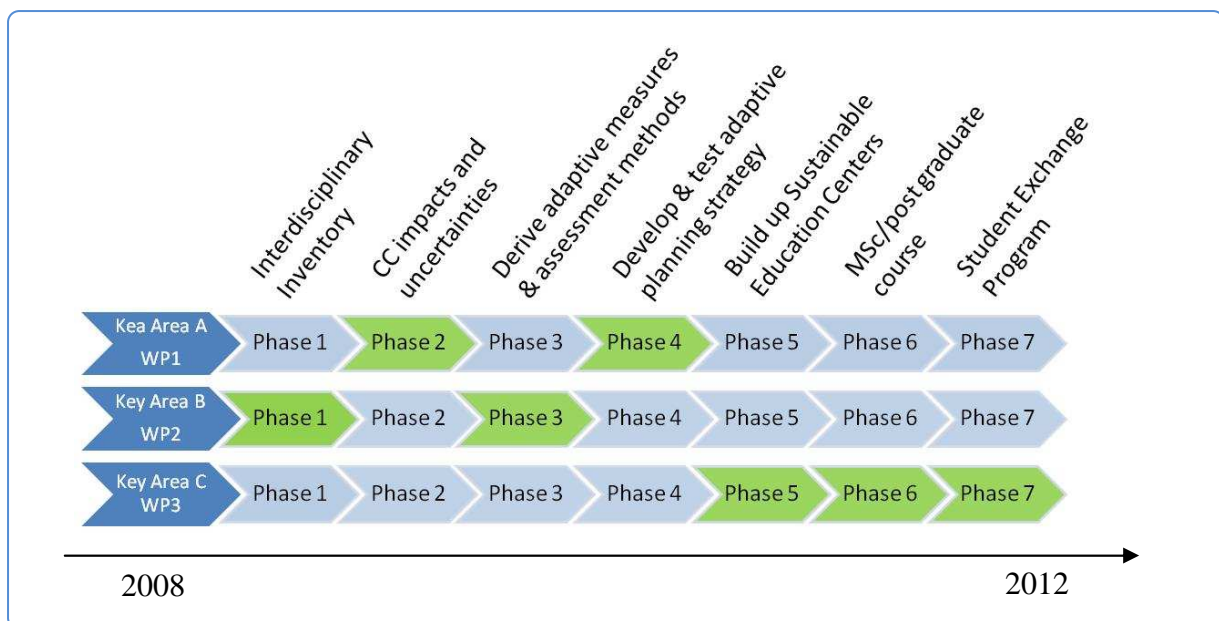


Figure 4: Schema of project phases

### 1.3.3 Report Structure in Detail

According to the described project structure the SAWA results will be collected and described in summary reports. The structure of summary reports is based on a modular design principle.

The Final report on SAWA is meant to be like an umbrella. Here we'd like to provide an overview on SAWA project and its results. More detailed information on contents, activities and recommendations can be found in our 6 final WP reports.

Each WP is described by 2 reports. In order to provide information in a condensed and very well structured way these reports are focused on special topics and well linked to each other. This should allow getting a quick insight in our results and recommendations.

If you are interested in special projects on national level we'd like to draw attention to our reports on national level. Some of them are offered in national language and provide further contact details.

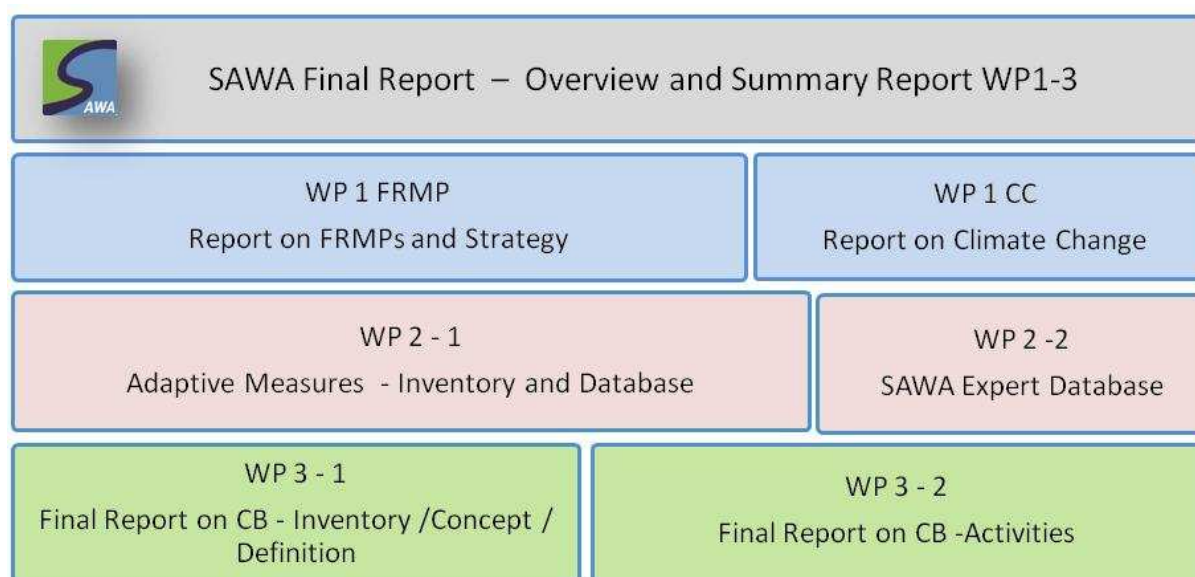












Figure 5: Overview on SAWAs reporting structure








All relevant SAWA outcomes will be presented at our SAWA website (<http://www.sawa-project.eu>). Here we are also offering the access to our expert database. We kindly invite you to get in contact with our partners.

## 1.4 SAWA Performance – Overview

SAWA results in numbers:

-  5 Flood Risk Management Plans on national level (SWE, NOR, GER, NL)
-  1 River Basin Management Plan on national level (GER)
-  1 cross-border Flood Risk Management Plan (NOR/FIN)
-  10 different DSS Tools for planning and operational purposes (accessible via WIKI <sup>(1)</sup>)
-  2 Contingency Plans (urban / rural area)
-  1 Database on Adaptive Measures (accessible via WIKI <sup>(1)</sup>)
-  1 Expert Database (accessible via WIKI <sup>(1)</sup>)
-  7 Sustainable Education Centres
-  1 Master Course on Flood Risk Management
-  2 computer supported educational games

Furthermore

-  SAWA analysed & tested different approaches for stakeholder involvement
-  SAWA produced educational material
-  SAWA developed numerous analysis and studies
-  SAWA created numerous reports, books and scientific articles
-  SAWA hold numerous workshops and seminars on national & international level
-  SAWA took part on numerous national and international conferences
-  SAWA created a vivid network on international level

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<sup>1</sup> <http://www.iwawaterwiki.org/xwiki/bin/view/Organizations/SAWA>

## 1.5 SAWA Performance – Summary & Recommendations

### 1.5.1 Key Area A: Adaptive Flood Risk Management (WP1)

Based on an inventory conducted in all partner countries, SAWA developed a preliminary common adaptive strategy for the implementation of FRMPs. SAWA then identified challenges and potential synergies when implementing FRMPs coordinated with RBMPs, appreciating the differences between rural and urban catchment conditions, institutional structures, stakeholder involvement, etc. The strategy became tested through developing 5 FRMPs, as well as local management plans demonstrating how FRMPs for river basins could be made operational at local level. An important component of the FRMPs is the flood risk assessment. As part of this, SAWA developed an integrated framework for assessing and communicating the effects of CC on regional hydrology – including a spatial representation of uncertainty.

Finally, decision support tools became implemented and tested in conjunction with the development of FRMPs leading to recommendations as to the most suitable methods of communicating FRMP and CC to stakeholders. In WP1 several very different DSS-tools have been developed. All DSS-tools are made accessible for the public via Water-Wiki -Database. DSS-tools developed or applied within SAWA are: Kalypso Planer Client, FLORETO, Drei-Wehr-Steuerung, Climate & Water Table, DSS-High Water, decentralized DSS, 3Di, MDST, Game Theory approach, SFRB.

Based on the outputs of the testing phase, the SAWA partners jointly refined the planning strategy and made good practice recommendations for integrated flood risk management on a river basin scale. Throughout this, SAWA used opportunities (workshops etc) for communication and interaction with the ongoing CIS process. The preliminary strategy has become discussed and refined by working with experts, practitioners and scholars across disciplines through a series of high profile transnational workshops.

Very detailed information on adaptive flood risk management results are provided in our WP 1 final report. This report delivers the results and experience of the three-year work on the development of FRMPs in the SAWA pilot regions. It targets all parties involved in the design and conduction of the flood risk management planning process, mostly being the responsible authorities together with the decision makers, research institutions and consultants.

The overall structure of the report follows the requirements set by 2007/60/EC addressing the preliminary risk assessment (PRA), flood risk mapping and flood risk management planning (FRMP) whereby the focus is put to the planning process.

The contents are given as following:

Chapter 2 outlines the working approaches in PRA and flood risk mapping in the SAWA countries. The current practices in the partner countries to deal with the uncertainties due to climate change are given.

Chapter 3 introduces the SAWA methodology for the development of FRMPs. The requisites for together with the national contexts in terms of legal and institutional conditions are analysed.

Chapter 4 presents the applied strategies for flood risk management planning and the final results- flood risk management plans. The applied methods and tools in the corresponding pilot regions are given.

Chapter 5 is devoted to the discussion of the experiences and results as well as outlining the lessons learned. Recommendations for future work are given.

This report relates to the outcomes of the other work packages (WP2- Adaptive Measures) and WP3 (Capacity Building) as well as the key issues defined within SAWA being as climate change (WP1) and decision support tools (WP1). They are given in separate reports or published within IWA Water Wiki platform (as a part of WP2).

In the report Lawrence D., Graham Ph., Van den Besten J (2012). “Climate change impacts and uncertainties in flood risk management: Examples from the North Sea Region” a thorough analysis on the climate change projections in the partner countries has been presented and current practices in its dissemination outlined.

