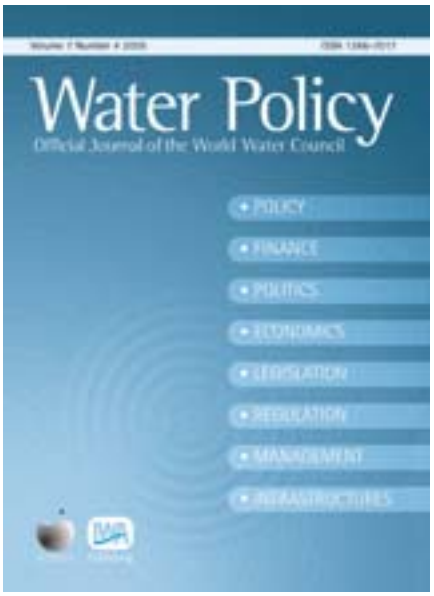

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Translating policies into actions: the case of the Elbe River

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Abstract

This paper describes methods and processes to link policy development to the implementation of those policies in actionable implementation plans. It is shown that policies can only be implemented effectively if they are embedded in a legal framework that is designed to facilitate achievement of the policy objectives. The paper shows different levels of policy making and decision support for the development of policies at different levels, ranging from the level of Federal States in Germany to policy development and implementation at the European level as part of the European Framework Directive. Using the Elbe River as a case study, the paper shows the need to anchor regional, transboundary and state level policies to mandated national institutions. A key lesson learnt from the Elbe River Basin is that policy integration is of utmost importance. The paper also demonstrates that a balance needs to be reached with regard to structural and nonstructural measures in flood risk management to arrive at a truly integrated flood risk management strategy and its implementation. The development of research policies on the basis of sound science is indispensable in support of policy development and its implementation.

Keywords: Cross-sectorial policy integration; Integrated flood risk management; Policy development and implementation

Introduction

The focus of this paper is on the German part of the Elbe River Basin. Looking at the entirety and complexity of the programs and measures taken to improve flood protection in the Elbe River Basin, the word ‘policy’ does not appear in any of the references, although the measures described in the IKSE (Internationale Kommission zum Schutz der Elbe; International Commission for the Protection of the Elbe River (ICPER)) Elbe Flood Protection Action Plan (IKSE, 2003) have all the characteristics of an integrated flood risk management plan. This plan is built on policies such as ‘giving room for the river’, ‘living with floods’, ‘prioritizing long-term spatial management’ as means for the retention of floods and lowering the peak of flood waves. To prevent confusion of the use and meaning of the

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word 'policy', the following paragraphs provide a brief overview. The use of the word 'policy' has several dimensions and is not an exactly defined term but is used in different contexts. Webster's dictionary has a number of closely related definitions. They include: 'A definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions'; 'A high-level overall plan embracing the general goals and acceptable procedures especially of a governmental body'. The Oxford Dictionary defines policy as 'a course or principle of action adopted or proposed by an organization or individual'.

Policy objectives reflect the goals that are meant to be achieved, such as minimizing the loss of lives and livelihoods including infrastructure through improved integrated flood risk management. Policy instruments are the means by which policy objectives are implemented through specific actions (ILRI, 1995). Different terms are used to characterize the increasing specificity with which policies are put into practice. This can be viewed as a hierarchy starting from policy formulation through the setting of policy objectives, moving further down this hierarchy to policy-derived 'plans', 'programs' and 'projects'. The formulation of policies requires an in-depth analysis of event-driven identified weaknesses and strengths in flood risk management. The causative factors of weaknesses and strengths, and derived policy options in response to these identified weaknesses and strengths, need to be identified. The identification of policy options is essential as each policy will have repercussions on other policies or ongoing action plans. The development of different flood scenarios has also proved to be a highly useful tool in policy development as these scenarios may project different futures for which appropriate policies need to be put in place. Ultimately, the policy development process leads to a prioritization of policies, as the implementation of policies is closely related to the availability of priority-driven allocation of scarce resources. This last step is usually undertaken at the level of politicians who also make decisions on the applicability of policies.

Policies can only be implemented effectively if they lead to the development of laws, rules and regulations that are designed to facilitate achievement of the policy objectives. Legal frameworks need adequate instruments for their enforcement and, ultimately, policies and legal frameworks can set minimum standards or benchmarks against which improvements can be measured.

As many of the sources cited in this paper are of German origin, it is necessary to note that in the German language there is no direct equivalent of the English word and meaning of 'policy'. In German, 'policy describes the entirety of a political theme area' such as 'Water Politics' (Wikipedia; see: http://www.de.wikipedia.org/wiki/Policy; see also http://www.bpb.de/nachschlagen/lexika/politiklexikon/18014/policy).

