



A new coastal defence master plan for Schleswig-Holstein

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Abstract

Schleswig-Holstein has a coastline of 1,190 km and about 3,800 km² of flood-prone coastal lowlands. In these lowlands, which represent almost 25% of total surface area, 345,000 people live and economic assets worth of 46 billion Euros are concentrated.

In the year 2001, the State Government of Schleswig-Holstein adopted a new master plan: "integrated coastal defence management in Schleswig-Holstein". The plan was established to protect the flood-prone coastal lowlands in Schleswig-Holstein against the destructive forces of the sea, particularly with regard to the expected increase in the rate of sea level rise. It contains the general concept for coastal risk management in Schleswig-Holstein in the coming decades.

For the first time in Germany, a master plan for one sector was established on the basis of the ICZM-principles, e.g., a (sector) vision as well as ten deduced (integrated) development goals for coastal defence were defined. After a description of the contents of the plan, this paper will focus on the steps taken to involve stakeholders and population in the process of plan development and implementation.

1 Introduction

Schleswig-Holstein, the German state between two seas, has a coastline of 1,190 km and about 3,800 km² of flood-prone coastal lowlands (Fig. 1). In these lowlands, which represent almost 25% of total surface area, 345,000 people live and economic assets worth of 46 billion Euros are concentrated (Hofstede & Hamann 2000). Further, the yearly gross value added in these lowlands amounts to about 8.5 billion Euros. In comparison, the yearly expenditures for coastal defence (flood defence and protection) are in the order of 0.045 billion (45 million) Euros.

These figures may underline the importance of protection against the forces of the sea (flooding and erosion) in Schleswig-Holstein. In recognition, the State Government adopted, in the year 2001, a new master plan: "Integrated Coastal Defence Management in Schleswig-Holstein" (IM Schleswig-Holstein 2001). It contains the strategies and the financial concept for coastal defence in the coming decades. For the first time in Germany, a master plan for one public sector was established applying the EU-principles on ICZM (European Commission 2002).

The plan contains 9 chapters. After a short introduction, vision and goals of coastal defence in Schleswig-Holstein are presented. Chapter three contains a description of the physiographic and socio-economics characteristics of the coastal defence planning area. Next, the general boundary conditions, e.g. responsibilities and legal aspects, are elaborated. The central part of the plan (Ch. 5 and 6) deals with the main public measures and techniques to maintain the safety standards. The measures that, after a safety check, received high priority are listed in Chapter 7 with their respective costs. How the Schleswig-Holstein coastal defence administration integrates the ICZM-principles (see above) or, rather, the modern societal demands in their planning and managing is explained in the next chapter. The plan ends with an outlook.

