



Awareness, perception and treatment of ecological issues in planning and realising flood management measures

Results of a questionnaire in the northwest-European territory

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Water board Aa en Maas



Water board Brabantse Delta



Water board de Dommel



Water board Mümling



The nofdp project is embedded in the INTERREG III B programme, an initiative of the European Commission aiming at the promotion of interregional co-operation within Europe. It is a four-year trans-national project with partners from The Netherlands and Germany launched in spring 2004. This project has received European Regional Development Funding (ERDF) through the INTERREG III B Community Initiative

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Why this questionnaire?

The aim of the INTERREG IIIB project "nature-oriented flood damage prevention" (nofdp) is to develop a harmonised multi-disciplinary way combining ecological, technical, and planning aspects, while realising future flood-management projects. Such projects almost always include technical and spatial measures, which affect the water body, the entire floodplain and thus the entire ecological system. In order to get an idea and to understand which problems exist in real life, we asked water managers for their experiences regarding the influence that ecology and nature conservation have on planning and realisation of measures related to the prevention of flood damage. A questionnaire was sent out to water managers in the Northwest-European (NWE) co-operation region of the INTERREG IIIB programme. We expected a broad spectrum of answers reporting innovative and successful solutions as well as less successful cases. The questionnaire was sent to the addressees in May 2005. Due to holidays of some participants, the last answers were received in August 2005.

An overview of these answers, our conclusions and remaining challenges for the future shall be described in this report.

The results of this questionnaire have contributed essentially to the development of the nofdp products, which are an Information and Decision Support System (IDSS), an online knowledge base and a handbook with guidelines. In future, all products will provide support for more sustainable and nature-oriented flood-damage prevention.

You are invited to visit www.nofdp.net for further information about the project, nofdp workshops and deliverables. You can also download reports and subscribe to become a test user of the future IDSS software, which will be open source and free of charge for any user.

What does the questionnaire contain?

This questionnaire (see Annex) consists of three parts.

- Part A contains general questions regarding the addressee's institution and field of activity.
- Part B addresses the topics of flooding and ecology.
- Part C contains questions regarding modelling and decision-support systems.

How did we select the persons to be contacted?

Because a database of public administrations or water boards is lacking, only INTERREG databases of nature-, water- and flood-related projects were used to get an overview of persons to be contacted. Additionally, we tried to find other suitable contacts mainly via the Internet. The ability to identify the 'right persons' in all countries was clearly restricted due to a lack of knowledge regarding the administrative and hierarchical structures in some countries (e.g. France, UK). We particularly tried to reach the executive level of persons, i.e. practitioners carrying out projects as well as planners and plan approvers.

How did we analyse the questionnaire?

The results of most parts of the questionnaire were analysed quantitatively and in a descriptive way, e.g. frequencies were plotted to visually highlight trends. Furthermore, a "deeper" statistical analysis was performed by an external expert (Meike Weiland, University of Freiburg). The goal of this analysis was to identify statistically significant trends or peculiarities in the answers, e.g. if in a country certain issues are dealt with or perceived in a special way. Furthermore, it was also analysed if there were relations between the answers to different questions, e.g. if certain parts of the ecosystem are regarded as much more important in one country than in another one. For this deeper

analysis M. Weiland used several methods like the cross-table analysis available in the software package SPSS®.

Results and discussion

First, the overall feedback is considered, and then the results for the most interesting questions are shown and interpreted according to *our view* and experience. In order to improve the interpretation we would like to encourage you to visit our nofdp webpage www.nofdp.net where you can comment on our findings and let us participate in your personal experience regarding flood management projects. This highly valuable input will form part of the best-practice examples, which will be included in the nofdp guidelines volume.

Feedback

The feedback to the inquiry was quite good. To 1297 questionnaires sent out, we have received 152 (12%) answers. Details are visualised in the following Figure 1.

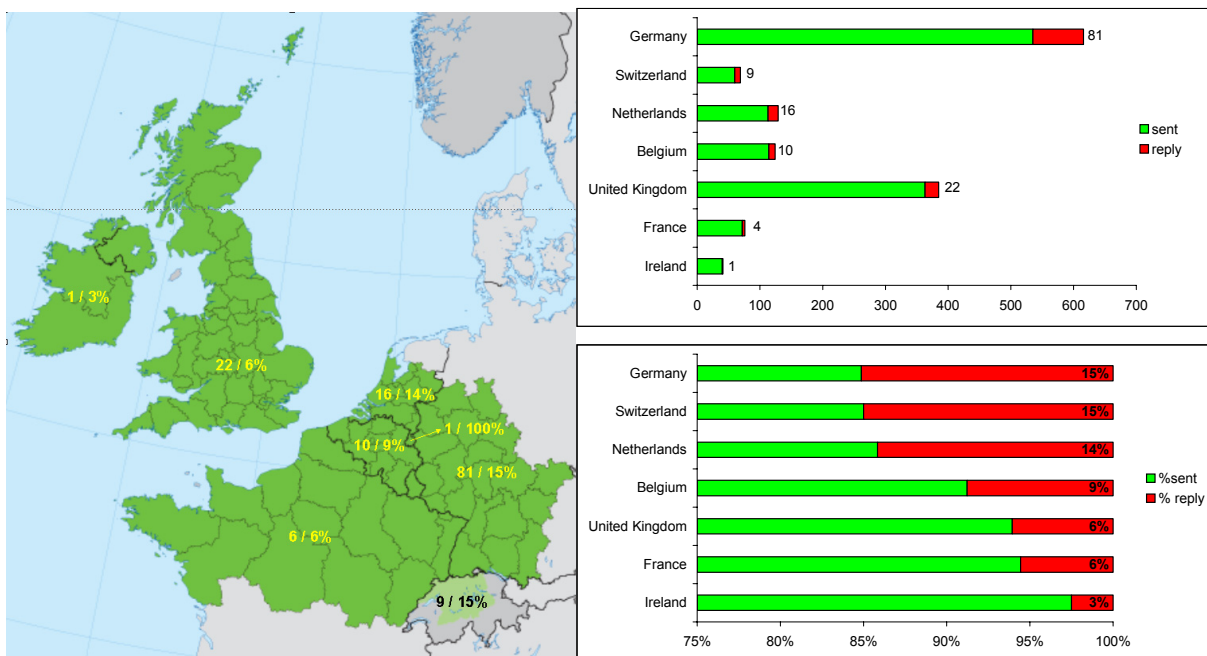


Figure 1: Left: Map of the NWE area (including the associated part of Switzerland) with the numbers / percentages of replies to our questionnaire. Right: total (upper part) and relative (lower part) contributions. The yellow arrow points to Luxembourg, from where one answer was received.

Figure 1 reveals a strong disproportion in the number of persons contacted and in the replies to our inquiry. Some differences can easily be explained by the population size

of the country, e.g. Germany versus The Netherlands. However, this does not hold true for France, where we expected much more answers. According to personal information by Dr. F. Scholles (Hannover University), we failed to send an official inquiry to Paris before contacting the local water boards. Regarding The Netherlands and Germany, we are quite sure that we have identified enough and the right addressees, because of the mother tongue and some personal contacts of our nofdp group members.

Below, some remarks are given about each country.

The Netherlands

Compared with Germany, many water boards in The Netherlands are much bigger in terms of personnel and the area covered. Consequently, the low absolute number of contributions (16) might be well representative although it is rather small for a statistical analysis. The relative number of replies (14%) is quite good. Due to the large number of persons working at one water board it sometimes turned out to be difficult to identify the right contact person for our request.

Germany

Although we had contacted only the NWE part of Germany, we got a high absolute number of replies (81). Eventually this was also due to the fact that the sender institutions (TU Darmstadt and German Federal Institute of Hydrology) are well known among the addressees. The relative contribution of 15% is regarded as good. Nevertheless, occasionally it turned out to be difficult to get an answer from community or city councils, because they generally require the approval of the German Association of Cities (Deutscher Städtetag).

United Kingdom and Ireland

Despite a relatively high number of inquiries, we had only a weak to average feedback (UK: 6%, IRE: 3%). We suspect that we might have identified addressees who might not be directly in charge of flood management or simply might not experience severe flood-related problems.

France

Although the questionnaire was translated into French, the feedback from France was rather low (6%). Later we were given the recommendation to ask higher hierarchies for approval prior to sending the questionnaire to any local or regional authority.

Belgium

Given the rule of thumb that 10% of feedback is a "good" average, the Belgian feedback of 9% can be regarded as more or less normal. We do not know if the absolute number of 10 is representative. Anyway, it is considered too small for a thorough statistical analysis.

Switzerland

The Swiss reply (15%) was as good as the German and can be regarded as quite representative. However, due to the fact that we only contacted the German part of Switzerland, the small absolute number of 9 prohibits a deeper statistical analysis.

Luxemburg

We are happy about the 100% reply, but of course the absolute number of one answer cannot be analysed statistically.

Given the low absolute numbers, the answers from Luxemburg, Ireland and France were completely excluded from any further analyses. Descriptive analyses were performed for Germany, United Kingdom, The Netherlands, Belgium and Switzerland. Concerning the concluding statistical analyses (→ assigning significance levels to the results), only those of Germany, United Kingdom and The Netherlands can be regarded as robust.

Answers to the questions of the questionnaire and first conclusions

The questions (Q) 1 to 5 of the questionnaire (see Annex) referred to general and administrative information about the addressees. They were not analysed because the main purpose of these questions was to receive background information. The remaining questions are discussed below. The **blue text** represents our personal interpretation of the findings and is supposed to be further discussed on the nofdp webpage (refer to www.nofdp.net).

Q6 General importance of ecosystem parts

The first question, which was analysed, was question no. 6 referring to the general importance of ecosystem parts. The aim of this question was to get an overview of how the issues nature and ecology are perceived in the NWE countries. Table 1 and Figure 2 give an overview.

Table 1: Overview of answers to question no. 6 "Which parts of the ecosystem are of particular importance to your local area? Please mention the 5 most important groups". High numbers are indicated in bold.

Ecosystem part	NWE		D		UK		B		NL		CH	
	#	%	#	%	#	%	#	%	#	%	#	%
<i>Total number of answers</i>	<i>153</i>	<i>100</i>	<i>81</i>	<i>100</i>	<i>22</i>	<i>100</i>	<i>9</i>	<i>100</i>	<i>16</i>	<i>100</i>	<i>9</i>	<i>100</i>
Physical river quality	115	76	63	77	15	63	8	80	16	80	8	89
Water quality	106	70	58	71	10	42	8	80	19	95	7	78
Groundwater	97	64	64	78	8	33	4	40	12	60	7	78
Vegetation	88	58	44	54	13	54	6	60	14	70	6	67
Fish	69	46	38	46	10	42	2	20	10	50	6	67
Soil	62	41	33	40	8	33	7	70	8	40	3	33
Aquatic macro-invertebrates	41	27	29	35	3	13	0	0	5	25	3	33
Birds	30	20	13	16	10	42	2	20	4	20	1	11
Climate	26	17	14	17	2	8	2	20	4	20	1	11
Amphibians/reptiles	19	13	10	12	3	13	2	20	3	15	1	11
Others	14	9	9	11	4	17	0	0	0	0	1	11
Mammals	12	8	1	1	9	38	0	0	2	10	0	0
Snails/molluscs	7	5	2	2	4	17	0	0	1	5	0	0
Insects/spiders	7	5	3	4	2	8	1	10	0	0	1	11