#### **1.5.1.1 Integrated framework for assessing and communicating the effects of CC on regional hydrology**

The EU Flood Directive (2007/60/EC) states that consideration should be given to the possible effects of climate change on flood hazard in flood risk assessment and management (Ch.II, Art.4.2 and Ch.VIII, Art.14.4). This requirement assumes that the information necessary to make this assessment is available for the relevant types of floods in a given area. Although general results regarding expected changes in annual temperature and precipitation and in global sea level have been available for several years (*e.g.* IPCC, 2001; 2007), such results are usually unsuitable for direct application in flood risk management. This is due both to the lack of spatial detail in these projections and to the need for further analyses to interpret changes in variables relevant to flood hazards (*e.g.* regional changes in extreme precipitation, local changes in peak river discharges).

As part of the EU Interreg IVB SAWA project, the Norwegian Water Resources and Energy Directorate (NVE), the Swedish Meteorological and Hydrological Institute (SMHI) and the Norwegian Meteorological Institute (met.no) have undertaken work quantifying expected changes in hydrological flooding and in extreme precipitation under a future climate for use in flood risk management. In addition, three SAWA partners from the Netherlands (Waterboard Hunze en Aa's, Provincie Flevoland, Waterboard Noorderzijlvest) have provided information as to how climate change impacts have been or will be taken into account in ongoing work in The Netherlands.

A SAWA report called “*Climate change impacts and uncertainties in flood risk management: Examples from the North Sea Region*” summarizes the methods and results from these studies and presents examples illustrating how results are being used in practice. A general overview of climate change and flood risk management in each of the five SAWA countries (Germany, the Netherlands, Norway, Sweden and the UK) was also previously presented at the SAWA



Midterm Conference in Gothenburg (Lawrence and Graham, 2010) as a deliverable to SAWA Working Group 1.

The mentioned report is organized into sections which describe:

- Projected changes in climate and related factors which may impact flood hazard (Section 2);
- Methods for analyzing likely changes in factors contributing to flooding, including ensemble methodology, hydrological modelling, flood frequency analysis, design flood estimation, and extreme value analysis of short-duration rainfall (Section 3);
- Climate projection data, including the global and regional climate model projections represented in the ensemble of models, and techniques for local adjustment of the data for use in local-scale modelling (Section 4);
- Results of climate impact analyses, including projected changes in flood magnitudes and seasonality and their uncertainties, expected changes in extreme precipitation at selected locations, and impacts on other water management issues (Section 5);
- Examples of methods and strategies for communicating the results of climate impact analyses related to flooding and water management (Section 6).

Each section is organized so as to highlight aspects of SAWA project work related to climate change and flood management in the three countries contributing to this report, *i.e.* Norway, Sweden and The Netherlands.

For further information please use this link: [http://www.sawa-](http://www.sawa-project.eu/uploads/documents/Climate%20change%20impacts%20and%20uncertainties.pdf)

[project.eu/uploads/documents/Climate%20change%20impacts%20and%20uncertainties.pdf](http://www.sawa-project.eu/uploads/documents/Climate%20change%20impacts%20and%20uncertainties.pdf)

#### **1.5.1.2 Process of developing a flood risk management plan**

In the context of the SAWA project, a governance concept (concept for stakeholder involvement) has been sought which best fits the national context and given problems in the area. Although participatory planning is not a novel issue in water management, few examples of good practice are yet available on efficient methods for developing FRMP and theoretical guidance is developing rather slowly. An important experience has been gained in the implementation process of the EU Water Framework Directive (EC-WFD) leading to innovative strategies and new knowledge about the more efficient involvement of stakeholder groups in the planning process (Pahl-Wostl et al, 2008). Further EU based research within the ERANET CRUE and FP6 initiatives has focused on stakeholder involvement in flood risk management (Pasche et al, 2008, Samuel et al, 2008).

There are different levels and ways of stakeholder participation. The simplest way of classifying the level of participation differs between a top-down and a bottom-up approach. In the first case the plan is developed by professionals. The public's opinion and input is only requested through public hearings and written objections at the end of the approval process. According to Article 10 (1) this scope of public participation is in line with the 2007/69/EC. But Article 10 (2) encourages seeking the active involvement of stakeholders in the whole planning process. More active public involvement can be achieved by employing the bottom-up approach. Here all stakeholders, professionals and public, are involved right from the start and together they develop the plan in a continuous collaborative process.

A more differentiated approach defines different levels of participations of the stakeholder groups including “non professionals”. In that sense, the concept of the “participation ladder” has been introduced by several authors (e.g. Arnstein, 1971, Row & Fewe, 2005, WMO, 2005). The method used by WMO, 2005 is depicted in Figure 6.

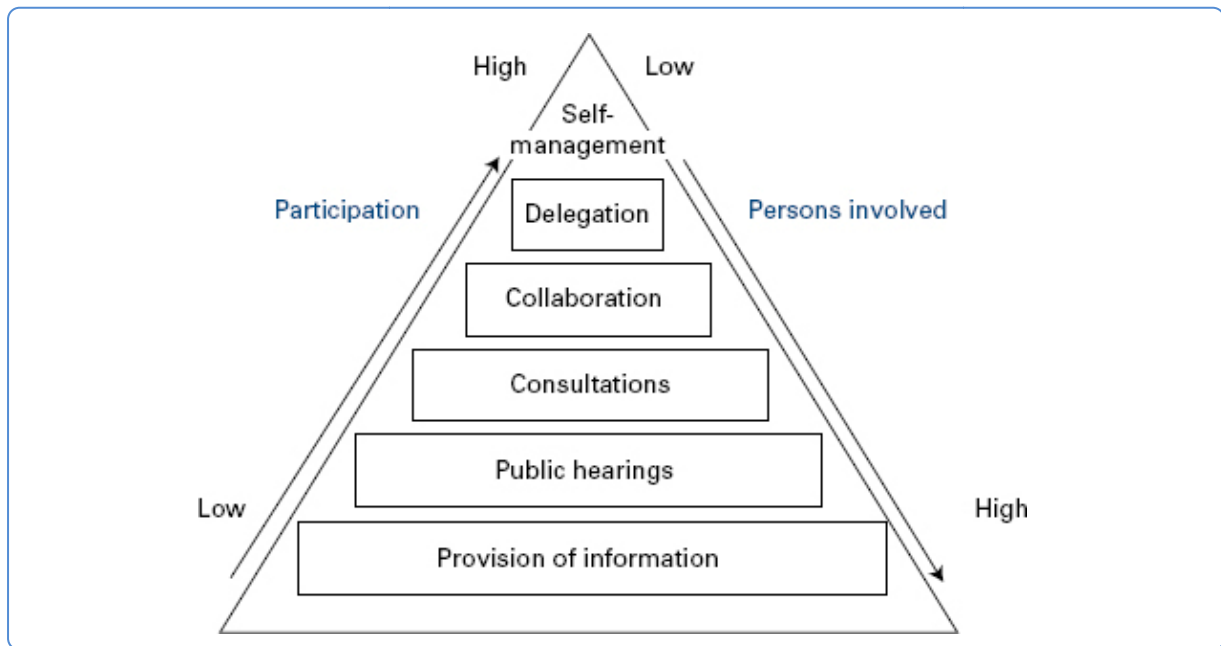


Figure 6: Levels of stakeholder participation (WMO, 2005)

The greater the extent of participation and control over decisions, the fewer the numbers of stakeholder representatives that are engaged in the process. Surpassing simply the provision of the information, the next participatory level, public hearings, requires more interaction with the public and dwellers, as their feedback is sought in the decision making process. Consultations mean engaging stakeholders in a dialogue. A step further is made through collaboration with the stakeholders, meaning that different groups come together with the authorities to share, negotiate and control the decision-making process. Delegation involves joint decision-making. Here stakeholder involvement is intensive, but is carried out through the representatives. Under self-management, the community or individual makes its own decisions (WMO, 2005).

Which level of participation will be adopted depends on the given social, political and legal conditions relevant for the planning area and the goal for the participatory approach.

Another possibility of selecting an appropriate method is to look at the theoretical guidelines of flood risk management planning at the international or national level. Although their availability is rather low, a few national documents and initiatives can be identified aimed at providing guidelines for development of FRMP plans. Out of the partner countries, such a document has been already put in practice in Germany in March 2010.

Document “Recommendations for development of FRMP”, by the German Working Group on water issues of the Federal States and the Federal Government- LAWA, 2010 has been published and is considered by the federal states as a reference document. Within the document, LAWA recommends the structure of the process and relates the steps to the

corresponding requirements of the 2007/60/EC. A streamlined process describing the development of FRMP defined by LAWA, 2010 is given in Figure 7.

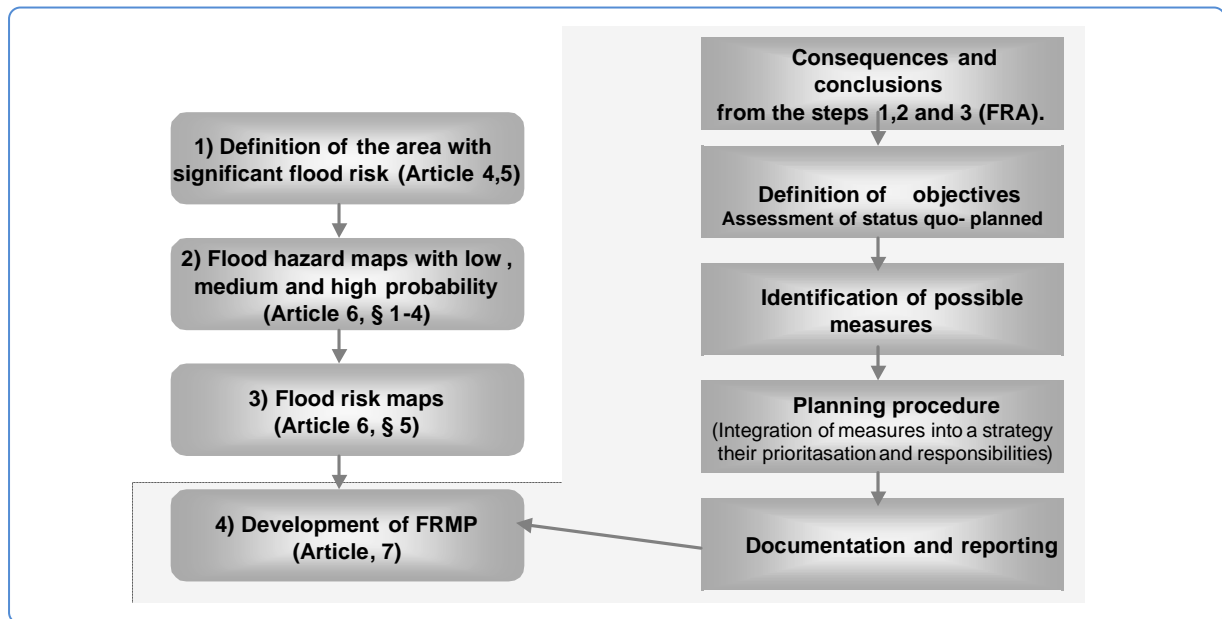


Figure 7: Development of FRMP (LAWA, 2010) (translated from German)

This flowchart is to be considered as a recommendation. Apart from giving the generic concept on how to develop FRMPs, the document outlines the measures to be considered as well as the structure of the final document- FRMP. The LAWA Recommendation Document is currently being used by a range of responsible authorities in Germany for developing FRMPs. Having the same document as a baseline enables comparison and exchange of experience among the federal states and municipalities.