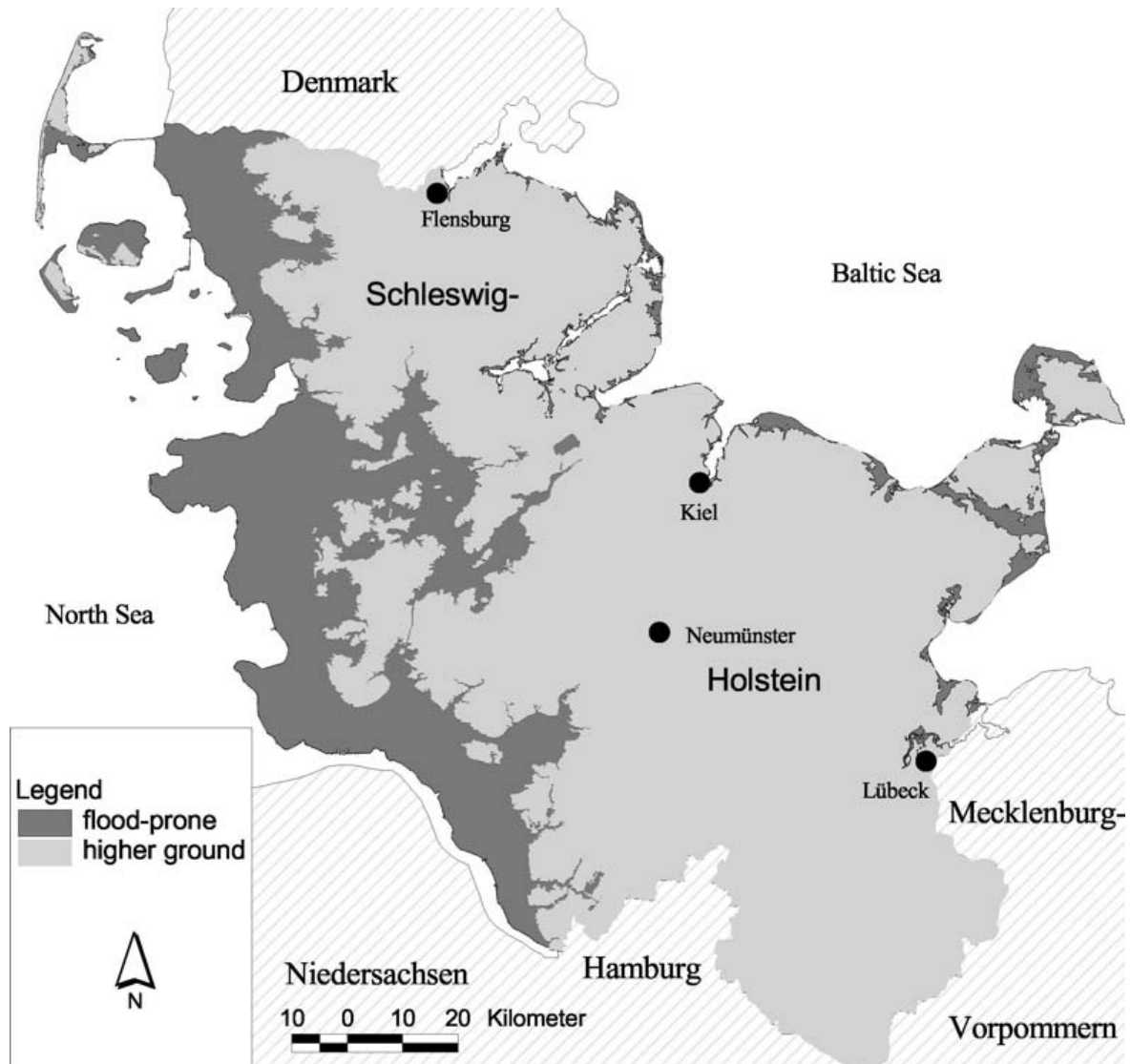


Fig. 1: Coastal flood-prone lowlands in Schleswig-Holstein.

This article contains a description of the main contents of the master plan (Chapter 2). A discussion of how the ICZM-principles are considered follows (Chapter 3). This includes the steps taken to involve stakeholders and population in the process of plan development and implementation.

2 The master plan

In Germany, public coastal defence is implemented by the coastal states. In Schleswig-Holstein, coastal defence is regulated in the State Water Act. The public strategy as well as the technical and financial concept are included in the master plan. The plan is not a legally binding document, but a (strong) self-commitment of the State Government who adopts it. In the preface the minister, responsible for the implementation of public coastal defence in Schleswig-Holstein, lists a number of political principles to underline this commitment:

- Political consensus exists (in Schleswig-Holstein) that coastal defence, i.e., the safeguarding of human lives, outweighs all other interests, including those of nature conservation.
- In politics and administration, coastal defence will, now and in the future, maintain its own and basic importance.

- As a consequence of its basic importance for the safeguarding of people, coastal defence cannot be executed on a purely benefit-cost basis. However, with respect to restricted public finances, priorities need to be set on the basis of risk assumptions.
- The goals and tasks of coastal defence must be considered in other political fields (e.g., tourism, nature conservation, spatial planning) as well. This requires a continuous campaign for these goals and tasks.

Applying these political principles, the coastal defence administration in Schleswig-Holstein developed a vision and 10 development goals. The vision and goals were presented to coastal stakeholders and the scientific community at a public conference in 1998 (MLR Schleswig-Holstein 1998). After a positive discussion, vision and goals (the 10 commandments of coastal defence) were included in the master plan.