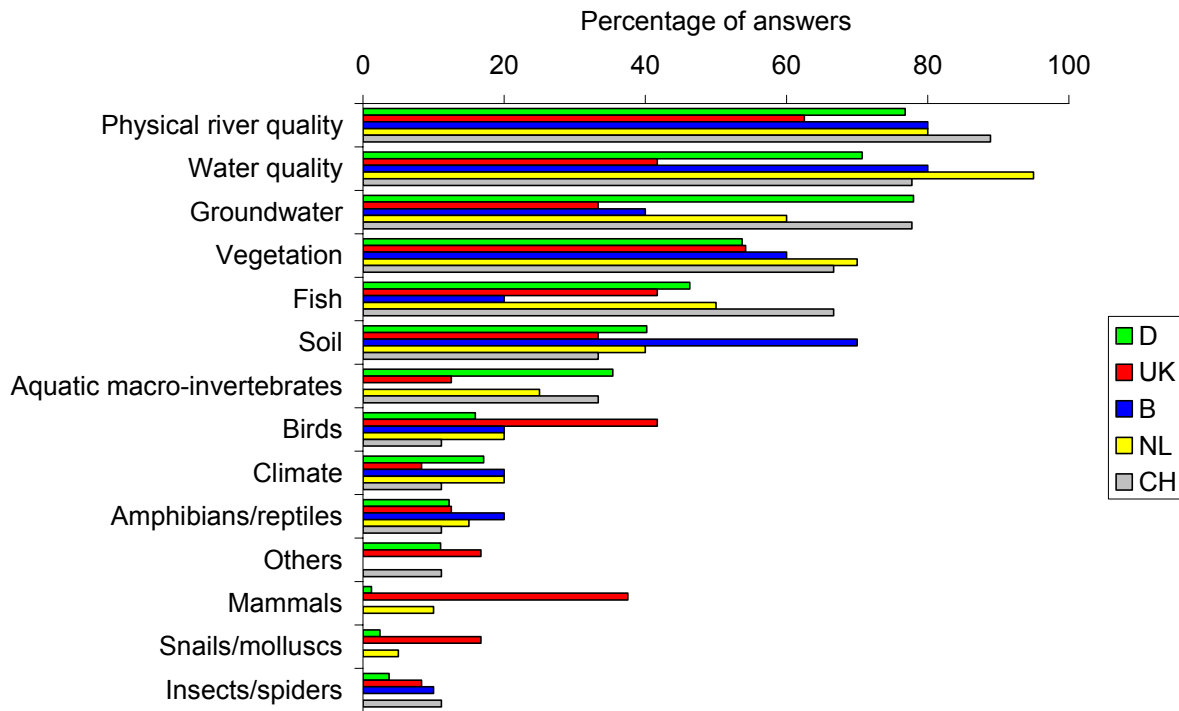


Figure 2: Important parts of the ecosystem based on answers (%) to question no. 6

Some ecosystem parts, such as the physical river quality (German: Gewässerstrukturgüte), water quality and vegetation are everywhere perceived as important. However, compared with the NWE average, there are also peculiarities:

- In the United Kingdom the water-related items water quality and groundwater and also fish appear to be less important, while birds, mammals, snails and molluscs apparently receive much attention.

Regarding the low importance granted to water quality and groundwater, the answers received from the UK might be misleading regarding a final conclusion. Certainly, these ecosystem parts are usually of bigger concern. Perhaps they were not so much an issue in the particular water boards or city councils which had been addressed. The same may be true in the case of fish. The relatively higher importance assigned to mammals and birds, as compared with the other addressees, leads to the conclusion that there is a broad public awareness and concern regarding bigger animals in the UK. This might be due to the intensive lobby work of nature conservation unions in this country.

- In Germany, Switzerland and The Netherlands, the items groundwater and aquatic macro-invertebrates seem to be taken as quite important parts of the ecosystem.

In densely populated areas such as The Netherlands and the NWE part of Germany, groundwater as a major source of drinking water is always an important issue. In Germany, The Netherlands and Switzerland, aquatic macro-invertebrates are traditionally used as indicator organisms for water quality and hence, receive some special attention in these countries.

- In Belgium soil seems to be of major importance while aquatic macro-invertebrates are not mentioned at all.

Parts of Belgium have intensive agriculture. This might be a reason for a special concern about soil as a natural resource. Aquatic macro-invertebrates normally are important in Belgium but they were not so much an issue in the last realised measure of the particular water boards which had been addressed.

Q7 Common and current flood management measures

Question no. 7 referred to the most recent flood management measures realised. The aim of this question was to get an impression of currently popular measures in the NWE area.

Table 2: Overview of answers to question no. 7 "What were the most recent flood management measures that were carried out?" High numbers are indicated in bold.

Measure	NWE		D		UK		B		NL		CH	
	#	%	#	%	#	%	#	%	#	%	#	%
<i>Total number of answers</i>	152	100	81	100	22	100	9	100	16	100	9	100
Re-naturalisation	59	39	43	52	1	4	1	10	6	30	7	78
Non-operated flood-control basin	51	34	35	43	3	13	5	50	5	25	1	11
Widening of drainage channels	45	30	15	18	12	50	3	30	8	40	7	78
Establishment of buffer strips on river banks	42	28	21	26	5	21	7	70	4	20	3	33
Construction of dykes/banks	39	26	22	27	5	21	4	40	11	55	0	0
Retention of rain water	39	26	23	28	6	25	2	20	6	30	0	0
Keeping floodplains free and verification of their legal status	35	23	17	21	6	25	5	50	5	25	2	22
Reclamation of retention areas	30	20	20	24	0	0	3	30	2	10	4	44
Non-operated retention areas	27	18	17	21	4	17	4	40	1	5	0	0
Operated flood-control basin	26	17	16	20	4	17	0	0	4	20	0	0
Relocation of dykes/banks	18	12	9	11	2	8	2	20	4	20	1	11
Others	17	11	5	6	5	21	0	0	2	10	3	33
Agriculture adapted to the needs of the individual site	12	8	6	7	2	8	2	20	0	0	1	11
Ecological forest development	5	3	1	1	2	8	0	0	1	5	1	11

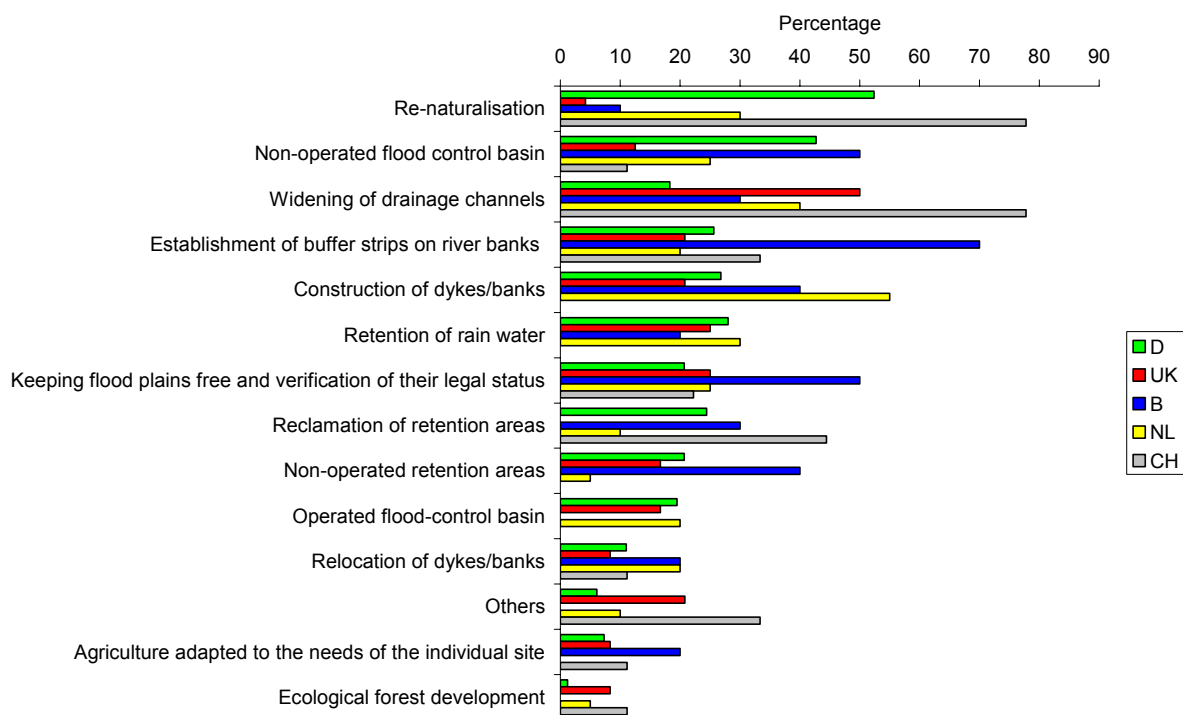


Figure 3: Types of flood management measure last realised based on answers (%) to question no. 7

Apparently, there is little congruence regarding the most recent flood management measures that were carried out.

The following peculiarities can be recognised:

- Re-naturalisation seems to be among the most favoured measures of flood management in Germany and Switzerland and among the least favoured ones in the United Kingdom and Belgium.

Referring to Germany, we can support this result by our own experience. Re-naturalisation is a popular measure and rather easily receives public funding. This is certainly at least partly an effect of the current implementation of the EC Water Framework Directive. We have no interpretation at hand regarding the apparent lack of such measures in the United Kingdom and Belgium. Here it is likely that the answers are not representative.

- Non-operated flood-control basins are frequently built in Germany and Belgium. Also in the past, this type of measure used to be very common.

At least in hilly regions of Germany this type of measure is the most suitable one for flood protection. In parts of Belgium this conclusion might also be true.

- Widening of drainage channels is a measure frequently applied in the United Kingdom and Switzerland.

We cannot identify a special reason why this measure should be favoured in these countries.

- Establishment of buffer strips on river banks is a method favoured in Belgium.

One aim of the establishments of buffer strips is to reduce nutrient and pesticide inputs into the rivers from adjacent intensively managed farmland. Belgium, with partly inten-

sive agriculture, may assign much priority to this effect.

- Construction of dykes/banks is the measure most frequently mentioned in The Netherlands.

Clearly, this is the measure of choice for flood protection in a flat country like The Netherlands.

- Keeping floodplains free and verification of their legal status is among the favoured measures in Belgium.

In a densely populated country like Belgium, this seems a reasonable measure to prevent future increase of flood risk.

The verification of statements from the other countries is not possible due to lacking experience in the nofdp project partnership.

Q11 Impacts on the ecological system

In question no. 10 we asked: *"Did any ecological problems occur during the realisation of this last flood management measures?"* (→ Q7).

If the answer was yes, question no. 11 had to be answered. With this question we wanted to know which parts of the ecological system were affected by these problems mentioned in Q10. The aim was to identify common conflict areas.

Table 3: Overview of answers to question no. 11 "Which areas of the ecological system were affected by the problems, which occurred during the realisation of this last flood management measures?" High numbers are indicated in bold.

Ecosystem area affected	NWE		D		UK		B		NL		CH	
	#	%	#	%	#	%	#	%	#	%	#	%
<i>Total number of answers</i>	<i>153</i>	<i>100</i>	<i>81</i>	<i>100</i>	<i>22</i>	<i>100</i>	<i>9</i>	<i>100</i>	<i>16</i>	<i>100</i>	<i>9</i>	<i>100</i>
Vegetation	31	21	17	21	3	13	1	10	9	45	1	11
Physical river quality	23	15	14	17	2	8	2	20	2	10	2	22
Fish	21	14	9	11	4	17	1	10	2	10	4	44
Land/soil	20	13	12	15	1	4	3	30	4	20	0	0
Water quality	19	13	4	5	4	17	3	30	6	30	1	11
Groundwater	16	11	8	10	0	0	0	0	5	25	2	22
Birds	16	11	8	10	1	4	1	10	6	30	0	0
Bed load transportation	15	10	6	7	1	4	3	30	2	10	3	33
Mammals	12	8	3	4	5	21	0	0	4	20	0	0
Aquatic Macro-Invertebrates	11	7	6	7	2	8	1	10	1	5	1	11
Amphibians/Reptiles	9	6	5	6	0	0	1	10	3	15	0	0
Erosion	7	5	3	4	0	0	2	20	0	0	2	22
Insects/spiders	6	4	3	4	2	8	1	10	0	0	0	0
Others	4	3	2	2	1	4	0	0	1	5	0	0
Snails/Molluscs	3	2	2	2	1	4	0	0	0	0	0	0
Climate	1	1	1	1	0	0	0	0	0	0	0	0