At the beginning of SAWA this document was still in preparation and could not be used as a reference document. Still, during the course of planning in German pilot regions, some aspects have been considered and will be presented in Chapter 4. Currently, there are not any published documents at the national level in the other partner countries, but they are expected in the next years (e.g. Sweden).

#### **1.5.1.2.1 Flood Risk Assessment**

*Article 4, paragraph 1<sup>2</sup> of the Floods Directive (FD) states: “Member States shall, for each river basin district, or unit of management referred to in Article 3(2)(b), or the portion of an international river basin district lying within their territory, undertake a preliminary flood risk assessment in accordance with paragraph 2 of this Article.”*

The purpose of the preliminary flood risk assessment is to get a good overview of within which areas the risks for and consequences of floods are the greatest within a country. The assessment should be based on information about historical events, predicted possible future

<sup>2</sup> Taken from Directive 2007/60/EC on the assessment and management of flood risks

events (information about changed conditions due to climate change is crucial) and the consequences' for population, economic activity and cultural heritage. Further analysis will be made within areas that are pointed out as particularly vulnerable.

### ***Availability of flood hazard and flood risk maps in the SAWA pilot regions***

Flood risk assessment is a necessary step of flood risk management planning. However, as SAWA started before they different availability of flood hazard and risk maps can be assessed in the partner regions before and during the course of SAWA.

Forced by national law the City of Hamburg and the state of Lower Saxony (*Germany*) have begun with the development of flood risk maps before the start of SAWA. The maps used as a basis for the development of FRMP- Wandse together with the methodology for their development are given in Golder, 2009. However, during the course of SAWA, the national guidelines LAWA have been released which had an influence on the layout and contents of flood risk maps. Instead of showing the economic impact on flood risk maps and defining the risk zones depending on it, it is now required to indicate the exposed elements, without giving any hint on the economic impact.

In *Sweden*, the flood hazard and risk maps have been developed during the course of SAWA.

In *Norway*, the preliminary flood risk assessment has been performed during the course of SAWA. The main results are given in the separate report. Flood hazard maps have been produced in 2002.

The *Dutch* case study area had the flood maps available prior to SAWA. An overview of the available maps is given in SAWA WP1 Final Report/ Appendix C.

It should be mentioned that meanwhile some European countries published guidelines on Preliminary Flood Risk Assessment such as the one from the *UK* <http://publications.environment-agency.gov.uk/PDF/GEHO1210BTGH-E-E.pdf> or *Sweden* [https://msb.se/Upload/Nyheter\\_press/Pressmeddelanden/Slutrapport\\_PFRA\\_MSB.pdf](https://msb.se/Upload/Nyheter_press/Pressmeddelanden/Slutrapport_PFRA_MSB.pdf).

### ***Conclusions and recommendations***

- It is important to remember the limitations in the flood and risk maps. There are big uncertainties regarding how water is transported in pipe systems, which might create flooding in “safe” low land areas relatively far from the river/lake. The duration of a lake flooding is long and will most likely rise the ground water level considerably, especially in areas built on sand/gravel material. A high ground water level will create problems with technical systems underground long before the water reaches the surface. Therefore the presentation of maps is important. The material should be sufficiently detailed so that different parts of the city and its features are easily identifiable, but, at the same time, not so detailed as to misrepresent the state of knowledge to the viewer.

- It's important to thoroughly describe the nature of the flood in a particular area and the nature of the area flooded in order to decide upon relevant risk reduction measures.
- It is important to compare measures at different scales. There are times when one measure at the regional scale could replace several local measures.
- Choice of hydrological scenarios when producing flood and risk maps seems to be more or less comparable between the North European countries that participate in SAWA (Germany, Netherlands, Norway and Sweden)
- There are however differences in strategies when considering climate change and when not to. In the SAWA-pilots only Norway and Sweden have taken climate change into consideration when producing flood- and risk maps. The method used is called ensemble analysis, which means using the output of several different global climate models. The variation between the results gives a hint of the uncertainty in the results. The method and results are thoroughly discussed in the SAWA-report Climate change impacts and uncertainties: Examples from Norway, Sweden and the Netherlands, published by NVE and SMHI.




For much more detailed information please read SAWA WP1-1 final report: <http://www.sawa-project.eu/uploads/documents/>

#### ***1.5.1.2.2 Participatory processes***

The process of flood risk management planning involves expertise from different fields involving a range of tools. In order to perform efficient planning and process design, a coordination of activities is required. Apart from the responsible authority, a contribution from the research institutions and consultancy is important in order to design and conduct the planning process. A general overview of the activities to be carried out in a coordinated manner are summarised in Table 1. The first stream covers the activities to be performed by the responsible authority. They are mostly related to implementation and operation the planning process as well as to the decision-making process. The second one deals with the development of the tools and instruments to support the participatory planning procedure and the third one focuses on consultancy support which is needed in the planning process e.g. development of simulation models, hydraulic design and planning of site specific measures out of the group of FReM and FPRM, and their integration in thematic plans of river restoration, urban drainage and urban development.

Within SAWA, all three groups of partners have been participated in the planning process. Depending on the selected method for stakeholder involvement, specific problems in the area and available data and resources different activated listed in Table 1: Main contributions from key parties involved in design and conduction of the process assessed within SAWA have been carried out in different pilot regions. A detailed description of the activities is given in chapter 4, together with the descriptions of SAWA flood risk management plans.

Table 1: Main contributions from key parties involved in design and conduction of the process assessed within SAWA

<b>Responsible authority (Decision Makers)</b> 	<b>Research</b> 	<b>Consultancy</b> 
<ul style="list-style-type: none"> <li>- Coordination of approval of flood hazard and risk maps</li> </ul>		<ul style="list-style-type: none"> <li>- Setting up mathematical models of the water system under consideration (rainfall-runoff, hydraulic and damage model),</li> <li>- Development of flood risk maps</li> </ul>
<ul style="list-style-type: none"> <li>- Selection of relevant stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>- Guidance document for stakeholder selection,</li> <li>- Learning material for social competence building</li> </ul>	
<ul style="list-style-type: none"> <li>- Raising flood awareness</li> </ul>	<ul style="list-style-type: none"> <li>- Development of methods for raising risk awareness</li> <li>- Supporting the capacity building process by lectures, presentations</li> </ul>	
<ul style="list-style-type: none"> <li>- Capacity building in risk management and NSM</li> <li>- Definition of the planning objective considering the aspect of climate change</li> </ul>	<ul style="list-style-type: none"> <li>- Learning material for capacity building in flood risk management</li> <li>- Supporting the capacity building process by lectures, presentations</li> <li>- Inventory of best practice of adaptive measures (NSM)</li> <li>- Methodology and tools for modelling of the climate change impacts</li> </ul>	
<ul style="list-style-type: none"> <li>- Active planning at the catchment level</li> <li>- Discussion on different planning options based on NSM</li> <li>- Exploring the hitch-hiking options with RBMP</li> </ul>	<ul style="list-style-type: none"> <li>- Development of corresponding Decision Support Tools for the efficiency assessment of the measures</li> </ul>	<ul style="list-style-type: none"> <li>- Designing NSM on a local level,</li> <li>- Integrating single measures to alternatives plans on urban drainage, river restoration and urban development</li> </ul>
<ul style="list-style-type: none"> <li>- Agreement CBA and MCA approach and assessment parameters</li> <li>- Assessment of alternatives by decision support system</li> <li>- Minimization of conflicts and adoption of the final plan</li> </ul>	<ul style="list-style-type: none"> <li>- Development of cost benefit assessment methods and tools</li> <li>- Development of assessment matrix for MCA</li> <li>- Development of methods for conflict minimisation and adoption of the final plan</li> </ul>	<ul style="list-style-type: none"> <li>- Moderation of the process of finding the final option</li> </ul>

#### ***1.5.1.2.3 Decision Support***

Successful participatory planning requires understanding the interactive structure of the components contributing to flood risk. This includes in urban river basins the understanding of the dominating hydrological processes, the impact of anthropogenic changes on the flood risk and its feedback with the socio-economic situation. Due to the complexity of these processes and system functions, instruments are needed in the decision process, which give stakeholders the possibility to define and test scenarios and study the impact on the hydrological and socio-economic system.

EC/2007/60 addresses several aspects where the decision making process is required:

1. combination of measures tailored to the specific characteristics of the river basin and flood typology
2. evaluation of the measures or combination of measures in terms of their cost benefit performance, or in the wider sense multi criteria analysis considering issues such as ecological or social impacts.

Due to the complexity of these processes and system functions, instruments are needed in the decision process, which give stakeholders the possibility to easily to define and test different planning options and study the impact on the hydrological and socio-economic system.

Decision support systems are given as computer models in which a non-expert gets the possibility to analyse complex problems and to find appropriate solutions (Hahn/Engelen, 2000). They range from simple assessment tools to complex systems in which scenarios of different solutions can be easily generated, their efficiency quantified by mathematical models and via a multi-criteria analysis preferences generated. In all cases, the user is the centre of the system and determines the capabilities of the system. Within SAWA different tools have been applied in terms of their scales, targeted users, the aspects of the flood risk management cycle they are addressing or technologies applied.

A description of DSS applied or developed within SAWA as well as according links and/ or additional information brochures are offered via internet at <http://www.iwawaterwiki.org/xwiki/bin/view/Articles/DecisionSupportTools>.