The vision:

Protected from flooding by storm surges and from land loss by the erosive forces of the sea, the people of Schleswig-Holstein live, work and relax in the coastal lowlands, today and in the future.

This vision resembles an optimal safety situation without considering external constraints (e.g., climate change, the vision for nature conservation, financial and technical limitations). In other words, it is purely sector oriented. It explicitly supports the use of the coastal zones by men and, therewith, their right to protect themselves against coastal flooding and erosion. Being a vision, this maximal situation will never be reached. On a next level, 10 development goals were defined. These goals should reflect the vision, but consider external limitations (see above) as well. Hence, they present compromises. The development goals might be called the starting point for ICZM in coastal defence.

The 10 commandments:

1. The protection of people and their houses by sea walls and other defence structures is of highest priority.
2. The protection of land and valuables by sea walls and other defence structures is an important condition for the vitalisation of the rural areas. It possesses a high priority.
3. The relocation or abandonment of sea walls remain exceptions.
4. Elevated coastlines that are not secured by sea walls are only to be protected if settlements or other important infrastructures are endangered by cliff retreat.
5. Islands and Halligen are protected from irreversible land losses.
6. The salt marshes immediately in front of sea walls are maintained according to coastal defence requirements. Further salt marshes are, in the interest of coastal defence and of nature protection, maintained. Where no salt marshes exist in front of sea walls they are enhanced by appropriate measures.
7. The long-term stability of the Wadden Sea is aimed for.
8. Hydro- and morphological developments and possible climate changes as well as their consequences are monitored and evaluated carefully. Scenarios are defined that allow prompt reactions.
9. Impacts on nature and the landscape due to the execution of coastal defence measures are minimised. The development and implementation of other justified claims for the coastal zone are enabled.
10. All coastal defence measures are carried out in a sustainable manner.

In the master plan, a planning area for coastal defence is defined, being the area where relevant processes (e.g., flooding, sediment redistribution) occur. Consequently, the landward boundary is defined as the elevation up to where flooding could occur without protective measures, i.e., GOL (German Ordnance Level) +5 m at the (tidal) North Sea coast, and GOL +3 m at the Baltic Sea coast. The lower (seaward) boundary is situated at the depth contour where waves and tidal currents induce sediment redistribution relevant for coastal defence. This contour line was set at GOL-10 m for both coasts. For this planning area, a number of relevant parameter are listed in Table 1.

	North Sea coast	Baltic Sea coast	Schleswig-Holstein
Coastline (km)	553	637	1,190
Primary state dikes (km)	364	67	431
Secondary dikes (km)	569	-	569
Overflow / other dikes (km)	44	52	96
Flood-prone are (km ²)	3,404	318	3,722
- inhabitants	252,618	91,606	344,224
- economic assets (million €)	31,627	15,439	47,067
- gross value added (million €)	4,367	4,065	8,432
- working places	85,089	87,091	172,180
- tourist bed capacity *	31,986	19,533	51,519

Tab. 1: Relevant coastal defense parameter for Schleswig-Holstein (*: only those facilities are considered that have a capacity of more than 8 beds).

For the planning area, relevant physiographic and socio-economic developments are described in the master plan, e.g., sea level rise and storminess (Fig. 2). As a consequence of a strongly varying physiographic context, major differences exist in the history and public perception of coastal defence among the North Sea and the Baltic Sea coast. The North Sea coast has, nearly, a 2,000 year history of coastal defence. It started with the construction of dwelling mounds and, about 1,100 years ago, the construction of sea walls (Meier 1993). Today, about 3,400 km² of former coastal marshes have been reclaimed. Along the Baltic Sea coast of Schleswig-Holstein, no such tradition exists. Here, comprehensive construction of sea walls to protect coastal lowlands started only after AD 1872 as a major storm flood struck the coast (Fig. 2). In consequence, people perceive coastal defence quite differently. Along the North Sea coast, normally, (more) protection is demanded for. Along the Baltic Sea coast, people are more sceptical towards coastal defence, as it might negatively interfere with the major sources of income (e.g., tourism, harbour industries).