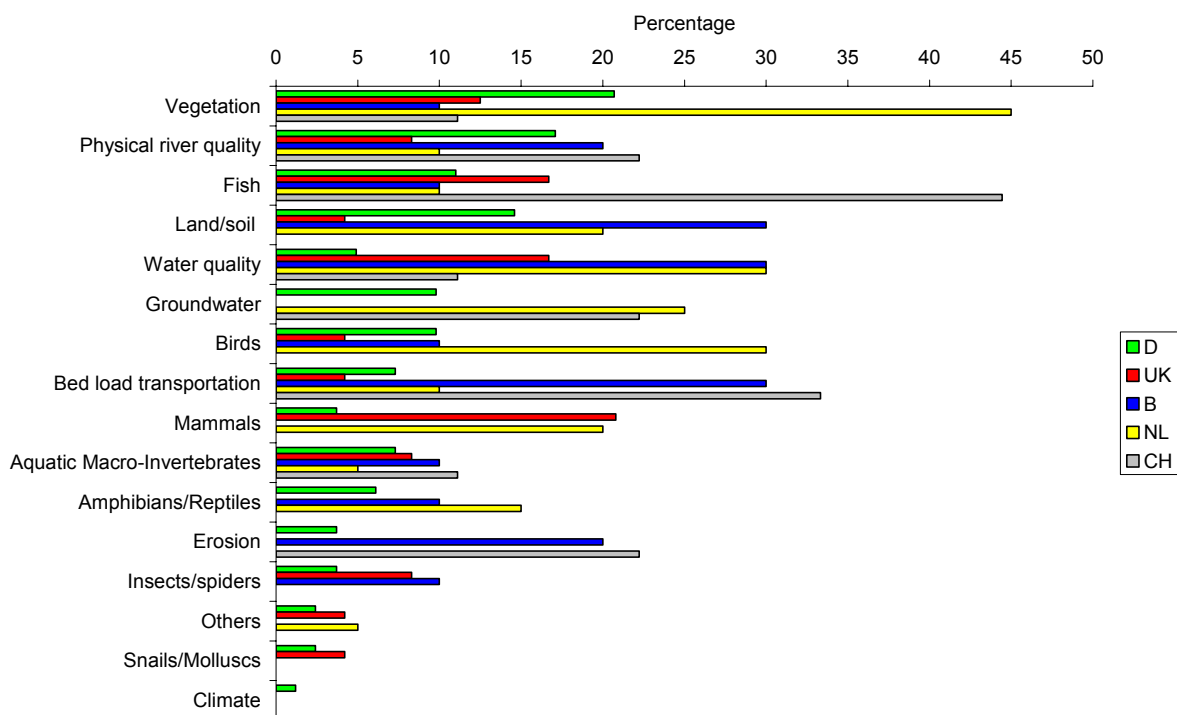


Figure 4: Areas of the ecological system, which were affected by problems occurring during the realisation of the last flood management measures. Based on answers (%) to question no. 11

Again there is quite a strong diversity in the answers. In most countries it looks like during the realisation of this recent management measures there have been rather little impacts on most parts of the ecosystem. However, again there are the following country-related peculiarities:

- Vegetation is very often mentioned as being affected in The Netherlands.

In a densely populated country like The Netherlands with rather little nature area left, the awareness of showy and important elements of nature, such as plants, is generally high. Furthermore, we assume that this refers mostly to dyke relocation, which usually alters site conditions for plant habitats.

- In Switzerland problems occurred often regarding the fish fauna.

This statement cannot be related to the most common measure realised in Switzerland (Widening of drainage channels → Q7).

- Impacts on the soil system and water quality caused problems in The Netherlands and Belgium.

In densely populated countries like The Netherlands and Belgium with a mostly intensive agricultural land-use and comparably little natural area left, the awareness of intact soils and clean water as elementary resources is generally high.

- The groundwater system was identified to be affected in The Netherlands and Switzerland.

In The Netherlands this could refer to a rather common groundwater-quality problem caused by the widespread intensive agricultural land-use. In both countries no particular linkage with any other measure (→ Q7) could be established.

- Problems with bed-load transportation occurred in Switzerland and Belgium during the realisation of the last measure.

In Switzerland this problem can be related to the measure of widening of drainage channels. Certainly, in Belgium the measure "non-operated flood-control basin" might have had a negative impact on bed-load transportation.

- Impacts on mammals were a topic in the United Kingdom and The Netherlands.

No linkage to the last type of measure realised can be established. Generally there seems to be a high awareness and concern about animals in these countries.

- Problems with erosion occurred in Switzerland and Belgium.

In any country erosion may cause increased silting of flood-control basins with the consequence of decreasing storage volumes. Why this is judged to be especially important in Switzerland and Belgium remains a bit uncertain.

Many of the ecological impacts could be related to the last measure realised. In some cases we think that the addressee referred to already existing problems within the region.

Q12 Impacts on sectors of the administrative and planning system

Question no. 12 also referred to question no. 10: *"Did any ecological problems occur during the realisation of this last flood management measure?"*

With question no. 12 we wanted to know which sectors were affected by these problems. The aim was to identify common conflict sectors.

Table 4: Overview of answers to question no. 12 "Which sectors were affected by these problems? High numbers are indicated in bold.

Sector affected	NWE		D		UK		B		NL		CH	
	#	%	#	%	#	%	#	%	#	%	#	%
<i>Total number of answers</i>	153	100	81	100	22	100	9	100	16	100	9	100
Nature conservation	51	34	23	28	5	21	5	50	14	70	4	44
Agriculture	38	25	14	17	4	17	6	60	9	45	3	33
Local authorities	36	24	15	18	1	4	7	70	8	40	3	33
Private persons	32	21	12	15	5	21	5	50	7	35	2	22
Spatial planning	25	17	6	7	1	4	4	40	11	55	2	22
Fishery	19	13	10	12	3	13	0	0	0	0	5	56
Sewage services	8	5	5	6	0	0	1	10	1	5	0	0
Public interest group	8	5	3	4	1	4	1	10	3	15	0	0
Drinking water supply	7	5	4	5	0	0	0	0	1	5	1	11
Forestry	7	5	5	6	0	0	0	0	0	0	1	11
Shipping	6	4	3	4	0	0	1	10	1	5	0	0
Other water boards	6	4	0	0	3	13	0	0	3	15	0	0
Others:	4	3	0	0	0	0	2	20	1	5	1	11

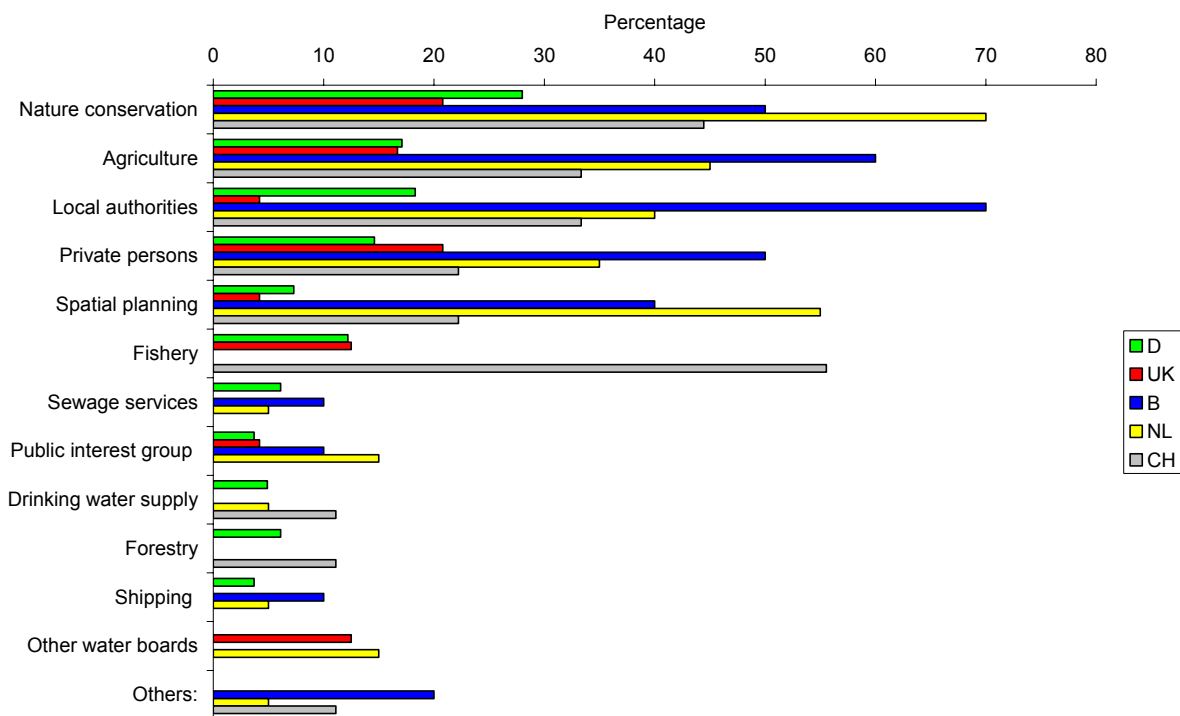


Figure 5: Sectors of the administrative and planning system, which were affected by problems occurring during the realisation of the last flood management measures. Based on answers (%) to question no. 12

There are notable differences in the answers, especially comparing the Benelux states and Switzerland with Germany and the United Kingdom. In detail these are:

- Nature conservation is often affected in The Netherlands, Belgium and Switzerland. The same is true for agriculture and local authorities.

According to our experience this statement is due to the public awareness of problems related to nature conservation in these countries. In The Netherlands and Belgium, agriculture is considered as very important and hence, often affected. Apparently there is much more involvement of local authorities in the planning process than in other countries.

- Private persons and spatial planning caused problems in The Netherlands and Belgium.

This statement could be explained by the high population density especially in The Netherlands and the resulting importance of spatial planning.

- Apparently fishery is very often affected in Switzerland

We have no interpretation at hand to explain this answer.

Summing up the outcome, the **most relevant conflict areas** are indeed almost all related to the **ecosystem** or parts of it, such as vegetation, fish, groundwater, soil etc. Consequently, on the administrative level, nature conservation ranks high in bearing a notable conflict potential. Furthermore, **authorities representing important stakeholders** such as agriculture, local community authorities and fishery can cause problems in some countries. A special case is the conflict potential associated with the **spatial planning authorities in The Netherlands and Belgium**.

Q13 Time of occurrence of 'ecological' problems during the planning process

Question no. 13 referred to the time in time when problems related to ecology occurred. The aim was to identify deficits in communication and/or interdisciplinary cooperation during the planning process.

Table 5: Overview of answers to question no. 13 "At which point in time did the problems related to ecology occur?" High numbers are indicated in bold.

Time of occurrence of problems related to ecology	NWE		D		UK		B		NL		CH	
	#	%	#	%	#	%	#	%	#	%	#	%
<i>Total number of answers</i>	153	100	81	100	22	100	9	100	16	100	9	100
During planning	38	25	17	21	3	13	5	50	8	40	4	44
Prior to planning	22	29	10	12	2	8	3	30	4	20	2	22
During realisation	20	13	9	11	1	4	1	10	4	20	4	44
After the planning, prior to realisation	17	11	8	10	1	4	2	20	5	25	0	0
After realisation	3	2	2	2	0	0	1	10	0	0	0	0
During a flood event	3	2	2	2	0	0	0	0	0	0	0	0
At another time	1	1	1	1	0	0	0	0	0	0	0	0