Their application in pilot regions is outlined in SAWA WP1 Final Report / chapter 4 (<http://www.sawa-project.eu/uploads/documents/>) together with the corresponding planning process they were supporting. SAWA DSS tools for planning and operational purposes are also presented in IWA Water Wiki.

#### ***1.5.1.2.4 Flood Risk Management Plans***

Based on the preliminary flood risk assessment and the flood risk maps, ***flood risk management plans (FRMP)*** has to be developed on the level of the river basin district for river basins, sub-basins and stretches of coastline. The Flood Directive EC 2007/60 specifies very clearly the requirements and objectives of the flood risk management plan and the favourable mitigation measures to be taken for reducing the risk. FRMPs should address the whole cycle of flood risk management focusing on prevention, protection and preparedness

and taking into account all relevant aspects, such as the cost effectiveness of the corresponding measures, environmental aspects or other planning activities in the area. The main requirements relevant for the development of FRMPs are given in the Article 7(1),(2),(3) of 2007/60/EC:

(Article 7 (1)): [On the basis of the maps referred to in Article 6, Member States shall establish flood risk management plans coordinated at the level of the river basin district, or unit of management referred to in Article 3(2)(b), for the areas identified under Article 5(1) and the areas covered by Article 13(1)(b) in accordance with paragraphs 2 and 3 of this Article].

(Article 7 (2)): [Flood risk management plans shall address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems and taking into account the characteristics of the particular river basin or sub-basin.]

(Article 7 (3)): Flood risk management plans shall take into account relevant aspects such as costs and benefits, flood extent and flood conveyance routes and areas which have the potential to retain flood water, such as natural floodplains, the environmental objectives of Article 4 of Directive 2000/60/EC, soil and water management, spatial planning, land use, nature conservation, navigation and port infrastructure.]

2007/60/EC also sets requirements on the content of a FRMP. A FRMP should encompass results from preliminary risk assessment and the produced flood risk maps as well as the conclusion derived from them. The adopted measures for the defined protection level should be described and prioritised. Here the activities and measures adopted within other directives and frameworks (e.g. Water Framework Directive-2000/60/EC) should be considered. If available, the methodology for a cost benefit analysis should be described. The main elements of FRMP as given in 2007/60/EC are summarised in Table 2: Contents of FRMP according to 2007/60/EC.

Table 2: Contents of FRMP according to 2007/60/EC

The conclusions of the preliminary flood risk assessment
Flood risk maps and the conclusions that can be drawn from those maps
A description of the appropriate objectives (level of protection
A description of the measures required to achieve the appropriate levels of protection
A prioritisation of the measures that promote the objectives laid down in the EU Water Framework Directive (2000/60/EC)
If available, methodology for cost benefit analysis should be described
A description of the coordination process within any international river basin district and of the coordination process with the EC Water Framework Directive.
A description of the public information and consultation measures/actions taken



Even if the objectives and general requirements are clearly stated in 007/60/EC, little information is given about the strategy to develop and implement FRMP on a local level.

Obvious is the need for finding a good governance<sup>3</sup> concept which is supporting the implementation process best and which will lead to acceptance and proper application of the new paradigm in flood risk management. A fundamental issue that is to be resolved is how the necessary stakeholder participation in the decision-making process can be carried out cost-effectively and in a timely manner so that the results are not technically but also socially acceptable. The Flood Directive EC 2007/60 does not give any guidance in developing such a governance concept for the implementation of the flood risk management plan. It only requires the participation of the public (Article 10 (2)) in the development and implementation process. (Article 10 (2)): [Member States shall encourage active involvement of interested parties in the production, review and updating of the flood risk management plans referred to in Chapter IV.]

Flood Risk Management Plans in the sense of 2007/60/EC have been developed for the following SAWA pilot regions:













-  FRMP Wandse, catchment of River Alster in Hamburg, GER, urban area
-  RBMP catchment of River Illmenau in Lower-Saxony, GER; rural area
-  FRMP water systems of Lake Värnen/Göta älv for the cities of Lindköping and Karlstad, SWE; urban area
-  FRMP catchment of River Gaula, NOR, rural area
-  FRMP catchment of River Tana, NOR, rural area (Cross border)
-  FRMP region Hunze en Aa's, NL, rural area









Figure 8: Overview on the planning areas

<sup>3</sup> In this report, "governance" is defined in general as the process of decision-making and the process by which decisions are implemented (UN – Economic and social commission of Asia and the Pacific). It is more a general road map to progress rather than being a well-defined destination to reach. Good governance stands for a multifaceted decision making process where the societal goals are pursued with the interactions of all the interested actors in all specific fields of development and in which ethical and democratic issues are respected, such as responsibility, accountability, transparency, equity, and fairness. This process requires promotion of dialogues in terms of decision-making, and participation of multiple actors.

Table 3 Summary of the main characteristics of the SAWA planning areas

Area	Planning area	Flood Type	Area at risk	Physiography & Landuse	Flood-Runoff [m³/s]
 Wandse	81,6 km² Two main rivers	Pluvial/Riverine	Small parts of the city	Low lands, Upstream- rural, downstream- urban	HQ100 = 15,70 m³/s HQ200 = 17,10 m³/s
 Illmenau	2984 km²	Flashfloods, backwater effect tidal infl	Identified as area with significant F.R	Upper- flat marsh land Mid- hills and valleys Lower- urban area	
 Gaula	3 566 km² One main river	Riverine, snowmelt, landslide	City of Melhus, farms, infrastructure	Mountainous, Farming, river training Forestry	HQ100 =2533 m³/s HQ200 =2829 m³/s
 Tana	16380 km²	Riverine Ice jams	Small communities along the river 8rather sparsely populated area)	Mountainous Mostly agricultural, Sami ethnic herritage	
 Vänern Klarälven	50230 km² Several large rivers (Klarälven and Göta)	Lake, landslides, riverine	2 mayor cities flooded Lidköping Karlstad and several smaller communities	Mountainous, steep and long catchment	HQ100 = 1490 m³/s
 Hunze en Aa's	<b>Various small catchments 2000 km² (6)</b>	Riverine	Mainly rural area	flat, low lands	

Area	Type of Stakeholder Involvement	Stakeholders addressed	Definition of objectives	Final Product and Legitimacy of the plan
 Wandse	Bottom up LAA: workshops, online, on site	Snowballed process: professional and private in the Wandsbek district	a matter of discussion (social acceptance) rather than modelling result 200 year flood as a basis	A list of 26 measures given as a document (LAWA, 2010) and map - Recommendation
 Illmenau	Bottom up - Workshops, meetings, interviews	Affected counties Lüneburg, Uelzen, Harburg		- Illmenau Atlas - Recommendation
 Gaula	Top down	employees at the municipality	Best practice recommendations for implementation of the FD at a regional level	- documents with a reference to hazard maps, and summary tables In total, 50 measures, divided into seven categories - pilot study
 Tana	Top down	- Professional stakeholders - Karasjok municipality and the Sami Parliament	Best practice recommendations for implementation of the FD at a regional level	- Enhancement of the 4P management cycle, focus on raising risk awareness - Pilot study
 Vänern Klarälven	“Top down” 2 step approach 4 workshops	1. step: local municipality 2 step: further affected professional stakeholders(e.g. transportation utilities)	- varying the water level in the lake - it is a trade off and should be discussed with the group	- A list of technical and planning NSM - pilot study but served as a catalisator for further activities
 Hunze en Aa's	Different level of participation Participation ladder	Professional and private	- CBA as a basis	- 6 plans (list of measures with costs and maps) - included in the official policy plan “Waterbeheersplan 2010-15

### ***1.5.1.2.5 Recommendations for Future Work***

#### ***Responsible authorities***



The following issues have been assessed as important for future activities of the responsible authority:

- Integration of the planning activities on a local scale into flood risk management planning on larger scales. The developed plans within SAWA addressed a specific location or area and it has been beyond the SAWA project to address the integration aspect. An exchange with the responsible authorities in adjacent areas or larger catchment units is required.
- It is to acknowledge that the quality of the decision making options as well as efficiency and effectiveness assessment is very much dependant on the data quality. Therefore, for reliable results and adequate decision support basis, a good quality data as well as flood hazard and risk maps are to be provided by the responsible authorities. Some of the data are crossing administrative borders and their management has to be optimised within the responsible authorities. The deficiency assessed during the SAWA Project in pilot regions in terms of data quality and availability (e.g. in Sweden, Lower Saxony) call for further improvements and should be addressed before the future planning process within the responsible authorities

#### ***Research***



The research should mainly focus on the further development of the methods and tools given as:

- The governance methods that consider local scale planning into the planning at the larger scales are still matter of research
- Within SAWA the aspect of climate change has been addressed, however the partners dealt with the issue differently. In general, the methods to integrate the climate change aspect in the plans need further research. The methods used in Sweden and Norway to include safety margins in flood hazard maps can be a first step to it.
- Decision support tools applied contributed to having a better insight into the problems and giving the overview of the main options to be undertaken with the impact to flood risk. Still there is a room for improvement of the applied tools mostly related to the following issues:
  - o Improvements of the physical models of the processes described
  - o More user friendly of the interfaces and tools in general (easier to use, less time intensive)
- Although assessed as useful and important, there are till a few tools for raising risk awareness and capacity building actively included in the planning process. Within SAWA e lectures and
- As flood risk management planning is still a new process the appropriate evaluation methods are a matter of research
- Together with the consultancy and responsible authorities, the contents of FRMP and layout of the corresponding maps is to be discussed and further improved. In case national initiatives or guidelines exist (e.g. in Germany- LAWA, 2010), the feedback can be given and coordinated with the other planning activities in the German catchments.

## ***Consultancy***



The main role of consultancy, where further work is needed is related to acceptance and utilisation of new tools and methods, mainly DSS or mathematical models being:

- Acceptance and utilisation of new methods and tools for the efficiency assessment of different measures (e.g. SUDS). The tools developed and using within SAWA, a though important for decision making, require experts to run them (e.g. Kalypso- Planner Client applied in Hamburg) or facilitate their application (CBA tool applied in Sweden)

Still, the efficient planning is seen in cooperation between those three groups, with the general distribution of tasks as given in Table 1. The contribution of single parties for a given case can vary depending on the scale, planning phase or.