As with any other public (and private) responsibility, coastal defence is tightly integrated in Germany in structures, rules and regulations. Hence, an own Chapter in the master plan deals with this. As prescribed in the Schleswig-Holstein State Water Act (§ 62), coastal defence is an obligation of the beneficiary. However, State takes over responsibility for a number of measures that are in the public interest (§ 63), e.g., primary state dikes and the protection of built-up coastal stretches that suffer a long-term erosive trend. According to law, primary state dikes should protect an area for all storm surges. This demands for a protective structure that, under consideration of scientific knowledge as well as technical and financial possibilities, guarantees optimal safety. The actual safety standard of primary state dikes is described in the master plan. If the dikes do not meet the safety standard (see below), a strengthening measure must be carried out. Following § 68 of the State Water Act, a formal procedure

for plan approval must be conducted, including the gathering and evaluation of comments from all public and private stakeholders (incl. NGOs) and affected. Further, an environmental impact assessment (EIA) that considers national and EU-regulations for nature conservation must be established.

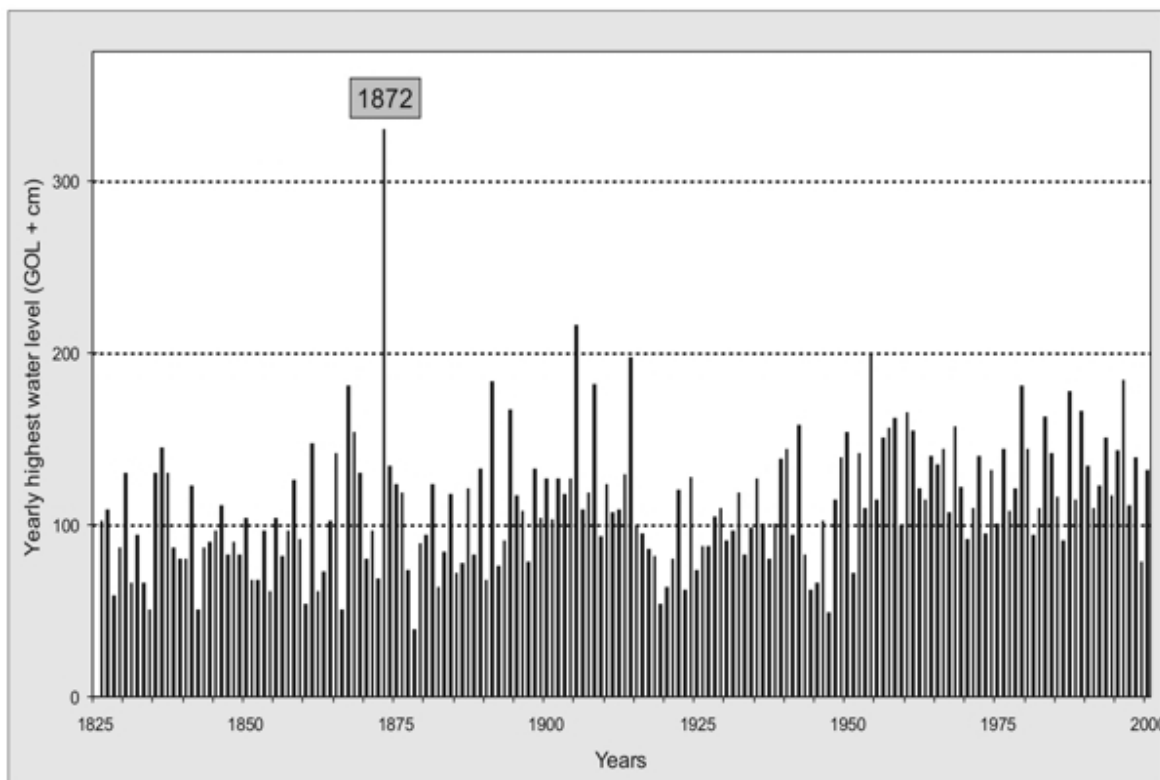


Fig 2: Yearly highest water level at gauge station Travemünde (near Lübeck).