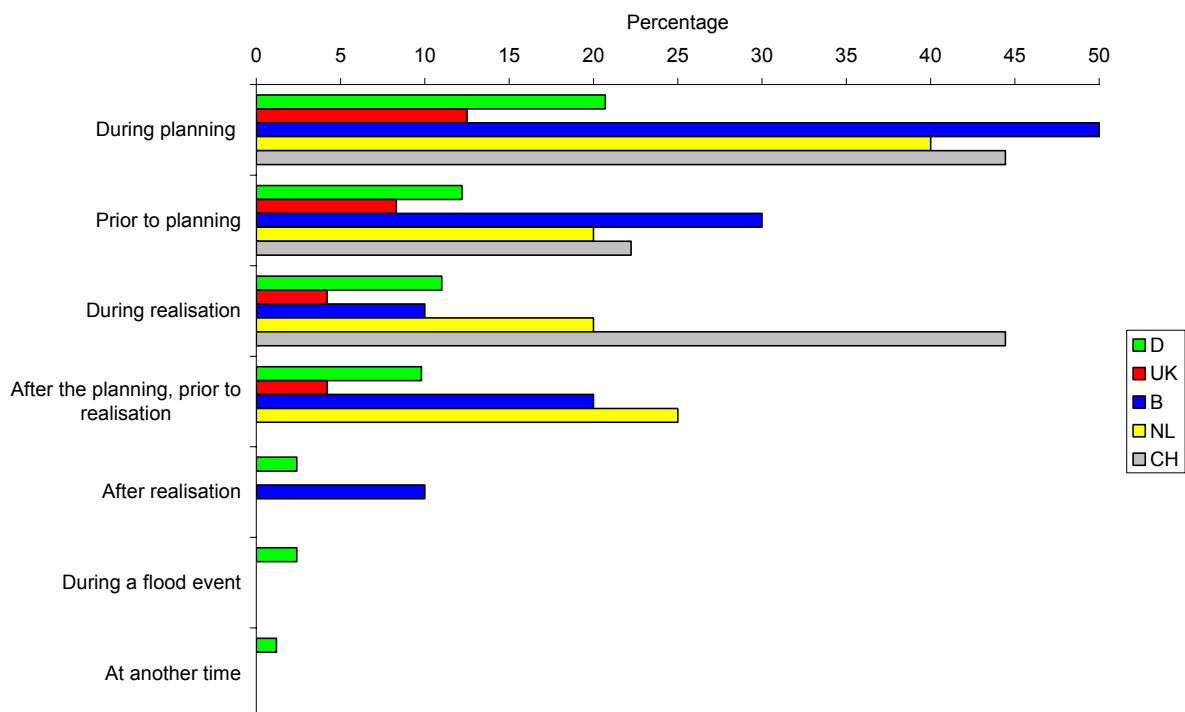


Figure 6: Time of occurrence of problems related to ecology. Based on answers (%) to question no. 13

The Benelux states and Switzerland revealed a considerable amount of problems during the whole planning process, while in Germany and the United Kingdom these seem to be less pronounced. In detail:

- Most problems are encountered prior to planning and during planning in Belgium, The Netherlands and Switzerland.
- During realisation of a measure most problems occur in Switzerland and The Netherlands.
- After planning but prior to the realisation of a measure sometimes problems occurred in The Netherlands and Belgium.

Potential reasons for these findings are discussed in a special section below (page 32).

Q14 Consulting other groups or public bodies during planning

Question no. 14 referred to if and which other groups or public bodies were consulted while the last measure was in the planning process. The aim was to get insight into the participatory process.

Table 6: Overview of answers to question no. 14 "Which other groups or public bodies were consulted while the last measure was in the process of planning?" High numbers are indicated in bold.

Consultancy of other groups or Public bodies during planning	NWE		D		UK		B		NL		CH	
	#	%	#	%	#	%	#	%	#	%	#	%
<i>Total number of answers</i>	<i>153</i>	<i>100</i>	<i>81</i>	<i>100</i>	<i>22</i>	<i>100</i>	<i>9</i>	<i>100</i>	<i>16</i>	<i>100</i>	<i>9</i>	<i>100</i>
Nature conservation authority	122	81	70	85	17	71	7	70	17	85	8	89
District/county councils	115	76	70	85	9	38	10	100	16	80	6	67
Private persons	70	46	49	60	8	33	2	20	8	40	1	11
Nature conservation association (NGO)	63	42	42	51	6	25	5	50	6	30	3	33
Fishery authority	62	41	45	55	4	17	0	0	1	5	9	100
Agricultural union	57	38	36	44	1	4	3	30	11	55	4	44
Spatial planning authority	50	33	18	22	1	4	7	70	15	75	6	67
Forestry authority	31	21	22	27	1	4	0	0	1	5	6	67
Public interest group	28	19	16	20	5	21	1	10	4	20	1	11
Others	24	16	12	15	5	21	2	20	3	15	2	22
Drinking water supplier	22	15	16	20	1	4	0	0	2	10	2	22
Other water boards	21	14	8	10	5	21	1	10	5	25	0	0
Sewage services	19	13	16	20	1	4	1	10	0	0	0	0
shipping authorities	12	8	8	10	0	0	2	20	0	0	0	0
None	3	2	2	2	0	0	0	0	1	5	0	0

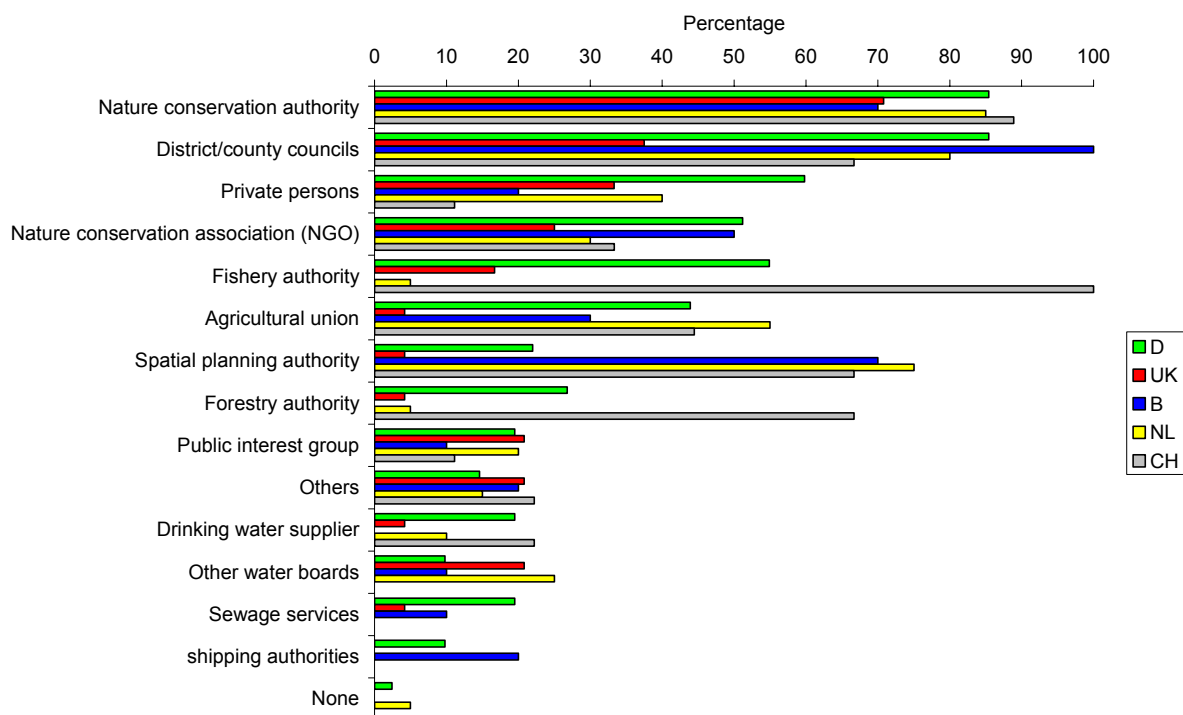


Figure 7: Consulting other groups or public bodies during planning. Based on answers (%) to question no. 14

The majority of the responsible persons of all countries stated that they searched for consultancy and/or participation of the nature conservation authorities. Sometimes

NGOs were important. There was a similar agreement, except for the United Kingdom, that district and county councils and, to a lesser extent, agricultural unions are included in the planning process. However, there are some peculiarities:

- To seek advice from the fishery authority seems to happen very frequently in Switzerland and often in Germany.

Referring to Switzerland, this statement is in line with the one that fishery is very often affected by the last measure implemented (→ Q7). Based on our experience in Germany there is also an increased sensitivity of private interest groups for fishery.

- Consultancy from spatial planning authorities is very often mentioned in The Netherlands, Belgium and Switzerland.

This statement is in line with the one given in Q12. Concerning Switzerland there is no interpretation available.

- To include the forestry authority was mentioned often in Switzerland.

We assume that in Switzerland forestry is traditionally considered to be important.

In general, it seems that quite many authorities and interest groups are regularly involved in the planning process.

Question no. 15. "How was the decision made regarding the last undertaken measure?" just served as general information and was not analysed further.

Q16 Important factors in planning and realising a measure

Question no. 16 referred to the importance of certain factors while making a decision. This question aimed to identify key factors while planning and also potential conflict areas.

Table 7: Overview of answers to question no. 16 "How important were the following factors, on a scale of 1 (not important) to 6 (very important), while making decisions regarding the last measure?" High numbers are indicated in bold. x = average value, sd = standard deviation.

Factor	NWE		D		UK		NL		B	
	x	sd	x	sd	x	sd	x	sd	x	Sd
Short-term flood prevention	5.4	1.4	5.5	1.5	5.2	1.3	5.3	1.3	5.3	1.2
Reduction of damage potential	5.0	1.0	5.1	1.1	5.2	1.1	4.7	0.7	4.9	0.9
City councils	5.0	1.0	5.3	1.3	4.1	0.6	4.4	0.7	5.0	1.1
Increased flood protection	4.9	0.9	5.0	1.0	3.6	0.5	5.1	1.1	5.1	1.0
Investment cost	4.7	0.8	4.5	0.7	5.2	1.1	4.8	0.9	4.1	0.5
Ecology	4.4	0.6	4.5	0.6	4.6	0.8	4.1	0.5	3.9	0.7
Nature conservation authority	4.1	0.5	4.2	0.6	3.9	0.6	4.0	0.6	4.0	0.8
Nature conservation association	4.0	0.5	4.1	0.5	4.5	0.9	4.0	0.8	3.4	0.8
Private persons	4.0	0.4	4.2	0.5	4.1	0.6	4.0	0.6	3.3	0.7
Operational costs	3.8	0.4	3.7	0.4	4.2	0.5	3.7	0.5	3.2	0.7
Public interest group	3.5	0.3	3.4	0.4	3.9	0.6	4.1	0.6	3.5	0.5
Spatial planning authority	3.5	0.3	3.0	0.2	3.6	0.4	4.3	0.8	4.8	1.0
Agricultural union	3.1	0.3	3.1	0.4	2.9	0.3	3.5	0.5	3.4	0.5
Fishery authority	3.1	0.3	3.1	0.4	3.1	0.2	2.2	0.3	2.2	0.5
Sewage services	2.8	0.2	3.0	0.3	2.9	0.8	2.4	0.3	3.2	0.4
Other water board	2.8	0.2	2.1	0.2	3.7	0.6	3.6	0.6	4.5	0.7
Drinking water suppliers	2.7	0.3	2.6	0.4	2.8	0.7	2.7	0.3	3.0	0.7
Forestry authority	2.5	0.2	2.6	0.2	2.2	0.3	2.5	0.4	2.0	0.4
Shipping authority	1.9	0.2	1.8	0.2	1.4	0.3	3.0	0.5	2.0	0.4

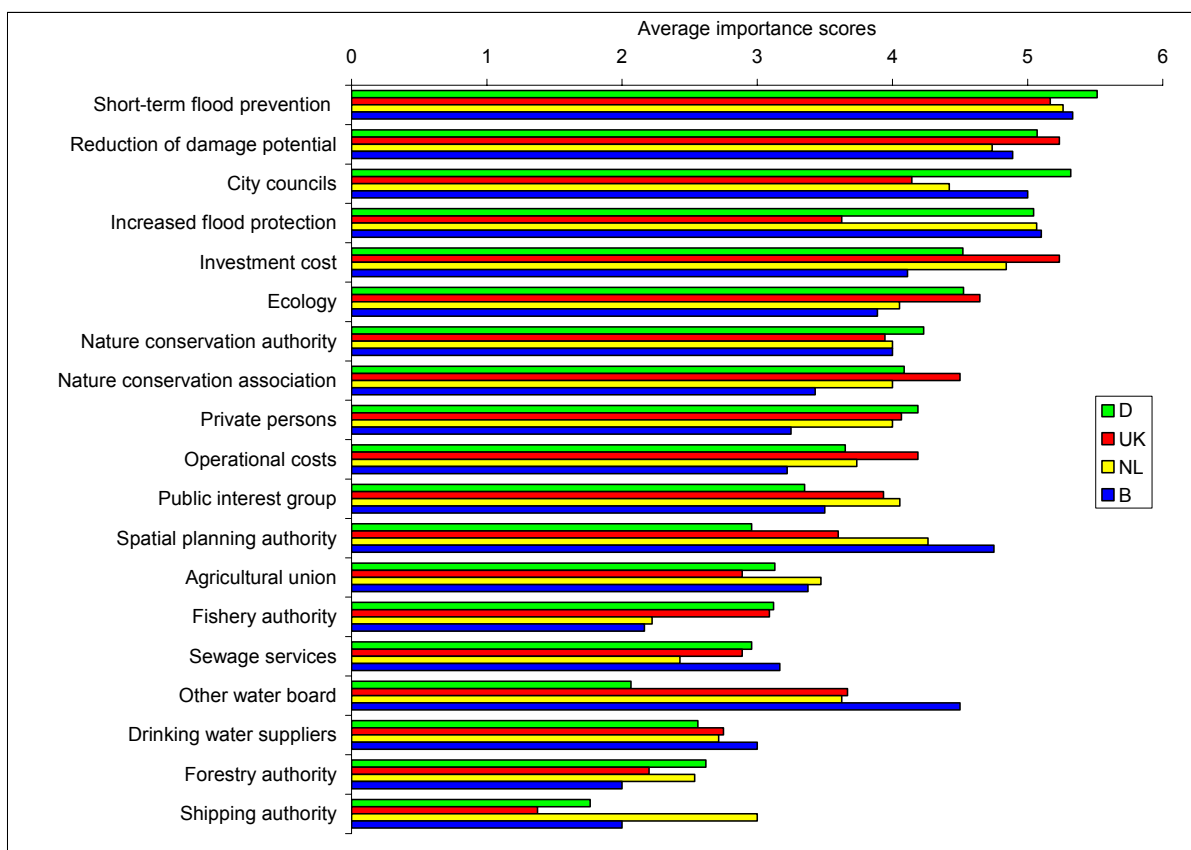


Figure 8: Average importance of certain factors while making a decision regarding the planning or realising of flood prevention measures.