### **1.5.1.3 Contingency plans**

In completion to the risk management cycle of risk identification, prevention & mitigation, preparation, response and recovery phase SAWA did also consider contingency planning aspects as knowledge and an active contingency planning are key factors for a successful crisis management.

SAWA produced two different Contingency plans.

The first one is called “Exercise Large Land Slide”. The same called report summarizes the test and evaluation results of the alarm plan for high water levels in the Göta River in west Sweden.

The second one is presented by a report called “Flooding and Agriculture – How do I protect my farm?”

### ***Exercise Large Land Slide***

The County administrative board of Västra Götaland has together with other key organisations in west Sweden identified the need of capacity building within the issue land stability. Large landslides that moves into water can result in extreme flooding events by creating large flood waves transplanted down streams the river. If a river is blocked by soil masses the river will sooner or later break through the temporary dam, the scenario can be either slow or explosive depending on factors like water velocity, geography, type of masses etc. Knowledge and an active contingency planning are key factors for a successful crisis management. In order to raise the preparedness for landslide events the exercise large landslide was planned and performed in October 2011. The exercise was planned by the County administrative board of västra Götaland together with the Swedish geotechnical institute (SGI). In total 20 organizations took part in the exercise including preparations and the subsequent discussions about lessons learned.

There are stability problems in the Göta River valley and it has occurred at least 15 major landslides in the Göta River (and tributaries) between the years 1150 and 1996. The earliest

documented landslide occurred about the year 1150 on the river's east side in Bohus. The question is not if but when the next event will occur. One result of a large landslide might be damage to one of the large hydro power dams in the river with a dam breach as a result. A dam breach will have negative consequences down streams the river. If there is a dam failure, there will not be a lot of time for planning rescue operations. In order to minor the time consumed by trying to communicate all important stake holders in such an event the alarm plan Göta älv was developed. One primary objective of the exercise was therefore to test and evaluate the efficiency if this plan. The result of the exercise shows that alarm Plan Göta River has not been sufficiently updated, despite the planned exercise. The problem illustrates the difficulties that always seem to appear to hold important document fully updated. Other interesting experiences from the exercise were:

- A majority of the organizations felt that it was difficult to stay sufficiently informed and updated on the development of events.
- Some key organizations were difficult to get in touch with, despite the thorough planning of the exercise.
- It took too long to reach decisions in relation to the brief time respite that is in a similar situation.

All participating organizations were however content with how the exercise was planned and felt that they had a good opportunity to test their respective emergency plans.

The country of Norway faces the same problems with landslides as in the west part of Sweden. Another similarity is that many of the Norwegian water systems contain large hydro power dams. In order to get inspiration and knowledge about how they work with raising the preparedness of these issues the Norwegian Water Resources and Energy Directorate (NVE) was invited to present their organisation and contingency work. Loose discussions were also held regarding possibilities of further cooperation between the both countries regarding exchange of personal or material recourses in case of a large crisis. There are currently no such cooperation. However, there is a long tradition of cooperation between the two countries in many fields of work. There are many indications, therefore, that a work would be relatively easy to establish if the need arises. NVEs participation in the exercise is part of the SAWA project's transnational work on preparedness for floods.

More detailed information can be found in the respective report. Please find it here <http://www.sawa-project.eu/index.php?page=documents>.

### ***Flooding and Agriculture – How do I protect my farm?***

In case of an emergency, farmers who are affected have little time to take effective action and protect the farm and livestock from floods, as well as to take measures to prevent the escape of contaminating materials. The mentioned report produced by the Chamber of Agriculture Lower Saxony is made to support farmers who may be affected by identifying the risks to which they are exposed, and by indicating the possible courses of protective action, to minimize potential damage to agricultural enterprises and the environment. This brochure is not intended as a comprehensive handbook on agricultural flood protection in the case of acute risk but should rather be seen as a call to self-responsibility for all concerned.

The brochure offers information on:

- Information services flood and flood protection
- Protection measures for house, farm and agricultural areas
- Emergency planning, equipment and evacuation procedures
- After the flood

Up-to-date information on flood levels is available from the website of the water and coastal protection agency NLWKN ([www.nlwkn.de](http://www.nlwkn.de) - click on Aktuelles > Warndienste/ Messwerte) [1 3] as well as from the local news services, TV and radio. As there may be a power cut in the event of a flood, battery-operated radio receivers and a supply of replacement batteries should be kept available. For current information on high water levels of the river Elbe, farmers can register with the Chamber of Agriculture for a flood warning per email via [www.lwk-niedersachsen.de](http://www.lwk-niedersachsen.de). A lot of useful information about protecting residential buildings can be found in the flood protection handbook of the Federal Ministry for Transport, Building and Urban Development under [www.bmvbs.de](http://www.bmvbs.de) (click on Start > Service > Publikationen > Hochwasserschutzfibel) [5].

#### 1.5.1.4 Overview on reports produced in Key Area A

##### 1.5.1.4.1 Transnational Level

March 2012: **SAWA Report WP1-1** "Adaptive Flood Risk Management Planning: Experience from the SAWA Pilot regions"; Lead authors: N. Manojlovic<sup>1</sup>, S. Hodgins<sup>2</sup>, J. Manheimer<sup>3</sup>, O. S. Waagø<sup>4</sup>, E. Annamo<sup>4</sup> M. Evers<sup>5</sup>, J. van den Besten<sup>6</sup>, Erik Pasche<sup>†1</sup>

#### FLOOD RISK ASSESSMENT

2012: "Preliminary Flood Risk Assessment in Norway", Published by: Norwegian Water Resources and Energy Directorate (NVE); Authors: Ivar. O. Peereboom, Oddrun S. Waagø, Marianne Myhre, Report no. 7/2011. ISSN: 1502-3540 ISBN: 978-82-410-0747-7

2010-02-25: „Flood and Risk Mapping under the Floods Directive – Scenarios in Lidköping and Karlstad”, Published by: Länsstyrelsen i Västra Götalands län (County administration of Västra Götaland); Author: Susanna Hogdin; Co-Authors: Johan Mannheimer, Länsstyrelsen i Värmlands län (County administration of Värmland) Jonas Andersson, Länsstyrelsen i Västra Götalands län (County administration of Västra Götaland) Frida Björckman, Security strategist, Lidköping Municipality Jan-Olov Moberg, Floods coordinator, Karlstad Municipality Barbara Blumenthal, Karlstad University Barbro Näslund-Landenmark, MSB (Swedish civil contingencies agency); Report number: 2010:69 ([www.lansstyrelsen.se/vastragotaland/Sv/Publikationer](http://www.lansstyrelsen.se/vastragotaland/Sv/Publikationer))

#### CLIMATE CHANGE

2012: **SAWA Report WP1-2** „Climate change impacts and uncertainties in flood risk management: Examples from the North Sea Region”; Report no. 05 – 2012; Published by: Norwegian Water Resources and Energy Directorate; Lead authors: D. Lawrence, Norwegian Water Resources and Energy Directorate; L. P. Graham, Swedish Meteorological and Hydrological Institute; J. den Besten, Waterboard Hunze en Aa's, The Netherlands; ISBN: 978-82-410-0783-5

#### DSS TOOLS

##### Technical Memorandum DSS

2012-02-15: "Collocation of experiences with SGI matrix based decision support tool (MDST) within SAWA"; Swedish Geotechnical Institute, SGI Varia 627; Author: Yvonne Andersson-Sköld

2010-08-19: Waterstorage Game Theory Main Report - A description of the redevelopment process 'the Onlanden' and a research towards the game theory for policy strategy and planning. Published by: Water board Noorderzijlvest. Authors: Mr. Jan Gooijer Mr. Christiaan Jacobs, Mr. Kees de Jong; Mathieu P.J. van Vrijberghe de Coningh

#### CONTINGENCY PLANS

2012-02-01: "Exercise large land slide, Test and evaluation of the alarm plan for high water levels in the Göta River in west Sweden"; Authors: Susanna Hogdin, County administrative Board of Västra Götaland (SWE); Knut Sörgeard, Norwegian Water Resources and Energy Directorate (NOR)



2011- 09: „Flooding and Agriculture – How do I protect my farm?“, Published by Landwirtschaftskammer Niedersachsen, Bezirksstelle Uelzen, Fachgruppe „Nachhaltige Landnutzung und Ländliche Entwicklung“; Authors: Monika von Haaren, Enno Eiben, Imke Mersch, Katrin Castelein

#### ***1.5.1.4.2 National Level***

### **FLOOD RISK MANAGEMENT**

2011: “Endbericht zum SAWA Ilmenau Projekt: Integratives Flussgebiets Management. Synergien und Zielräume im Einzugsgebiet der Ilmenau”; Autors: Mariele Evers. Monika Tischbierek . JM . PA . Leuphana Universität Lüneburg; ISBN 978-3-935786-54-6

2012: Waagø, O. S. Flomriskoplan for Gaula ved Melhus. Et eksempel på en flomriskoplan etter EUs flomdirektiv (Flood risk management plan for river Gaula at Melhus. An example of a FRMP according to EUs floods directive, in Norwegian). NVE-report 8/2012; 60 pages.  
<http://www.sawa-project.eu/uploads/documents/rapport8-12.pdf>.

Annamo, E. (2012). Challenges in flood risk management planning. An example of a flood risk management plan for the Finnish-Norwegian River Tana. NVE-report 16/2012; 39 pages + appendixes, in press.

### **CLIMATE CHANGE**

2011-2012: Norwegian Ministry of Oil and Energy Stortingsmelding nr. 15.Hvordan leve med farene – om flom og skred (How to live with natural hazards – floods and landslides). White paper that includes results on climate change from SAWA report made by D. Lawrence (e.g., page 18, figure 3.7 on future floods):  
<http://www.regjeringen.no/pages/37614562/PDFS/STM201120120015000DDDPDFS.pdf>

2012: “Climate change and agriculture in Flevoland” report finished. Entry to be supplemented

### **DSS TOOLS**

2012-02: „DSS Flooding - Waterschap Hunze en Aa’s“; Author: Jan den Besten;

2012-04: “SAWA Activities at Heriot-Watt University – Urban Flood Risk Management“; Editor: Heriot-Watt University; Author: Dr Scott Arthur.