The authority, responsible for the plan approval must, finally, decide upon the measure duly considering relevant regulations, all comments and the EIA. The measure should be implemented in a way that minimises the negative effects on the environment. Remaining negative effects should be compensated following relevant legislation. In the end, however, the public interest and the safeguarding of human beings has a higher value than environmental concerns.

In all, about 430 km of primary state dikes protect the coastal lowlands of Schleswig-Holstein (Table 1). The establishment of the new master plan included the execution of a safety check for these dikes. Already with the establishment of the first master plan in the year 1963, a safety standard, including a design water level and a design wave run up, was introduced. The design water level should meet three basic requirements:

1. it should have a (statistical) return period of once in a century,
2. it should not be lower than the highest water level observed in the past (incl. sea level rise since then), and
3. it should not be lower than the sum of highest spring tide water level and highest observed surge.

For the North Sea coast, the statistical value delivered the highest water level, for The Baltic Sea coast it was the storm surge of 1872 (Fig. 2). In consequence, these values represent the respective design water levels, on top of which a wave run up was calculated applying empirical data as well as modelling results.

At more than 400 positions along the state dikes, a safety check was conducted with localised values for water level. Wave run up was calculated applying Hunts formulae adapted to local circumstances with empirical Beiwerte. If the dike turned out to be too low, wave overtopping occurs. The amounts

were established using the method of Van der Meer. It is assumed that modern dikes are able to withstand an overflow of at least $2 \text{ l/m}^2 \cdot \text{s}$. If the calculated values exceeded this, the dike stretch was included in a priority listing for dike strengthening. It turned out that, in all, 110 km of primary sea walls (Baltic Sea 33 km; North Sea 77 km) need to be strengthened to meet the safety standard. Focal points are the islands Pellworm, Föhr and Fehmarn. The estimated costs amount to about 250 million Euros. It is obvious, that this strengthening program cannot be implemented all at once. Hence, an internal ranking was applied on the basis of technical as well as socio-economic criteria. Per dike stretch (flood unit), the number of inhabitants and values were assessed that are protected by the respective sea wall (Table 1, Hofstede & Hamann 2000). Weak dike stretches with a higher number of inhabitants got a higher ranking and will be strengthened sooner.

Sand nourishment at the islands Sylt and Föhr constitute another main aspect of the coastal defence strategy in Schleswig-Holstein (Fig. 3). Since 1963, about 36 million m^3 of sand has been nourished on the beaches of these two islands (Sylt 33, Föhr 3 million m^3). With this sand, the coastal erosion at these two islands could be halted. The total costs amount to 144 million Euros. Comprehensive investigations clearly demonstrate that this technique, the results of which are sometimes questioned, is most effective for technical as well as economic and environmental aspects (BMFT 1994). Both islands are stabilised in a sustainable manner.