Realising the last flood-prevention measure, the most important aims were to achieve short-term flood prevention and to reduce the damage potential. Furthermore, there was good agreement on the high importance of better flood protection and the investment costs. The issues concerning ecology (also including nature-conservation authorities and nature-conservation association) were rated similarly to be somewhat less important than the previous factors.

Some country-related peculiarities were:

- High importance of city councils in Germany and Belgium.

In Germany, water boards are closely linked by their organisational structure with city councils. The executive board is also part of the district council. We have no interpretation for Belgium at hand.

- High importance of the spatial planning authority in The Netherlands and Belgium.

Being a densely populated country, The Netherlands have to pay much attention to spatial-planning issues, therefore its importance.

- High importance of the fishery authority in the United Kingdom and Germany

For Germany this statement is in accordance with the one given to Q14. For England there is no interpretation at hand. Switzerland is not included in this analysis.

- High importance was given to other water boards in Belgium, while in Germany they were considered less important.

For Germany, we must interpret that cooperation between water boards is poor. For Belgium we know that currently water boards are being built up, so that the country undergoes a process of transformation in the water-management sector. Therefore, we cannot provide an interpretation now.

- The shipping authority played a more important role in The Netherlands than in the other countries.

This is due to the fact that there is a dense network of navigable waterways in The Netherlands.

Q17 Models and/or decision-support systems generally used to assist the planning process

Question no. 17 referred to the use of software to support the planning process. This question aimed at identifying whether it is common to apply such software and which kind of software is generally used. Furthermore, it asked for the potential willingness use a Decision Support System in the future.

The names and types of models and software used as well as some conclusions are listed in the Annex (Table1 - 5). We obtained the following result:

Model type	hydrological	hydraulic	groundwater	sediment transport	ecology	DSS	GIS
No. of models used	14	16	3	2	1*	0	14

* STOWA: rather a method than a model

Apart from these models, various "manual" methods were mentioned (See Table 1 - 5 in the Annex), which are not implemented in software.

In conclusion, it seems that a variety of hydrological and hydraulic software is quite often and widely used. Groundwater and sediment transport model are applied less often. A drastic deficit in ecological models and DSS software is obvious. Apparently water managers do not know such software, do not trust them or simply do not intend to approach ecological or decision problems in a systematic and computer-aided way.

Q18 Operation of models

Question no. 18 referred to whether the aforementioned models are operated internally in the organisation or by an external consultant. This question aimed at getting an idea of the willingness of persons working in water management to deal with technical software. It turned out that 16 % of the addressees operated the models internally, 33 % used external advisors, and a majority of 51 % operated the model internally but with the help of external advice.

Question 19, regarding the position of the addressee in her/his institution was skipped because of the extreme heterogeneity of answers, which could not be classified.

Q20 Professional background of the addressees

In question no. 20, the addressees were asked about their profession or professional qualifications. We managed to roughly classify the answers into 5 classes. The results are presented in figure 9.

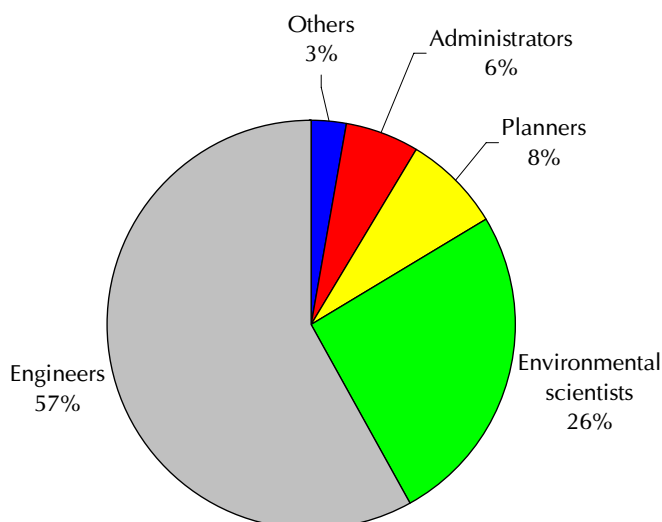


Figure 9: Professions of 141 addressees

The big majority were engineers followed by environmental scientists (biologists, geographers etc.), and a few planners and administrators.

Analysis of some hypotheses and first conclusions

To test some hypotheses or assumptions ("if...then"), further analyses of the questions, including some cross-table analyses (one question versus another question) were carried out. The aim of such analyses was to get more insight into the problems commonly occurring in flood management.

The analyses were based on the complete data set and hence are biased towards the German situation (majority of answers).

The most important results are presented.

- *Hypothesis (Q7 vs. Q11): There were certain types of measures especially affecting the factor "physical river quality".*
 - Significant correlations could be found for the measures "re-naturalisation", "agriculture adapted to the needs of the individual site", and "relocation of dykes/banks". The first two measures contribute to an improvement of the physical water quality. In case of dyke/bank relocation, the effect must be evaluated for each case separately.

- *Hypothesis (Q7 vs. Q11): There were certain types of measures especially affecting the factor "water quality".*
 - Significant correlations could be found for the measures "retention of rain water" and "operated flood-control basin". In practice, there is a possible interpretation of both correlations. A number of flood-control-basins are operated with permanent backwater and therefore frequently suffer problems with water quality. A sudden release of this water might have severe effects on the downstream ecosystem. Increasing the capacity for the retention of rain water prevents frequent overflow of the sewer system. This contributes to an overall enhancement of the water quality in the receiving river course.

- *Hypothesis (Q7 vs. Q11): There were certain types of measures especially affecting the factor "bed-load transportation".*
- Significant correlation could be found for the measure "keeping floodplains free and verification of their legal status". This statement could not be related directly to a known physical process affected by the measure.

- *Hypothesis (Q7 vs. Q16): The importance of operational costs was considered to be different depending on whether operated flood-control basins or dykes were built.*
- This assumption proved to be statistically wrong.

- *Hypothesis (Q10 vs. Q14): The more public interest groups (NGOs etc.) and authorities were involved in the planning process, the fewer problems occurred.*
- No significant correlation could be found. Also no significant correlation could be found that these groups caused more problems if involved in the planning process.

- *Hypothesis (Q11 vs. Q12): There were certain types of ecological problems showing up during the realisation of the latest flood management measure that especially affected the sector "nature conservation".*
- A significant correlation could be found for those ecological problems associated with vegetation. Often an explicit area of affected vegetation can be defined. Furthermore, the impact on vegetation is rather well-known and can be assessed. Hence, it is easy to address and quantify problems related to vegetation.

- *Hypothesis (Q12 vs. Q14): If problems occurred regarding spatial planning, the spatial planning authorities were involved.*
 - This assumption proved to be statistically true. But a causal relationship identifying the spatial planning authority as originator (cause) should not be concluded, because most likely the identified problem had existed before and was the reason why the spatial planning authority became involved.

- *Hypothesis (Q16 vs. Q20): Engineers consider ecological issues as less important.*
 - No significant correlation could be found. However, environmental scientists tend to consider the spatial-planning authority as being more important than engineers do. The same is true concerning the factor "investment costs".

General conclusions

First, it has to be repeated that although we have received a fairly good number of responses (12%) to our questions, the picture still might be biased, because of the "natural" drawback of the method (questionnaire) applied.

The overall bias in the answers is clearly towards the German perception of the topic, because 57% of all answers came from this country. Since Ireland (1%) and France (3%) and Luxembourg (1%) are highly underrepresented in the answers, no conclusions were drawn regarding these countries.

Nevertheless, we believe that we have obtained a good overview and some essential ideas of the chances and problems of the current planning procedure in some big countries in the NWE region.

We identified two topics, from which it appears especially suitable to draw more conclusions, (1) the effectiveness of flood management measures and (2) the time of occurrence of problems.

Effectiveness of flood-management measures

The first topic refers to the current practice of realising flood management measures (question 7). We derived two criteria for further analysis:

1. We subjectively classified the different measures into two categories addressing the scale (area), on which the measure is realised, works on, or has an impact on. Renaturalisation, for instance, is currently often realised as a local, small-scale measure, which needs rather little area to be realised, while keeping the floodplains free and verification of their legal status is a large-scale measure that usually needs and affects a big part of the floodplain.

Most likely, large-scale measures are more effective for flood-damage prevention in terms of naturalness, cost-benefit ratio, and robustness towards extreme flood events.

2. We tried to assess the effect of each measure on the three targets "improvement of flood protection", "reduction of absolute damage potential", and "benefit for nature".

The results are shown in Figure 10.

	Number of answers (%)				Improvement of flood protection	Reduction of damage potential	Benefit for nature
	0%	2%	4%	6%			
Re-naturalisation	13%				0	0	++
Non-operated flood control basin	11%				++	-	0
Widening of drainage channels	10%				+	-	+
Establishment of buffer strips on river banks	10%				0	0	+
Retention of rain water	9%				0	0	0
Construction of dykes / banks	9%				++	--	-
Keeping flood plains free and verification of their legal status	8%				0	++	++
Reclamation of retention areas	7%				+	+	+
Non-operated retention areas	6%				+	+	+
Operated flood-control basin	5%				++	-	0
Relocation of dykes/banks	4%				++	0	+
Agriculture adapted to the needs of the individual site	3%				0	+	+
Ecological forest development	1%				+	0	++

Figure 10 Last realised kind of flood management measure based on answers (overall percentages) to question no. 7 and the assessment of the degree of fulfilment of three criteria ranging from --: very counterproductive to ++: very supportive, 0: neutral. Red bars are judged to be small-scale measures, blue bars are large-scale measures.

About 70% of all measures are classified as small-scale measures, about 30% as large-scale in their effects and demand of land consumption.

The overall result of the assignment to the targets is visualised in Figure 11.

It can be concluded that 55% of all measures are likely to serve the aim to improve flood protection. Only 26% of all measures are estimated to efficiently contribute to a reduction of the damage potential, while 74% may have no or only little effect.

About 36% of all measures are estimated to be beneficial to nature.