2009-11: Report on Game Theory Approach - Meaningful Stakeholder Engagement. Published in Conference Proceedings - Peer Reviewed: Unwin, D., & Arthur, S. (2009), A Proposal to use Game Theory to Enhance Stakeholder Engagement in the Formulation of Catchment Flood Risk Management Plans, Proceedings of the final conference of COST action C22 Urban Flood Management, Paris, France. 25th - 27th November 2009.

2011-07: Report no. 7/2011; Preliminary Flood Risk Assessment in Norway; Published by: Norwegian Water Resources and Energy Directorate (NVE); Authors: Ivar. O. Peereboom, Oddrun S. Waagø, Marianne Myhre

### **CONTINGENCY PLANS**

2011-09: ”Flooding and Agriculture – how do I protect my farm?” Editor: Landwirtschaftskammer Niedersachsen, Bezirksstelle Uelzen, Fachgruppe „Nachhaltige Landnutzung und Ländliche Entwicklung“; Editorial staff: Monika von Haaren, Enno Eiben, Imke Mersch, Katrin Castelein; Layout: Sarah Lühmann; Uelzen

### **1.5.2 Key Area B: Adaptive Measures (WP2)**

In order to support the change in paradigm from large scale mitigation measures to more adaptive local scale measures, SAWA is offering a holistic appraisal of adaptive measures so that they may be objectively considered by flood risk managers and planners. To achieve this, a transnational interdisciplinary team of experts, practitioners and scientists formed a solid foundation.

#### **1.5.2.1 Concept and realization of SAWA Expert Database**

This team of experts, practitioners and scientists can be contacted via SAWA Database of regional and transnational experts. Our SAWA expert database is connected to SAWA website via web-interface (<http://experts.sawa-project.eu/>). Access is open to the public. The appropriate contact person(s) can be selected by name, organization, country, project or keyword. An optional description offers additional information on the person's qualifications.

The database query is supported by search functions whereas the respective results are listed below.

A report on SAWA Experts Database is provided at SAWA website. Please visit our website to get more detailed information: <http://www.sawa-project.eu/index.php?page=documents>.

#### **1.5.2.2 Concept and realization of SAWA Database on Adaptive Measures**

Upon that the remainder of SAWA has been based by constructing a partly case-based-reasoning (CBR) decision support database for adaptive flood protection measures covering a wide range of scales from individual properties to whole developments. This database is organized in IWA Water WIKI. After building a network of experts within SAWA, a number of relevant case studies on an EU wide level have been identified. Each case study will serve as reference for the development of new adaptive measures and became integral part of the database. An assessment as regards cost- benefit aspects of the different measures is offered as well.

SAWA Database on adaptive measures targets all parties involved in the design and conduction of the flood risk management planning process, mostly being the responsible authorities together with the decision makers, research institutions and consultants. Please find us here: <http://iwawaterwiki.org/xwiki/bin/view/Organizations/SAWA>

The aim is to augment the existing Wiki content in way that benefits both SAWA's and IWA's stakeholders. We built this catalogue of measures based on a classification approach derived from Pasche, Ashley, Lawson, Schertzer (2008): "Risk Assessment and Risk Management in Small Urban Catchments" which has been amended.

Table 4 List on adaptive measures considered in IWA Water Wiki

Flood Resilience Measures	Flood Probability Reduction Measures
<p><b>Capacity Building</b></p> <ol style="list-style-type: none"> <li>1. Flood Maps and Plans <ul style="list-style-type: none"> <li>• Flood Hazard Maps</li> <li>• Flood Risk Maps</li> <li>• Flood Risk Management Plans</li> </ul> </li> <li>2. Public Engagement (like Information Brochure "Flooding and Agriculture")</li> </ol> <p><b>Decision Support Tools</b></p> <ol style="list-style-type: none"> <li>1. Decision Support in General <ul style="list-style-type: none"> <li>- Decision support tools management/ operation</li> <li>- Decision support tools planning</li> </ul> </li> </ol> <p><b>Land Use Control</b></p> <ol style="list-style-type: none"> <li>1. Building Codes/ Regulation</li> <li>2. Zoning Ordinance/ Zoning Maps</li> </ol> <p><b>Adapted Land Use</b></p> <ol style="list-style-type: none"> <li>1. Afforestation</li> <li>2. Conversion to extensive grassland (like Floodplain Management)</li> <li>3. Land set aside</li> <li>4. Managing Cultivation for Flood Risk Management</li> <li>5. Depth Loosening</li> <li>6. Green Corridors/ Strips</li> </ol> <p><b>Contingency Measures</b></p> <ol style="list-style-type: none"> <li>1. Flood Protection, Evacuation and Rescue Plans (like Livestock Evacuation Plan)</li> <li>2. Flood Forecasting and Warning Services (like Flood Warning Service Agriculture)</li> <li>3. Flood Control Emergency Operation</li> <li>4. Mobile/ Demountable Flood Defence Devices</li> <li>5. Flood disaster Recovery Plans</li> <li>6. Insuring Flood Risk</li> <li>7. Reserve Fond for Flood Consequences</li> </ol> <p><b>Flood Preparedness</b></p> <ol style="list-style-type: none"> <li>1. Flood Adaptive Architecture</li> </ol>	<p><b>Sustainable Urban Drainage Systems</b></p> <ol style="list-style-type: none"> <li>1. Keeping / reconstituting groundwater (like Unsealing Measures, Permeable Paving)</li> <li>2. Evaporation and retention structures (like Green Roofs, Rain Gardens)</li> <li>3. Filtering and retention structures (like Constructed Wetlands, Soil Filters, Sedimentation Structures - ponds / basins)</li> <li>4. Infiltration and retention structures (like Filter Strips and Swales, Infiltration Trenches, Filter Drains etc.)</li> <li>5. Rainwater Harvesting</li> </ol> <p><b>Controlled Surface Conveyance</b></p> <ol style="list-style-type: none"> <li>1. Conveyance Structures</li> <li>2. Multi Functional Space</li> </ol> <p><b>Watercourse Restoration</b></p> <ol style="list-style-type: none"> <li>1. Relocation of Dikes (like Impact Study "Dyke Relocation")</li> <li>2. River/ Floodplain Maintenance</li> <li>3. River / Floodplain Maintenance - measures influencing roughness (like Development of flood plain forests) or to manage debris (like Trash Screens).</li> </ol> <p><b>Traditional Flood Defense Measures</b></p> <ol style="list-style-type: none"> <li>1. Flood Defence Wall/Embankments/dikes (Dykes)</li> <li>2. Flood Safety Standard</li> <li>3. Retention Structures</li> <li>4. Optimizing the Operation of Retention Structures</li> <li>5. Groundwater Defence</li> </ol>

For each of the listed measures (Table 4) the following information will be given:

**General description (mandatory)** of measure (could include category of measure: technical, economic, risk prevention, awareness and information, land use change or regulatory measure).

**Pictures (desirable)** with descriptive text (can also be put in the last part: case studies)

**Pro & Con (mandatory)** to what extent does the measure benefit or mitigate other objective in the FD, the WFD and other economical, social and environmental objectives? Other words

to use: win-win, no regrets, flexibility and robustness to function under uncertainties (this part should make it easy for users to add one sentence information as the measure is used).

**Literature and links (mandatory)** (If PDF-files are uploaded and not mentioned in the text over, a two sentence description of the content makes it user-friendly).

**Case studies (desirable)** sorted after country (makes it possible to scroll to the climate zone of most interest) Could include name of site, year of implementation, a photo, soil type, why the measure was chosen, cost of implementation (size if possible), maintenance, problems, lesson learned.

### 1.5.2.3 Overview on reports produced in Key Area B

#### 1.5.2.3.1 *Transnational level:*

2012-05-22: “Adaptive Measure Database - **SAWA Report WP 2-1**”, Published by: Ministry of Economy, Traffic and Innovation (BWVI), Agency for Roads, Bridges and Waters Germany (LSBG), Hamburg. Supported by: Ingenieurbüro Sieker, Ingenieurbüro Goltermann.

2012-04-26: ”SAWA Expert Database - **SAWA Report WP2-2**”; Editor: Ministry of Economy, Traffic and Innovation (BWVI); Agency for Roads, Bridges and Waters Germany (LSBG), Hamburg; Supported by: Wilde Zeiten. Authors: Dagmar Goltermann, Jeff Marengwa.

#### 1.5.2.3.2 *National Level:*

2011-09: Hochwasser und Landwirtschaft – wie schütze ich meinen Betrieb? Herausgeber: Landwirtschaftskammer Niedersachsen, Bezirksstelle Uelzen, Fachgruppe „Nachhaltige Landnutzung und Ländliche Entwicklung“; Editorial staff: Katrin Castelein, Enno Eiben, Imke Mersch, Monika von Haaren; Layout: Sarah Lühmann; Uelzen

2012- 03: Abschlussbericht “Retentionspotentiale im Siedlungsbestand - Synergetische Maßnahmen zwischen WRRL und HwRMRL; Herausgeber HafenCity Universität Hamburg; Author: Wolfgang Dickhaut, Tobias Ernst; ISBN 978-3-941492-41-7

2011: “Measures to manage climate change in Sweden - Altered rainfall and sea levels”; Published by: Swedish Geotechnical Institute, SGI; Authors: Ramona Bergman, Yvonne Andersson-Sköld, Jan Fallsvik, Carina Hultén, AnnLouise Elliot

2011-12-22: “Guidance on how to perform a Cost-Benefit Analysis of alternative flooding protection measures” Editor: Sweco Environment AB För Karlstad Kommun; Authors: Lars Rosén, Johan Nimmermark, Andreas Lindhe, Mats Andréasson, Andreas Karlsson, Jonas Persson; Göteborg

2010-04-21: “Mitigation of flow distribution and sedimentation problems in the Klarälven using groynes”; Published by: Karlstad Municipality, DHI. Diarienummer: TFN 2011-2509 dpl 7

2012-02-06: “Environmental impact statement - Pilot study for dredging the river Klarälven, Karlstad municipality” Karlstad; Published by: Sweco Environment AB för Karlstad Kommun; Authors: Johanna Gelang Alfredsson, Magnus Löfqvist, Magdalena Westerberg

2012-04: “SAWA Activities at Heriot-Watt University - Urban Flood Risk Management“; Editor: Heriot-Watt University; Author: Dr Scott Arthur.