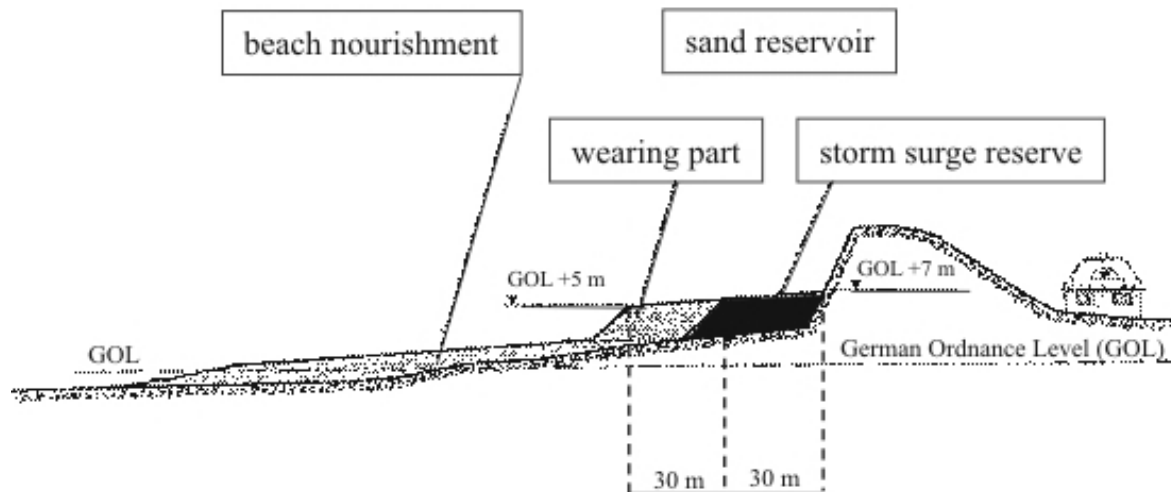


Fig. 3: Schematic presentation of a sand nourishment on the island of Sylt.

Almost one third of yearly expenditure in coastal defence occur for so called salt marsh management techniques. As demonstrated by Führböter (1979), a broad and wide salt marsh in front of sea walls significantly reduces wave energy impact at the outer dike slopes. In consequence, the establishment and maintenance of salt marshes in front of sea walls is, according to the State water Act (§ 63), a public obligation. At the same time, salt marshes have a high ecological value (Stock et al. 1997) and are protected under the State Nature Protection Act (§ 15a). In 1995, coastal defence and environmental administration, together with local water boards, adopted an integrated salt marsh management concept to integrate both functions (Hofstede 2003). The results of this concept are regularly evaluated in a technical board (see Ch. 3).

Apart from these three main types of technical measures (primary state dikes, sand nourishment and salt marsh management), a number of further measures are described in the master plan (e.g., overflow and other dikes, secondary dikes, groins, revetments). In all, in the master plan a capital spending program of 282 million Euros is included. Further, yearly costs (for maintenance, sand nourishment and small measures) of about 17 million Euros is anticipated. Public financial recourses come

from the European Commission as well as Federal and State Government. Pending on the yearly available budgets, it is anticipated that the implementation of the capital spending program will take at least 15 years.

3 Integrated Coastal Defence Management

With the new master plan, an innovative planning concept: “Integrated Coastal Defence Management (ICDM)”, based on the principles of ICZM, was introduced (Fig. 4). ICDM stands for a dynamic and continuous planning concept by which sustainable decisions for the protection of people and their assets against the natural forces of the sea are taken. Safety against storm floods and land loss is the aim, ICDM is the instrument to achieve this goal. It presents an enhancement of the traditional methods, in that:

- it considers coastal defence as a spatial planning process (instead of holding the line / sea wall),
- it duly and early integrates others demands for the coastal zone into the development goals for coastal defence (see above),
- it increasingly involves the public into the planning process for coastal defence, and
- it increasingly considers climate change (as well as the uncertainties in its predictions).