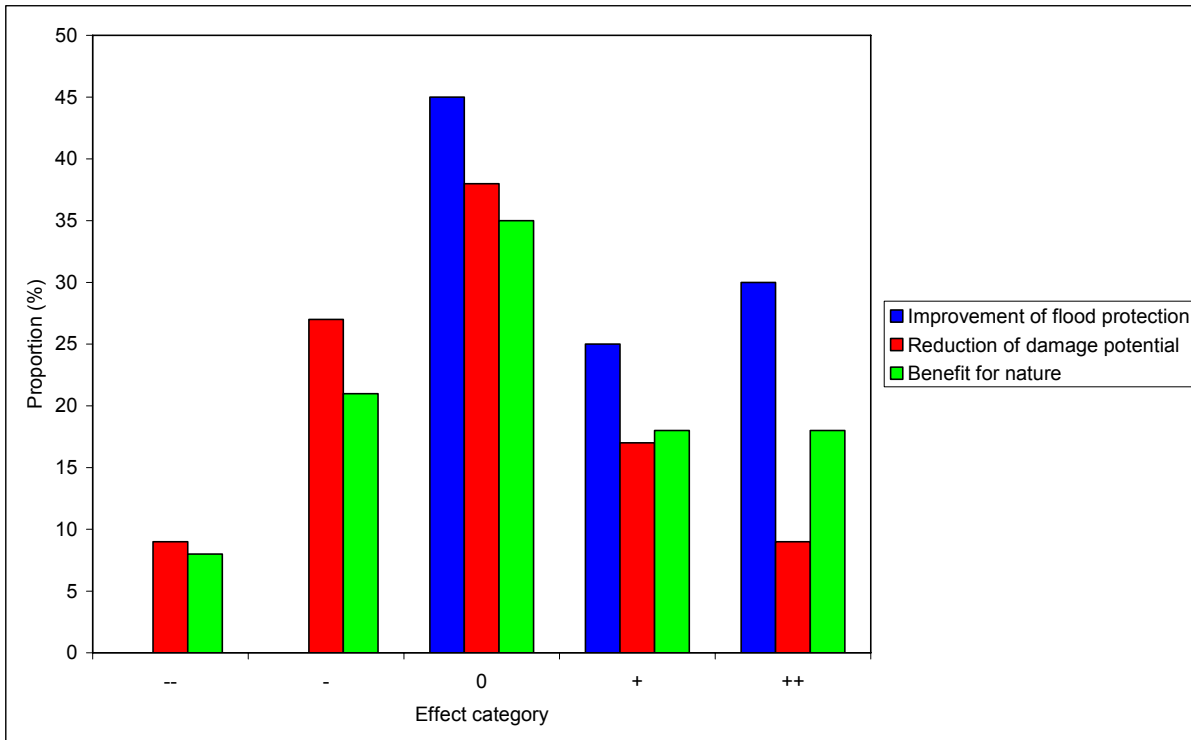


Figure 11 Assignment of all kind of flood management measure (question no. 7) to effect-categories regarding their contribution to the target states. Effect categories: --: very counterproductive to ++: very supportive, 0: neutral.

Extracting the essence of these figures leads to the conclusion that today small-scale, and in some regard less efficient flood-management measures are realised.

Many measures (24%) are carried out with the principal objective to improve the situation of nature, eventually hoping for a secondary flood reduction/retention effect.

Time of occurrence of 'ecological' problems

Looking at the overall picture (Figure 12) regarding the question of the time of occurrence of problems related to ecological issues during the planning process, it can be seen that many problems (37%) commonly occur before planning has started. Another big proportion of problems occurs during (21%) and after (29%) the planning process. A remaining 15% of 'ecological' problems occur during the realisation phase of a measure.

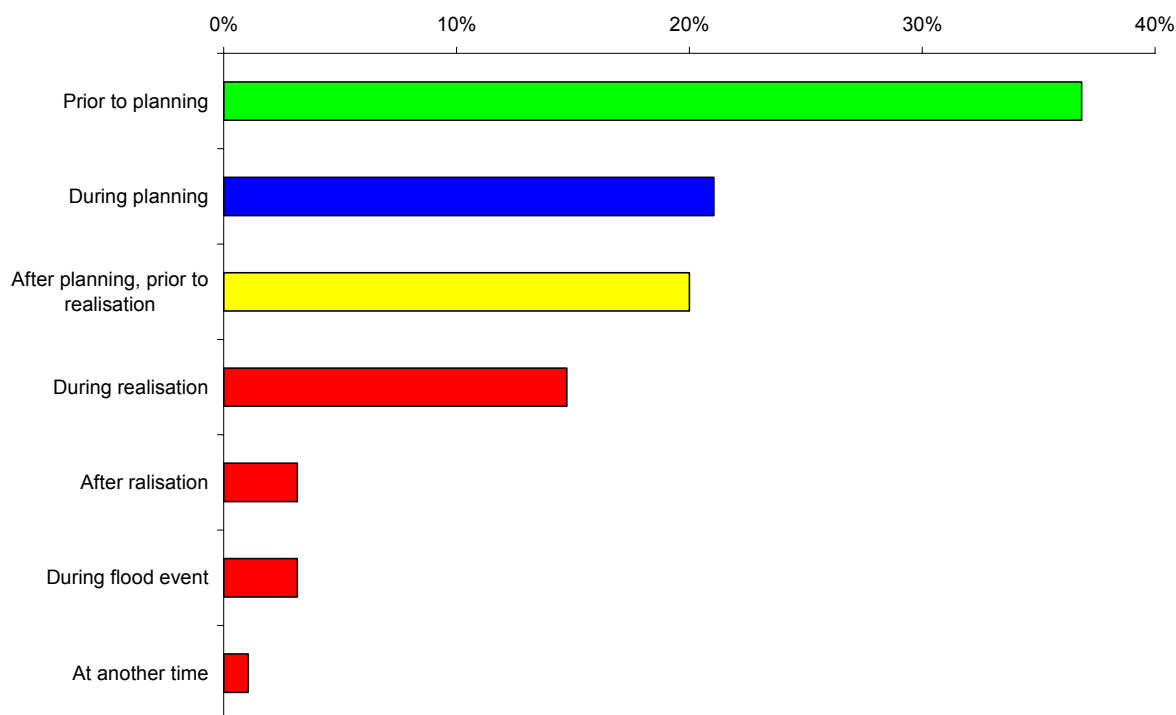


Figure 12 Time of occurrence of problems related to ecology. Based on the overall proportion (%) of answers to question no. 13. The colour coding serves as reference for the text below.

The interpretation of the picture is:



The high amount of problems **prior to planning** can be considered as rather normal; they are probably the reason for the planning. This is the time when discussions with stakeholders (incl. ecologists) should be started. If those discussions reached an agreement of all partners (in an ideal case), subsequent problems during the further planning phase would have been avoidable.




However, in the real world not all problems are solved in the pre-planning phase and hence, are transferred **into the planning** procedure. This is somehow "normal" or "human" but could eventually be avoided by better communication and complete stakeholder participation during the pre-planning or early planning process.



After the final **planning** has been agreed on, some problems still may arise, because certain stakeholders have not been involved or some administrative settings have changed due to a long-lasting planning procedure. Again, a better communication and

participation process could help to (partly) avoid such problems. At this stage of the planning procedure changes would still be possible.



If "ecological" problems occur **during the realisation of a measure**, obvious deviations from the planned procedure or poorly executed construction work or even accidents can be the reasons. Disregarding of legal obligations such as disturbances or noise during the breeding season of birds could also be the cause for protests by ecologists. Furthermore, the planner might have failed to clearly visualise the dimension of the planned project and hence the strength of the disturbance effect. Besides the strict observance of legal obligations and close adherence to the plan, again a much better communication and visualisation strategy could be a solution.

All **subsequent problems** definitely indicate a poor realisation of the planned work, insufficient stakeholder participation, and a lack of appropriate communication strategy. Such problems should have been solved at a much earlier stage of the planning process.

These results allow the conclusion that the whole planning process might be improved in a way that less problems occur. Especially the pre-planning process seems to bear a high conflict potential. For the success of planning it is crucial to recognise and solve any problem as early as possible. Much better communication and visualisation techniques and strategies could be a solution. We are convinced that the nofdp IDSS will facilitate to achieve this goal.

Conclusion for the nofdp project

In most countries there is already a rather high awareness of ecological issues. Certainly the implementation of the EC Water Framework Directive contributed to this.

As indicated by the high amount of realised re-naturalisation measures, the conclusion can be drawn, that ecological questions and targets sometimes dominate the planning although flood management is the goal. This may be due to the fact that re-naturalisation measures are favoured by arguing that they (also) contribute to increase flood protection. In case of severe flood problems certainly other measures will be favoured. However, in the cases of re-naturalisation measures mentioned in this questionnaire (24%) it might have been unproblematic to give a higher priority to the ecological targets.

To avoid potential future misconceptions about the effectiveness of such measures (compare Figure 10, page 26), there is a need to clearly address what certain measures are good for and what not. For nofdp this can be done by including best-practice and worse-case studies into the knowledge base and the guidelines for further reference.

Regarding the potential to reduce 'ecological' and any other conflicts before, during and after the planning process, a strong emphasis should be given to any possibility to facilitate communication. This shall be achieved mainly by using the IDSS (incl. the knowledge base) as communication tool.

Some countries show pronounced differences in how they perceive and handle ecological issues. Hence, the nofdp products must be multi-lingual in order to provide an optimised understanding of all issues.

Lessons learned

The answers to the questionnaire we have received are somewhat unbalanced in the sense that many answers came from Germany and very few from France. Furthermore, it appears that in some cases the questionnaire did not find its way to the "right" addressee.

We speculate that we might have failed to use the right words or the right "tone" in the accompanying letter and the questionnaire itself in some cases (e.g. United Kingdom, Ireland and France).

We failed to ask for the general approval of the German Association of Cities (Deutscher Städtetag). As a consequence, some city councils may not have answered. For the United Kingdom and Ireland we suspect that we failed to identify the right persons or to consider the right administrative level.

In the case of France, we most likely failed to identify enough contact persons. This is eventually due to our lack of knowledge regarding the French administrative structure and/or that we missed to include higher hierarchies in the information process.

We conclude that it is essential to know the administrative structures in the countries to be addressed and to check well the wording in any language used.

Annexes

Questionnaire in English

Tables of commonly used models or methods in

- Hydrology
- Hydraulics
- Ground water
- Sediment transport
- Ecology

Part A – General information about your institution

The following questions refer to general information concerning your institution and fields of activity. Please try to fill in the form completely.

1. In which country is your institution located?

Country (e.g. England): _____

2. What are the fields of activity of your institution? (Multiple answers are possible)

Surface water / Flood protection

Groundwater

Drinking water supply

Nature conservation

Sewage services

Others: _____

3. How many persons are employed in your institution?

_____ Persons

4. What is the size of the area that your institution is responsible for?

_____ [km]

5. How many catchment areas are you responsible for?

_____ areas

Please describe the three most important catchment areas:

Catchment Area	name of the water body	Is your institution completely or partly responsible for the catchment area?	Size of the catchment area	Land-use in the area	Dominant relief
1	Water body _____	<input type="checkbox"/> completely <input type="checkbox"/> partly	_____ [km]	Farming ca. _____ % Forestry ca. _____ % Urban area ca. _____ %	<input type="checkbox"/> mountainous <input type="checkbox"/> hilly <input type="checkbox"/> flat
2	Water body _____	<input type="checkbox"/> completely <input type="checkbox"/> partly	_____ [km]	Farming ca. _____ % Forestry ca. _____ % Urban area ca. _____ %	<input type="checkbox"/> mountainous <input type="checkbox"/> hilly <input type="checkbox"/> flat
3	Water body _____	<input type="checkbox"/> completely <input type="checkbox"/> partly	_____ [km]	Farming ca. _____ % Forestry ca. _____ % Urban area ca. _____ %	<input type="checkbox"/> mountainous <input type="checkbox"/> hilly <input type="checkbox"/> flat

Part B – Ecology and Flood Management

The following section refers to ecological or flood-management measures in your field of responsibility. Please try to fill in the form completely. Multiple answers are possible!

6. Which parts of the ecosystem are of particular importance to your local area? Please mention the 5 most important groups.