2009-07-22: “Effecten peilbeheer en waterberging Oldambtmeer” published by: Waterschap Hunze en Aa's. (report on effects of water level management and storage on water quality in the Oldambtmeer [end report Blue lakes HEA with eng summary])

2011-12: NOTA VEENOXIDATIE”, Published by: Waterschap Hunze en Aa's; Authors: Marie Louise Meijer, Henk van Norel, Erik Jolink

2012-05-04: “Klimaatverandering & Waterkwaliteit Gebiedsuitwerking beheersgebied waterschap Zuiderzeeland“. Published by: Grontmij, Waterschap Zuiderzeeland; Authors: Jelle R. Zoetendal, Bart Volkers, Evalyne Swart, Mario Maessen.

### 1.5.3 Key Area C: Capacity Building (WP3)

Aim of WP 3 was to prepare institutional, expert and public structures for an optimal implementation and operational capability of the FD in coordination with WFD, focusing on education, communication, capacity building and adaptive measures.

In order to compile relevant state-of-the-art methods for CB in FRM an inventory was conducted based on a document analysis. The following working steps were undertaken for this study.




1. Research on potential projects on FRM
2. Analysis of selected projects and research on relevant documents
3. Analysis of the documents
4. Development of an evaluation matrix
5. Compiling results along the matrix structure

Following projects were chosen for the document analysis: Freude am Fluss, Harmoni-Ca, NeWater, IMRA, CapHaz-Net, Floodsite, FLOWS.

More detailed information on the inventory can be found in SAWA report on Capacity Building. SAWA Capacity Building Concept and Methods for Flood Risk Management: <http://www.sawa-project.eu/uploads/documents/>.

As a basis for all Capacity Building activities in SAWA and in the future, a fundamental concept has been shaped, describing involved parties, aspired capabilities, necessary changes, possible conflicts and didactic methods for capacity building on the way to sustainable floodplain management (sfm). Via interdisciplinary cooperation, the concept derived from range of sources such as today's commonly used strategies, recent research results, pedagogic philosophy, leading into Best Practice Methods for education in promotion of and information on sfm.

Guided by these methods and based on the previous prepared educational material for schools, universities and adults the following educational structures became developed:

-  Establishing a network of sustainable education centres (SECs), providing hands on educational activities, tools and information
-  Developing a course for European students (MSc/postgraduate) which is conducted conjointly at universities in the partner countries by experts with educational and practical backgrounds.
-  Integrating schools into an exchange and cooperation network, engaging pupils of different ages with project work linked to sfm.

#### 1.5.3.1 Capacity Building – Definition and didactic concept

A definition of capacity building in flood management naturally includes a definition of capacity in flood management. Its building or development again requires the capacity to do so, the capacity to build capacity.

*“Capacity in flood management is the capability of individuals, groups, institutions, authorities, and of local societies as a whole, to live with and adapt to a locally specific situation of flood*

*hazard in a sustainable way, thus lowering damage potential, raising resilience with respect to floods and minimising the interference with waters and associated ecological values.*

*In this sense, capacity building in flood management, as aimed for in the SAWA project, comprises tasks, strategies and methods that enable local societies and their individuals to develop this capability.*

*And while capacity building is widely recognised as an ongoing process, ongoing activity is regarded crucial for the development of capacity in flood management due to the psychological mechanisms in hazard cognition and their requirements in education and training.”*

In accordance with the 5 different levels given by Global Development Research Centre (GDRC), capacity building in flood management goes beyond training individuals, but includes

- Development of human resources, “equipping individuals with the understanding, skills and access to information, knowledge and training that enables them to perform” accordingly.
- Development of organisations, elaborating “management structures, processes and procedures, not only within organisations but also the management of relationships between the different organisations and sectors (public, private and community)”.
- “Institutional and legal framework development, making legal and regulatory changes to enable organisations, institutions and agencies at all levels and in all sectors to enhance their capacities.”

Although the latter is no planned part of SAWA-activities, recommendations for changes or enhancement of legal framework could result from research into suitable methods in capacity building. The definition of capacity building states, what capacity building is, what its aims are. However, it does not state, how these aims are to be reached.

Based on the UN Decade of Education for Sustainable Development principles, didactics and findings in learning theory in risk awareness we figured out that the following elements are crucial to be included and be respected for CB in SFRWM: Information, Internationality, Interdisciplinary, Interactivity, Identification, Interconnection, and Internalising. A brief description of these elements will be given in the SAWA report on Capacity Building – Concept and Definition which is presented at SAWA website: [http://www.sawa-project.eu/uploads/documents/WP%203\\_Report%20concept%20and%20methods%20on%20CB\\_evers\\_nyberg.pdf](http://www.sawa-project.eu/uploads/documents/WP%203_Report%20concept%20and%20methods%20on%20CB_evers_nyberg.pdf).

#### **1.5.3.2 Capacity Building Activities**

One important part of WP3 in SAWA was the education activities. In this report three activities are reported: 1) the 7 sustainability education centres (SECs), 2) the higher education (master and upper bachelor level) and 3) the student exchange programme (SEP).

The 7 SECs that were developed at universities and public institutions in 4 of the SAWA countries became nodes for education, information dissemination. They linked school and university activities to local (SAWA) projects and authority activities within the implementation process, whilst supporting public perception and integration. Several target groups have been addressed, e.g. the public, school pupils, university students, and water experts within and outside SAWA.



The SECs have reached a very large number of Europeans, in the efforts to educate and build capacity for flood risk management. The centres have had impact on local, on regional and on national level in the SAWA countries. Several of the activities have also been trans-national. The SECs has created arenas for meetings, for reflections, for discussions and for learning. And the public, the flood experts, students and various stakeholders have been connected because of the SAWA SECs. The future plans for the 7 SECs are also a guarantee for a substantial impact also onwards in Europe from the SAWA project.

Higher education has been a focus area for the 7 SAWA universities. There are several incentives for education on water management and flood risks. One driving force is to spread the knowledge and experiences from the serious flood events that has occurred in Europe the last decades. Another strong force is the climate change, which causes need for new knowledge and education. A third incentive in the floods area is the EU Flood Directive that was adopted in 2007 and now is implemented in all member states.

A jointly developed and implemented master course (15 credits) has engaged ca. 30 students and complementary master and upper bachelor education more than 300 students. The students were both regular students and professionals from 12 different countries. The SAWA master course has been given 2011 and 2012. Four themes gave the structure of the course: governance and legal framework, flood risk analysis, integrative planning and adaptive measures. The learning components were lectures, excursions, individual assignment and a group work. Many of the SAWA partners have actively contributed to the activities which have given valuable examples. The post-evaluation for 2011 gave an over-all score of 4.1 on a five-degree scale.

A 1-2 year master programme was outlined among the SAWA universities. The bearing components were the combination of water and flood risk management. This education idea can be implemented in future transnational projects.

A concept for student exchange was developed and more than 50 students at bachelor, master and doctoral level took part in the SAWA exchange. The SAWA network is a tremendous basis for future student and staff exchange activities. The SAWA master course that is now a permanent course at Karlstad University will be a platform for student exchange and for continuous cooperation between the SAWA universities.

#### ***1.5.3.2.1 SAWA SECs***

As mentioned above, centres for education towards sfm (SEC) became installed at universities or public institutions, providing hands on educational activities, tools and information on sfm education for the public, schools and universities, linking school and university activities to local (SAWA) projects and authority activities within the implementation process, whilst supporting public perception and integration.

SAWA has established a network of SEC's where information and education material is concentrated either as a virtual (www) or, in some cases, a real office. The established structure provides a platform for dissemination of SAWA outputs (e.g. course materials, contact persons, student exchange programs, etc.) and will outlive SAWA.








The idea of local centers that engage in education for sustainable use of floodplains and respective approaches to water is predicated on these requirements. The overall aim is the

integration into the local culture, to develop a “water culture” that recognizes waters and floods as qualities of the area and provides approaches to adapt to and live with it.

The scope is that of the authentic surrounding and the flood and water related activities and project. The content is generally experience-based, giving a positive meaning and value to the water-affected surrounding. This shall happen in a collaborative way, integrating different target groups in interaction with the water and flood issues and with each other, thus aiming to establish a local network, which will broaden to comprise a whole local society and thereby evolve into a local water-tinted culture.

The role of the SEC in these and similar cases would be initiation and coordination. But a SEC can just as well or in addition offer own activities like workshops, excursions, talks or establish a recurring memorial day and coordinate the activities – all and always with the vision of a cultural integration.

In the SAWA project 7 sustainability education centres have been established. Those are:

- 1  Centre for Climate and Safety, Karlstad University
- 2  Delfland Mobile Flood Exhibition
- 3  Dike protection training centre, Hamburg
- 4  Flood animation studio, TUHH, Hamburg
- 5  Lake Vänern Mobile exhibition
- 6  Physical SUD model, Heriot-Watt University, Scotland
- 7  Virtual centre for integrated water management (vIWa), Leuphana University

The 7 SAWA SECs have reached a very large number of Europeans, in the efforts to educate and build capacity for flood risk management. School children, university students, the public, flood experts, politicians, etc, have been engaged by the SECs. The centres have had impact on local, on regional and on national level in the 5 SAWA countries. Several of the activities have also been trans-national. The SECs has created arenas for meetings, for reflections, for discussions and for learning. And the public, the flood experts, students and various stakeholders have been connected because of the SAWA SECs. The future plans for the 7 SECs are also a guarantee for a substantial impact also onwards in Europe from the SAWA project.

For more detailed information please read our SEC report “WP3 - SAWA Education - Sustainable education centres, master education and student exchange”. It is available here: <http://www.sawa-project.eu/uploads/documents>

### ***1.5.3.2.2 SAWA Master Course Integrated Flood Risk Management***

#### **1.5.3.2.2.1 Purpose**

There are several incentives for education on water management and flood risks. One driving force is to spread the knowledge and experiences from the serious flood events that has





occurred in Europe the last decades. Another strong force is the climate change, which causes need for new knowledge and education. A third incentive in the floods area is the EU Flood Directive that was adopted in 2007 and now is implemented in all member states. The directive with its broad perspective on flood risk management (FRM) requires new methods and practices regarding risk mapping and risk-reducing measures, which all in all create needs for education.

There are also specific needs for *transnational* and *European flood education*. Many countries in Europe share several characteristics regarding flood hazards and vulnerabilities. The climate, the geography and the societal structures are fairly similar, which opens for common knowledge development and education. There are also a number of transnational rivers that call for transnational knowledge development and risk management.