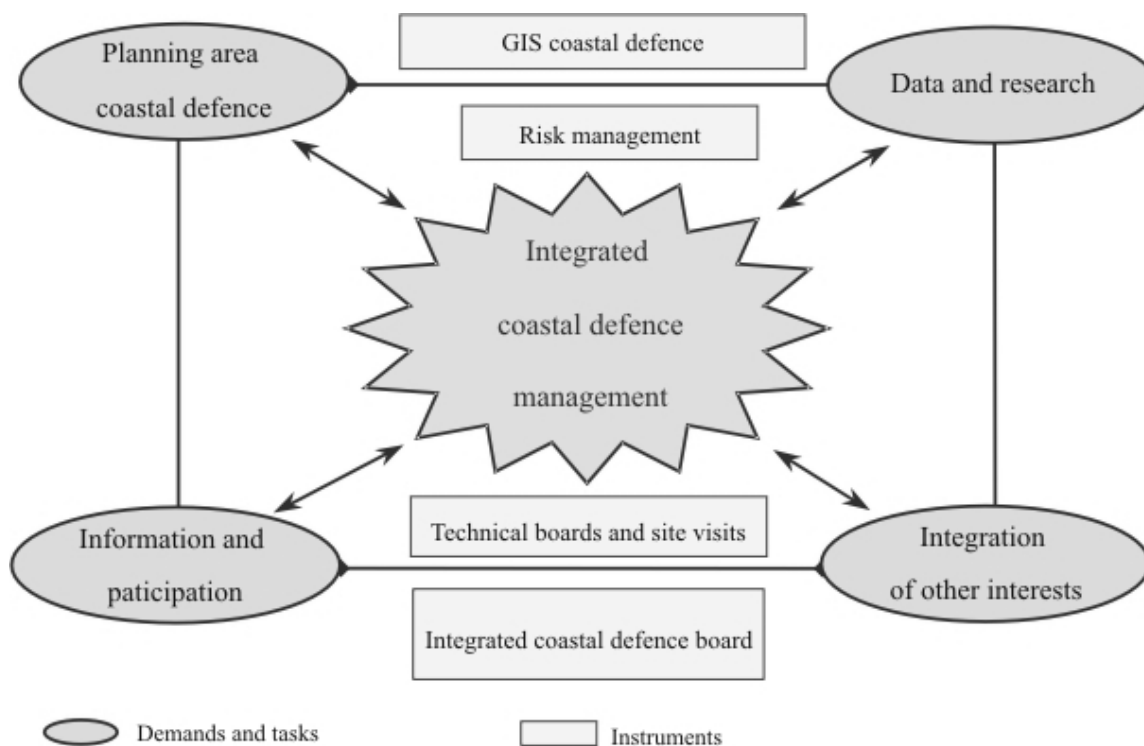


Fig. 4: Structure of the integrated coastal defence management (ICDM) concept in Schleswig-Holstein.

As an example of a participatory instrument, the Integrated Coastal Defence Board (BIK) is presented here in more detail (Hofstede & Hamann 2002). In 1999, the BIK was initiated by the responsible minister. The board consists of 27 members that represent public and private interest groups (stakeholders) in the coastal zone on a state, regional and local level. Members come from the coastal de-

fence administration (7 members), the environmental administration and NGOs (6), dike and water boards (7) and from municipal, city and county administrations (7). Two meetings per year are held under the chairmanship of the minister. It has an advisory status. The main objective of the board is an active involvement of the private and public stakeholders in the planning of policies and strategies in coastal defence. Technical aspects are discussed under duly consideration of other claims for the coastal zones. A flow of information in two directions is aimed at. The coastal defence authorities inform the population about new developments (e.g., master plan, regulations, financing, etc.). Whereas, the representatives of local people may inform the coastal defence authorities about concerns that exist in the local population. Possible conflicts may be anticipated or compromises be found by the early integration of other interests. To evaluate more technical and actual aspects, three technical boards were installed under the BIK addressing: (1) integrated salt marsh management (see Ch. 2), (2) secondary dikes (in the responsibility of dike and water boards), and (3) dike defence in case of emergencies along the Baltic Sea coast (in the responsibility of the counties).

Another example of ICDM is the procedure that was chosen for the establishment of the master plan. As describe before, the master plan is not a legally binding document, but a self-commitment of the State Government who adopts it. In consequence, a formal procedure for plan approval must **not** be conducted. Nonetheless, a broad involvement of the public in the establishment of the plan was performed. Apart from several preparatory discussions in the BIK, a number of steps were taken to secure public involvement. As soon as a first Governmental draft was established, it was distributed to all institutions (public and private) that might be affected by the plan, e.g., water boards, NGOs. They were asked to comment in a written form. Further, five regional conferences were organised open to the public. Here, the about 300 participants were enabled to discuss the plan with the responsible minister (Photo 1).



Photo 1: Regional conference in Husum.

The written and oral comments were, then, discussed in the BIK and decided upon. In all, about 20 amendments were included in an updated draft. This new draft was brought into parliament. In several meetings, the parliament and its committees discussed the draft. Finally, in December 2001, the State Government adopted the plan. Although this process was very time consuming and capacity binding, the broad acceptance of the plan (even by the opposition) showed that the effort was successful. Thus, by promoting open and straightforward communication, planning can be made more transparent and, in the end, accepted.

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