- | | | | |
|--|---|--|-------------------------------------|
| <input type="checkbox"/> Groundwater | <input type="checkbox"/> Soil | <input type="checkbox"/> Climate | <input type="checkbox"/> Vegetation |
| <input type="checkbox"/> Water quality | <input type="checkbox"/> Mammals | <input type="checkbox"/> Aquatic Macro-
Invertebrates | <input type="checkbox"/> Fish |
| <input type="checkbox"/> Physical river qual-
ity | <input type="checkbox"/> Amphibi-
ans/reptiles | <input type="checkbox"/> Insects/spiders | <input type="checkbox"/> Birds |
| <input type="checkbox"/> Snails/molluscs | <input type="checkbox"/> Others: _____ | | |

7. What were the most recent flood management measures that were carried out?

- | | |
|---|---|
| <input type="checkbox"/> Construction of dykes/banks | <input type="checkbox"/> Re-naturalisation |
| <input type="checkbox"/> Retention of rain water | <input type="checkbox"/> Operated flood-control basin |
| <input type="checkbox"/> Non-operated retention areas | <input type="checkbox"/> Relocation of dykes/banks |
| <input type="checkbox"/> Non-operated flood-control basin | <input type="checkbox"/> Agriculture adapted to the needs of the
individual site |
| <input type="checkbox"/> Ecological forest development | <input type="checkbox"/> widening of drainage channels |
| <input type="checkbox"/> Reclamation of retention areas | <input type="checkbox"/> Establishment of buffer strips on river
banks |
| <input type="checkbox"/> Keeping floodplains free and verification
of their legal status | <input type="checkbox"/> Others: _____ |

Which catchment areas (compare question 5) have been the subject of these measures?

- 1 2 3

8. When has this last flood management measure been carried out?

_____ (Year)

9. Did it affect any conservation areas (e.g. FFH (guideline 92/43/EWG), Ramsar ...) located within your area of responsibility?

- yes no

10. Did any ecological problems occur during the realisation of this last flood management measures?

- yes (Please go to question 11) no (Please go to question 14)

11. Which areas of the ecological system were affected by these problems?

- | | | | |
|--|---|--|-------------------------------------|
| <input type="checkbox"/> Groundwater | <input type="checkbox"/> Land/soil | <input type="checkbox"/> Climate | <input type="checkbox"/> Vegetation |
| <input type="checkbox"/> Water quality | <input type="checkbox"/> Mammals | <input type="checkbox"/> Aquatic Macro-
Invertebrates | <input type="checkbox"/> Fish |
| <input type="checkbox"/> Physical river qual-
ity | <input type="checkbox"/> Amphibians/Reptiles | <input type="checkbox"/> Insects/spiders | <input type="checkbox"/> Birds |
| <input type="checkbox"/> Snails/Molluscs | <input type="checkbox"/> Bed load transporta-
tion | <input type="checkbox"/> Erosion | |
| <input type="checkbox"/> Others: _____ | | | |

12. Which sectors were affected by these problems?

- | | | |
|--|--|--|
| <input type="checkbox"/> Nature conservation | <input type="checkbox"/> Agriculture | <input type="checkbox"/> Forestry |
| <input type="checkbox"/> Fishery | <input type="checkbox"/> Shipping | <input type="checkbox"/> Private persons |
| <input type="checkbox"/> Spatial planning | <input type="checkbox"/> Local authorities | <input type="checkbox"/> Public interest group |
| <input type="checkbox"/> Drinking water supply | <input type="checkbox"/> Sewage services | <input type="checkbox"/> Other water boards |
| <input type="checkbox"/> Others: _____ | | |

13. At which point in time did the problems related to ecology occur?

- | | |
|---|---|
| <input type="checkbox"/> Prior to planning | <input type="checkbox"/> During planning |
| <input type="checkbox"/> After the planning, prior to realisation | <input type="checkbox"/> During realisation |
| <input type="checkbox"/> After realisation | <input type="checkbox"/> During a flood event |
| <input type="checkbox"/> At another time (please specify): _____ | |

14. Which other groups or public bodies were consulted while the last measure was in the process of planning?

- | | | |
|---|---|---|
| <input type="checkbox"/> Nature conservation au-
thority | <input type="checkbox"/> Agricultural union | <input type="checkbox"/> Forestry authority |
| <input type="checkbox"/> Fishery authority | <input type="checkbox"/> shipping authorities | <input type="checkbox"/> Private persons |
| <input type="checkbox"/> Spatial planning authority | <input type="checkbox"/> District/county councils | <input type="checkbox"/> Other water boards |
| <input type="checkbox"/> Drinking water supplier | <input type="checkbox"/> Sewage services | <input type="checkbox"/> Nature conservation
association (NGO) |
| <input type="checkbox"/> Public interest group | <input type="checkbox"/> None | <input type="checkbox"/> Others: _____ |

15. How was the decision made regarding the last undertaken measure?

- | | |
|---|--|
| <input type="checkbox"/> internally | <input type="checkbox"/> in cooperation with a superior authority |
| <input type="checkbox"/> with support by external consultants | <input type="checkbox"/> in cooperation with a secondary authority |
| <input type="checkbox"/> other: _____ | |

Part C – Modelling and decision support systems

17. Which models and/or decision support systems are generally used in your institution or used to assist the planning process? How are they called? Which modelling/decision support systems were used during the last flood management project? (Multiple answers possible)

	Is generally used in the institution	Is used while planning flood management measures	Model was used during the last project	Model not known
Hydrological Model	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/>
Hydraulic Model	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/>
Groundwater model	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/>
Sediment transportation model	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/>
Water quality model	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/>
Ecological Model	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/>
Decision Support Systems (DSS)	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/>
Geographical Information systems (GIS)	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes, namely: _____ <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/>
Other: _____	_____	_____	<input type="checkbox"/> yes <input type="checkbox"/> no	

18. Are the above mentioned models operated internally or by an external consultant?

Internally External advisor both

19. Which is your position in the institution at present?

20. What is your profession (professional qualifications etc.)?

We are very grateful that you have taken the time to fill in this questionnaire.

Many thanks for your participation in the survey "Ecology and Flood Management".



Annex: Tables of commonly used models or methods

Hydrological Models – Rainfall-Runoff Models

Model	Developer(s) or supplier	Remarks
AQUARIUS	U.S. Department of Agriculture, Forest Service	Free-ware, a state-of-art computer model devoted to the temporal and spatial allocation of water among competing uses in a river basin.
Internet link		www.fs.fed.us/rm/value/aquariusdwnld.html
FLUTER	Institut für technisch-wissenschaftliche Hydrologie GmbH	Hydrological rainfall-runoff model for small catchments with a high spatial resolution - no English information available.
Internet link		http://www.itwh.de/S_flutinfo.htm
HYBNAT	Brandt-Gerdes-Sitzmann Wasserwirtschaft GmbH	HYBNAT determines event based discharge from catchments which feature canalised and/or natural flow paths - no English information available.
Internet link		http://www.bgswasser.de/hybnat.htm
HYDRA	Pizer Incorporated	HYDRA is a full-featured programme used to model and design urban drainage systems. Includes the SCS method to determine runoff.
Internet link		http://www.pizer.com/
Inforworks RS River	Wallingford Software	An integrated software solution for simulating flows in rivers, in channels and on floodplains. Rainfall-runoff simulation is available using both event based and conceptual hydrological methods.
Internet link		http://www.idswater.com/water/us/wallingford_software/info_work_rs/75_0/g_supplier_4.html
ISIS Flow	Wallingford Software	ISIS Flow is a tool for designing cost-effective engineering schemes and developing catchment strategies.
Internet link		http://www.wallingfordsoftware.com/products/isis/
KOSIM	Institut für technisch-wissenschaftliche Hydrologie GmbH	The continuous simulation model KOSIM is applied in urban hydrology to dimension combined sewer overflows with or without tanks - no English information available.
Internet link		http://www.itwh.de/S_Pakete.htm
LARSIM	University Freiburg	LARSIM is a raster-based model that contains several modules to describe a number of hydrological sub processes - no English information available.
Internet link		http://www.hydrology.uni-freiburg.de/publika/band11.html
Mike 11	DHI software	MIKE 11 is an industry standard for simulating flow and water level, water quality and sediment transport in rivers which also includes a rainfall-runoff module.
Internet link		http://www.dhigroup.com/Software/WaterResources/MIKE11.aspx
NASIM	Hydrotech – Ingenieurgesellschaft für Wasserwirtschaft	NASIM simulates the discharge from rural and urban catchments. It is used to develop concepts for flood protection and to evaluate the effect of measures aiming at reducing high discharges - no English information available.
Internet link		http://www2.hydrotec.de/vertrieb/nasim/

Model	Developer(s) or supplier	Description
SIMGRO	Alterra, Green World Research	SIMGRO is a mechanistic distributed model with a (nearly) unified saturated-unsaturated flow description at its core. Innovative use is made of dynamic 'metamodelling' techniques for the soil water and surface water.
Internet link	http://www2.wau.nl/ccb/index_files/main_files/downloads/Simgro_CCB2004.pdf	
SOBEK	WL Delft Hydraulics	SOBEK has three basic product lines covering any fresh water management situation in River, Rural and Urban systems alike.
Internet link	http://www.sobek.nl/prod/index.html	
StormNet	Boss International	StormNET™ is a comprehensive storm water and wastewater modelling software available for analysing and designing urban drainage systems, storm water sewers, and sanitary sewers.
Internet link	http://www.bossintl.com/html/stormnet-overview.html	
WinDes	Micro Drainage	WinDes is used by every water services company in the UK and by 90 per cent of the top drainage consultancies. WinDes uses proven and universally adopted methodologies to design and analyse drainage systems, including a flow simulation module, and a comprehensive costing and quantities package.
Internet link	http://www.microdrainage.co.uk/mdwindes_module.asp	
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

Despite a comprehensive and intensive internet based research a number of notions we could not have related to a known software product. However, some of these notions we could have associated with other documents or products:

Notion	Developer(s) or supplier	Remarks
DVWK guidelines	DWA Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V.	The German representative of specialist working in the fields of water management, wastewater and waste - no English information available.
Internet link	http://www.dwa.de/english/willkomm.htm	
FEH	CEH Wallingford	The Flood Estimation Handbook (FEH) is a new publication from CEH Wallingford, giving guidance on rainfall and river flood frequency estimation in the UK.
Internet link	http://www.nerc-wallingford.ac.uk/ih/feh/	
KOSTRA Atlas	Deutscher Wetterdienst	Report that includes statistical analysis of extreme precipitation events covering the whole territory of Germany - no English information available.
Internet link	http://www.dwd.de/de/wir/Geschaeftsfelder/Hydrometeorologie/a_href_pages/KOSTRA-DWD-2000/Grundlagenbericht.pdf#search=%22Kostrat%20dwd%22	
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

We were not able to classify the following names either as software or as a document or product: Egelsyn, Hackesch, HYDRO36, HRB, R-WIN.

There are some conclusions that can be drawn from this analysis and the background information that the nofdp project partners have. There is no indication for one internationally favoured hydrological model. Most rainfall-runoff models are used in those countries, where they have been developed. One reason might be the existing particularities of the respective hydrological regimes that require different modelling approaches. Furthermore, some of the models have been developed especially for modelling the urban environment.

In Germany, the software NASIM was identified as the most frequently mentioned software (7 times). All other models have been stated 2 times as the maximum. However, due to the relative small number of answers received from countries except Germany one cannot conclude that there might not be another more popular rainfall-runoff modelling system.