Joint education, involving universities from different countries, has different positive effects:

- bringing knowledge between countries, by exchange of students, teachers and researchers and professionals
- shared experiences of flood events
- shared examples of approaches, strategies and measures taken in different countries

This background encouraged SAWA to establish a Master Course on Integrated Flood Risk Management. Seven universities are partners in SAWA, each with an own profile in the water management and flood areas. These are

Universities	Profiles
 Hamburg University of Technology HafenCity University, Hamburg Leuphana University, Lüneburg	flood management, water engineering, hydrological modeling urban water, architecture and planning sustainable development and flood risks, collaborative planning and modeling
 Norwegian University of Science and Technology, Trondheim (NTNU)	hydraulic and environmental engineering
 University of Salford Heriot-Watt University, Edinburgh	environmental engineering, water and wastewater systems, flood retention basins water resources, catchment and flood management
 Karlstad University	climate (esp. flood) risk management, vulnerability studies, learning from flood events

#### 1.5.3.2.2.2 Design

A Masters course of 15 credits was developed at was given first time during spring semester 2011. Six of the seven SAWA universities have contributed, and Karlstad University in Sweden has hosted the course.

The scope for the course is flood risk management principles and practices. The relation to neighbouring management perspectives, like water quality and land-use, is elucidated. There is a need for an integrated approach which has to consider economic, social and ecological aspects of vulnerability and potential risk-reducing measures. Interdisciplinary and trans-sectoral work as well as collaboration among stakeholders is needed. The EU Flood Directive and its requirements are central in the course content, as well as the interface between the Flood Directive and the Water Framework Directive as illustrated in the figure below:

The course content is structured into four areas:

<b>I</b>	Governance and Legal Framework <ul style="list-style-type: none"> <li>• Floods directive (&amp; WFD)</li> <li>• Risk governance</li> </ul>	Impact Assessment <ul style="list-style-type: none"> <li>• Hydrological/hydraulic modelling</li> <li>• Vulnerability analysis</li> </ul>	<b>II</b>
<b>IV</b>	Integrative Planning <ul style="list-style-type: none"> <li>• Flood risk management plans</li> <li>• DSS/PSS</li> </ul>	Adaptive Measures <ul style="list-style-type: none"> <li>• Structural/non-structural</li> <li>• Relation to sust. Development</li> </ul>	<b>III</b>

The course is both offered to students already active in masters programs and to professionals that need wider and deeper knowledge about the Flood Directive and flood risk management. Suitable disciplinary background for the participants are for example water management, risk management, environmental science, physical planning, geography, ecology, technical infrastructure, contingency planning and education. To be admitted to the course, the students needed at least 120 credits at bachelor level from previous studies, or at least three years of work experience in the area.

With a unique SAWA profile the course is based on the broad and wide expertise that can be found at the SAWA universities, and also with contributions from all SAWA partners. The SAWA specialities are:

- Trans-European and trans-disciplinary learning in order to develop capacity for integrated flood risk management
- Synergies between and coherence of Floods Directive (FD) and Water Framework Directive (WFD)
- Development and application of instruments for integration and implementation such as integrative planning
- Identification and implementation of measures which are regionally and temporally adaptive (e.g. adapted to local conditions or flexible for future adjustments)
- Development, implementation and testing of governance approaches in order to include stakeholder and citizens in decision processes
- 22 SAWA partners from five countries contribute case studies and examples for good practise for different measures and methods.

For more detailed information please read our SAWA report “WP3 - SAWA Education - Sustainable education centres, master education and student exchange”. It is available here: <http://www.sawa-project.eu/uploads/documents>

### ***1.5.3.2.3 SAWA Student Exchange Program***

#### **1.5.3.2.3.1 Purpose**

In line with the intentions in SAWA a Student Exchange Program (SEP) was developed, which mainly was directed towards (integrated) flood risk management.

In the Application to Interreg 4B, the SAWA consortium presented the plans for a Student Exchange Program (SEP) as phase 7 in SAWA. The project wanted to develop a basic concept for international exchange between schools and universities, and also exchange activities in relation to other SAWA activities (e.g. SEC activities).

A concept paper was written by Leuphana University after the starting exchange activities in 2009 and 2010. The aim was to answer the following core questions:

What are the prerequisites for the SEP?

How should the SEP be organised?

Before answering these questions it seemed suitable to clarify the meaning of the SEP. The main purpose of a SEP should be that students from different countries and universities with different (scientific) backgrounds work together on a specific topic, learn about country-specific approaches, and thereby develop new technical and social competences/capacities.

The first important question that must be answered for the SEP deals with its prerequisites.

It is crucial that both sides have enough resources (e.g. financial, manned and time) for an exchange and that students are willing to and have the capacities to attend the program. The financial resources refer in particular to the costs for face-to-face exchange and possible reimbursements for students, as for example excursions that could be assumed to be costly.

Moreover it must be considered that the study systems in the EU Member States are different. The successful organisation of the SEP depends on the clarification of the differences and similarities between the systems before setting up the SEP. It could be assumed that the interest in the SEP will be higher, if the program fit in the students' schedules. Furthermore it must be clear who is responsible for the SEP at the universities (unambiguous contact persons) and how long the SEP should last – should it be an on-going program independent from other university schedules?

The organisation of the SEP should be subdivided into two major aspects: the design of the platform and the design of the face-to-face exchange of students.

With regard to the face-to-face exchange it is necessary to develop/design a diversified program with enough time slots for professional input, student presentations, discussions and free time. To guarantee enough time for the stated aspects a 5 day excursion seems to be a suitable framework<sup>4</sup>.

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<sup>4</sup> It should be kept in mind that the travelling times during the excursion are not too long.

The space of time for the face-to-face exchange depends on the different systems. For German students the education-free periods between the semesters would be a good opportunity.

Highly relevant during the face-to-face exchange is the input from practitioners (e.g. representatives of municipalities) about water and flood risk management aspects (e.g. planned measures).

A further issue concerning the organisation of the SEP deals with the participants. It must be clarified how many students could participate in the SEP. This question is linked to several other questions and depends on the final design of the SEP, but nevertheless the maximum size should be 12 (to 15) from each country (with regard to for example excursions).

A further aspect that should be mentioned here concerns the course achievements of the students. Should the achievements be based on presentations and written elaborations or could the organisation of excursions or the development of guided tours also be a course achievement?

Finally it must be clarified how the SEP participants should become familiar with each other – the SEP could either start via a web-platform or via a first excursion. The latter would be a good opportunity to ensure that the participants/students become acquainted with each other at an early stage and develop a feeling of togetherness.

It should also be mentioned that the SAWA Master course and the SEP could be linked.

#### **1.5.3.2.3.2 Overview on Activities**

The student exchange activities in SAWA were integrated in other work such as SEC activities and the Master education. The major exchange was following:

1. Exchange between universities
2. Exchange in relation to master course
3. Exchange during SEC study tour

In total, more than 70 persons have been involved in exchange activities.

#### **1.5.3.2.3.3 Future student exchange**

The SAWA network is a tremendous basis for future student and staff exchange activities. One concrete follow-up that already is taking place is cooperation between Leuphana University and Karlstad University in the German Bachelor Plus programme. Students within Environmental Science can take one year at the exchanging university. The program starts in autumn 2012. It was the SAWA network that created this exchange which will last for several years ahead.

The SAWA master course that is now a permanent course at Karlstad University will be a platform for student exchange and for continuous cooperation between the SAWA universities.

For more detailed information please read our SAWA report “WP3 - SAWA Education - Sustainable education centres, master education and student exchange”. It is available here: <http://www.sawa-project.eu/uploads/documents>



### 1.5.3.3 Overview on reports produced in Key Area C

#### *1.5.3.3.1 Transnational Level*

2012: **SAWA WP3-1 Final Report** “SAWA education - Sustainability education centres, master education and student exchange”; Authors: Lars Nyberg, Karlstad University (SWE); Mariele Evers, Leuphana University/Wuppertal University (GER); Co Authors: Natasa Manojlovic and Erik Pasche, Hamburg University of Technology (GER), Scott Arthur, Heriot-Watt University, Edinburgh (UK), Wolfgang Dickhaut, HafenCity University, Hamburg (GER), Thecla den Hoed, Delfland Water Board (NL), Susanna Hogdin, County Administrative Board of Västra Götaland (SWE), Timm Geissler, Wasserland (GER). Published at <http://www.sawa-project.eu/index.php?page=documents>










2012: **SAWA WP3-2 Final Report** “SAWA Capacity Building Capacity building concept and methods for flood risk management”; Authors: Mariele Evers, Leuphana University/Wuppertal University (GER), Lars Nyberg, Karlstad University (SWE); Co Authors: Timm Geissler, Wasserland (GER); Franziska Lichter, Leuphana University (GER), Scott Arthur, Heriot-Watt University, Edinburgh (UK). Published at <http://www.sawa-project.eu/index.php?page=documents>

#### *1.5.3.3.2 National Level*

2012-04: “SAWA Activities at Heriot-Watt University - Urban Flood Risk Management”; Editor: Heriot-Watt University; Author: Dr Scott Arthur.



## 1.6 SAWA links:

-  SAWA Website: <http://www.sawa-project.eu/>
-  SAWA Experts Database: <http://experts.sawa-project.eu/>
-  SAWA Adaptive Measures Database in IWA WaterWiki:  
<http://www.iwawaterwiki.org/xwiki/bin/view/Organizations/SAWA>
-  SAWA Communication Platform (internal): <http://atrium.sawa-project.eu/?q=user/login&destination=>
  
-  Interreg Website: <http://www.northsearegion.eu/ivb/projects/details/&tid=86>
  
-  Laa Wandse: <http://laa-wandse.wb.tu-harburg.de/>
-  Center for Climate and Safety: <http://www.kau.se/en/ccs>
-  virtual SEC: [http://wiki.leuphana.de/viwa/wiki/index.php?title=Main\\_Page](http://wiki.leuphana.de/viwa/wiki/index.php?title=Main_Page)
-  Water lessons: [http://wiki.leuphana.de/viwa/wiki/images/d/d9/Water\\_lessons.pdf](http://wiki.leuphana.de/viwa/wiki/images/d/d9/Water_lessons.pdf)