Hydraulic Models

Category 1: Models based on a conceptual flood routing method

Model	Developer(s) or supplier	Description
FLUSS		FLUSS calculates the water level for a given discharge in symmetric as well as asymmetric profiles - no English information available.
Internet link		http://www.rehm.de/
Hydra	Pizer Incorporated	HYDRA is a full-featured programme used to model and design urban drainage systems. It uses the Hydrographic Simulation Method as the flood route method.
Internet link		http://www.pizer.com/
Hydra-WSP	unknown	HYDRA-WSP is designed to perform one-dimensional hydraulic calculations under stationary flow conditions.
Internet link		No references found
Hydroworks	Engineered Works	Storm water calculation program using Rational Method.
		http://www.softplatz.com/Soft/Business/Calculators-Converters/HydroWorks.html
NASIM	Hydrotech – Ingenieurgesellschaft für Wasserwirtschaft	NASIM simulates the discharge from rural and urban catchments. It contains a channel module that uses the non-linear Kalinin Miljukov Equation - no English information available.
Internet link		http://www2.hydrotec.de/vertrieb/nasim/
TALSIM	SYDRO Consult GbR	TALSIM is a river-basin model including modules for rainfall-runoff modelling, flood routing in open channels and the operation and management of reservoirs. For flood routing it uses the non-linear Kalinin Miljukov Equation.
Internet link		http://www.sydro.de/de/soft_detail.asp?id=9&menu=3&content=17
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

Category 2: 1-D numerical models

Model	Developer(s) or supplier	Description
Duflow	Stichting Toegepast Onderzoek Waterbeheer (STOWA)	Duflow includes a water quality module - no English information available.
Internet link	http://www.mx-groep.nl/producten/Duflow/Duflow-web/	
HEC-RAS	U.S. Army Corps of Engineers	Free-ware - HEC-RAS is designed to perform one-dimensional hydraulic calculations (steady and unsteady for a full network of natural and constructed channels. The unsteady flow component was developed primarily for subcritical flow regime calculations.
Internet link	http://www.hec.usace.army.mil/software/hec-ras/hecras-hecras.html	
Infoworks	Wallingford Software	InfoWorks RS includes full solution modeling of open channels, floodplains, embankments and hydraulic structures. It uses the ISIS flow module (see ISIS flow).
Internet link	http://www.idswater.com/water/us/wallingford_software/info_work_rs/75_0/g_supplier_4.html	
ISIS Flow	Wallingford Software	ISIS Flow is a tool for designing cost-effective engineering schemes and developing catchment strategies. It can simulate either in full unsteady mode, or as an advanced steady state simulation. Flow routing techniques are also available, including Muskingum and VPMC methods.
Internet link	http://www.wallingfordsoftware.com/products/isis/	
Jabron	Hydrotech – Ingenieurgesellschaft für Wasserwirtschaft	Hydraulic simulation software under stationary and unstationary flow conditions
Internet link	http://www2.hydrotec.de/vertrieb/jabron/	
Mike 11	DHI software	MIKE 11 is an industry standard for simulating flow and water level, water quality and sediment transport in rivers. It consists of a hydro-dynamic core module that solves the complete non-linear equations of open channel flow (Saint-Venant).
Internet link	http://www.dhigroup.com/Software/WaterResources/MIKE11.aspx	
Sobek	WL Delft Hydraulics	SOBEK has three basic product lines covering any fresh water management situation in River, Rural and Urban systems alike. The module 1DFLOW is Based upon the complete de Saint Venant Equations, thus including transient flow phenomena and backwater profiles.
Internet link	http://www.sobek.nl/prod/index.html	
WASPLA	Brandt-Gerdes-Sitzmann Wasserwirtschaft GmbH	WASPLA is designed to determine the one-dimensional and stationary course of the water level. The calculation is based on the energy equation derived by Bernoulli - no English information available.
Internet link	http://www.bgswasser.de/waspla.htm#b0	
WSPWIN	Björnsen Beratende Ingenieure	WSPWIN is designed to simulate water level under stationary and unstationary flow conditions - no English information available.
Internet link	http://www.bjoensen.de/	
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

Category 3: 2-D numerical models

Model	Developer(s) or supplier	Description
Hydro AS 2D	Hydrotech – Ingenieurgesellschaft für Wasserwirtschaft	The performance of the Hydro_AS-2D simulation software is based on the numerical solution of the 2D depth averaged flow equation using a finite-volume discretisation.
Internet link		http://www2.hydrotec.de/vertrieb/hydro_as_2d/
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

Despite a comprehensive and intensive internet based research a number of notions we could not have classified either as software nor as any other type of product: DO, FGM, RRZ, Wagua

Conceptual flood routing models and one-dimensional numerical models were commonly used to determine water levels under steady and unsteady flow conditions. At the time it seems that two-dimensional models are not yet state of the art in planning of real world measures. Only 3 addressees are generally using a two-dimensional model. In contrast to the hydrological models, some hydraulic models could have been identified as commonly used. The modelling system Sobek for example is commonly used in The Netherlands. At least 5 addressees are using the model HEC-RAS, which has been developed by the U.S. Army Corps of Engineers. At the same time this is the only hydraulic software which is free-ware. 4 addressees stated that they are using the software Infoworks and ISIS, where ISIS is an integrated module of Infoworks. Although there was only one two-dimensional model identified 3 addressees stated that it is used in their organisation.

Groundwater Models

Model	Developer(s) or supplier	Description
MIKE SHE	DHI software	MIKE SHE can be used for the analysis, planning and management of a wide range of water resources and environmental problems related to surface water and groundwater. There is conjunctive use of groundwater and surface water implemented in the model.
Internet link		http://www.dhisoftware.com/mikeshe/
MODFLOW	U.S. Geological Survey	Free-ware , MODFLOW is a modular three-dimensional finite-difference ground-water flow model.
Internet link		http://water.usgs.gov/nrp/gwsoftware/modflow2000/modflow2000.html
SIMGRO	Alterra, Green World Research	SIMGRO is a mechanistic distributed model with a (nearly) unified saturated-unsaturated flow description at its core. Innovative use is made of dynamic 'metamodelling' techniques for the soil water and surface water.
Internet link		http://www2.wau.nl/ccb/index_files/main_files/downloads/Simgro_CCB2004.pdf
Sobek	WL Delft Hydraulics	SOBEK has three basic product lines covering any fresh water management situation in River, Rural and Urban systems alike. Sobek itself is no groundwater model but there is an interface function with MODFLOW.
Internet link		http://www.sobek.nl/prod/index.html
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

In contrast to hydrological and hydraulic models only 7 addressees stated that a groundwater model is used within the organisation. A total number of 3 groundwater models was identified. The Sobek model is not an actual groundwater model, it only provides an interface function to the MODFLOW software. MODFLOW was identified as the only model that is free-ware.

Sediment transport Models

Model	Developer(s) or supplier	Description
DELFT3D	WL Delft Hydraulics	DELFT3D is a fully-integrated two or three-dimensional compound modelling system. It simulates the flows, waves, sediments, morphological developments and water quality aspects. The sediment transport module models bottom and suspended transport of sediment separately using a variety of formulae. The effects of wave motion on transport magnitude and direction are included. The morphological module computes bottom changes due to transport gradients and various types of boundary conditions.
Internet link		http://www.wldelft.nl/soft/d3d/intro/index.html
Erosionsmodell-3D		The Erosionsmodell-3D is a Computer-based model for the simulation of soil erosion by water.
Internet link		http://www.geog.fu-berlin.de/~erosion/
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

Only 2 addressees stated that their organisation is using a sediment transport model. Due to this small number of answers only one conclusion can be drawn: Sediment transport models are not commonly used in planning flood management measures.

Ecological Models

Model	Developer(s) or supplier	Description
BIO-Safe	EU IRMA-Sponge project	Tool for the assessment of species protected by law
Internet link		http://www.gencat.net/mediamb/bioassess/bacontr33.htm
Riverfox	The Association for Environmental Health and Sciences Amherst, MA (USA)	E-learning tool for the explanation of risks for humans and ecology considering as example the river Fox (USA)
Internet link		http://www.aehs.com/journals/humanandecojournal/teachingtool.htm
STOWA	Alterra, Wageningen (NL)	Online assessment tool of the suitability of habitats or agricultural use for water retention and storage in The Netherlands
Internet link		http://www.synbiosys.alterra.nl/waterberging/
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

There was no genuine ecological model mentioned although these do exist. Most often mentioned were reports or methods on how ecological issues can be treated or assessed. The very few remaining tools listed above are based on empirical knowledge (laws, directives or expert judgement) implemented in data bases.

Apparently there is little demand for ecological models even in The Netherlands where such models have existed for a long time. The reason for this is unclear.

Decision Support Systems

There was not a single addressee from an organisation that is using computer-based Decision Support Systems. Some addressees stated that written guidelines are used as some kind of decision support. Due to these findings we conclude that in the field of flood risk management Decision Support Systems cannot be added to the state of the art tool box.

Geographic Information Systems

Model	Developer(s) or supplier	Description
AutoCAD	Autodesk	AutoCAD is used to create conceptual designs, technical drawings, and documentation in many industries. Designers, architects, engineers, land planners, contractors, facility managers, and educational institutions and students are examples of customers who currently use AutoCAD. The AutoCAD foundation technology supports other Autodesk® industry-targeted applications, as well as hundreds of third-party applications. It fits into any design solution that requires a general, customizable drafting and design tool.
Internet link	http://usa.autodesk.com/adsk/servlet/home?siteID=123112&id=129446	
ArcGIS products	ESRI	ArcGIS is an integrated collection of GIS software products for building a complete GIS.
Internet link	http://www.esri.com/	
Cadcorp	Cadcorp	Cadcorp is a developer of industry leading GIS (Geographic Information System) software. This includes the popular Cadcorp SIS - Spatial Information System which runs on Microsoft Windows and encompasses desktop GIS modules, ActiveX and COM based Developer Kits, web-based GIS software (GeognoSIS) and a mobile data capture solution (mSIS).
Internet link	http://www.cadcorp.com/	
GISterm	Disy	disy GISterm is a Java-based geographical information system. The functionality of the desktop application includes GIS functions as GIS application as well as a development framework - no English information available.
Internet link	http://www.disy.net/products-by-disy.html	
GTIS (IBM)	graphservice	The IBM solution for a geographic-technical Information system (GTIS) encompasses as a client/ -server implementation the following three basic components: <ul style="list-style-type: none"> * IBM geoManager/6000 (GIS-Data server) * IBM geoGPG für AIX (graphic-interactive work station) * IBM geoInterface (PC-information desk) no English information available.
Internet link	http://www.graphservice.de/produkte/010-Basistechnologien/050-ibmgtis/	
Ingrada		The geographical information system INGRADA offers a comprehensive tool box for planning offices, engineering consultancies, communities and public utility companies - no English information available.
Internet link	http://www.ingrada.de/	
INTWIS	INTWIS	The INTWIS software was primarily designed for the use in integrated water management.
Internet link	http://www.intwis.nl/intwis/intwis/pages/fronthomepageread/ffhcaiffjadg	
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

Model	Developer(s) or supplier	Description
Idrisi	Clark Labs	IDRISI Andes is an integrated GIS and Image Processing software solution providing over 200 modules for the analysis and display of digital spatial information. Tools for land planning, decision support, and risk analysis are included side-by-side with tools for spatial statistics, surface analysis, and spatial modeling.
Internet link		http://www.idrisi.com/
Geomedia		Geomedia enables a far reaching spatial analysis of data. It provides solutions for spatial-related problems.
Internet link	http://www.geo-media.de/	
MapInfo	MapInfo	MapInfo Professional is a mapping application that enables business analysts and GIS professionals to visualize the relationships between data and geography. With MapInfo Professional, you can perform data analysis by leveraging the power of location. Including location in your decision making and daily operations can help you increase revenue, lower costs, boost efficiency and improve services.
Internet link		http://extranet.mapinfo.com/products/Overview.cfm?productid=1044&productcategoryid=1
Poly-GIS		Polygis is a module embedded into the Archikart GIS. It is used for the visualisation of geodata and to produce thematic maps - no English information available.
Internet link		http://www.archikart.de/opencms/opencms/produkte/gis/progs/polygis/
SICAD	AED-SICAD AG	SICAD/open is the platform for the standard applications SICAD-UT, SICAD-LM and various applications for local authorities. Due to it's integrated development environment the most demanding applications can be set up without problems. With Geo Service Providing, you can for the first time use the full GIS functionality via Internet.
Internet link		http://www.aed-sicad.com/
Smallworld GIS	Mettenmeier GmbH	Smallworld GIS is one of the leading geopgraphical information systems (GIS) designed for the management of complex utility or telecommunications networks.
Internet link		
Topol	TopoL Software Ltd.	TopoL is a general Land/Geographic Information System software which can be adjusted for applications in many areas. It allows the creation, maintenance and analysis of geographical data. This original Czech product was first developed for the purpose of providing desktop-mapping and querying capabilities in forest-management applications. Now TopoL can meet many needs for GIS and remote-sensing image-analysis software. (http://directory.eoportal.org/pres_TopolGISdigitalphotogrammetryandremotesensingsystem.html).
Internet link		http://www.topol.cz/english/share?doc=.../docs/about.php3
Disclaimer: The nofdp is not responsible for any description of the models. All information was taken from the respective internet sources.		

There is a large number of geographical information systems used in the Northwest European territory. Most commonly used are ArcGIS products by ESRI. More than 75 %

of the addressees, which are using a GIS have stated to use a product from the ArcGIS family. It can be concluded from the analysis of the questionnaire that using GIS software refers to the current state of the art in flood risk management.