A large number of policy contexts exist that drive decision-making in flood risk management. Such policy contexts have been analyzed for England and Scotland with regard to their influence on flood risk management practices with a focus on finding a balanced approach between structural and nonstructural measures (CRUE, 2008). A few policy contexts are mentioned here as examples: policies regarding land use, housing, agriculture, industry, ecology, insurance policy and climate change. It is evident that all these policies, that have probably in most cases been developed in isolation from each other, influence to a varying degree the development of integrated flood risk management policies on the basis of an entire river basin. The comparative influence of different policies on decision-making in flood risk management (including finding a balance between structural and nonstructural measures) is difficult in the absence of metrics to quantify policy influences. The authors of the CRUE (2008) report state, for example, that it is not possible to quantify the impact of a policy on climate adaptation on flood risk management over the next 20 years.

Being already difficult in more centrally governed countries such as the United Kingdom, the problem is aggravated in countries that have a clear federal structure, such as in Germany. In the Elbe River Basin, policy contexts at different government levels are manifest: federal policies, the sector policies of 10 federal states, policies of riparian countries (especially those of the Czech Republic) that have a strong influence on flood risk management in the German part of the Elbe River, and policies at the level of the European Community. It needs to be noted that most of these sector policies have their own legislation and governing administrative super-structures ensuring adherence to and implementation of these different policies.

The key approach under these circumstances is that of 'policy integration'. The main thrust of policy integration is to adapt existing policies to be non-contradictory with respect to flood risk management. The baseline condition is a general acceptance by politicians, interest groups and the general public that integrated flood risk management (including all relevant sector policies) has a higher societal benefit than benefits derived from single-sector driven policies.

Description of floods in the Elbe River Basin

The Elbe River is the fourth largest river basin in Central Europe (Figure 1) with a length of 1,165 km and a catchment area of 148,000 km² of which the majority is in Germany (97,000 km²) and in the Czech Republic (50,000 km²), in addition to smaller parts of the river basin amounting to 1,000 km² located in Austria and Poland (Figure 2). The population of the basin is about 25 million. In terms of flood management it needs to be noted that the hilly character of the basin in the Czech Republic results in short flood forecasting and warning times because of the short time interval between floods occurring and the antecedent rainfall event. Furthermore, flood characteristics in Germany are always

Fig. 1. Location of the Elbe River Basin in Germany (Federal Institute of Hydrology, Koblenz, Germany).

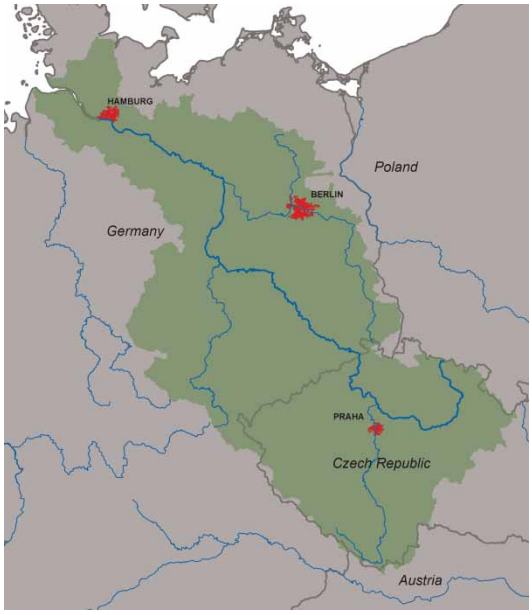

Fig. 2. Map of the Elbe River Basin (Federal Institute of Hydrology, Koblenz, Germany).

dependent on upstream flood management in the Czech Republic with its numerous dams and reservoirs (Raadgever, 2005).

The Elbe floods of 2002 exceeded total costs of just above 20 billion[1] euros in the Elbe River Basin, with some 13 billion euros in Germany alone and about 7 billion in the riparian countries of the Elbe River. These damages amounted to the highest-ever damages from floods in the region at that time (Plate, 2011).

Half of the damage occurring in Germany impacted on public property. About 7.8 billion euros of tax-payers money was used for immediate assistance to flood victims in Germany (WWF, 2007). In 2013, the total damages in Germany amounted to an estimated 12 billion euros in comparison to an estimated 17 billion euros of flood damage in Europe (Zurich Insurance, 2014a).

The overall 2013 flood damage costs in the Elbe River Basin (German part) were considerably lower compared to the 2002 flood loss costs (see Table 1). Although in the Elbe River Basin the number of insured damage cases rose from 150,000 in 2002 to 180,000 in 2013, the Association of German Insurance Companies (GDV) stated that individual damages were lower than in 2002 (Cash Online – Finanznachrichten, 23 July 2013). This could be attributed to some extent to precautionary measures by the affected population which in this context underlines the positive effects of flood risk awareness campaigns that started after the 2002 flood event. It is also important to note that the damages incurred during the 2002 floods were partially attributed to flash floods occurring in the Erzgebirge. In the 2013 flood event, flash floods with their highly destructive character did not occur.

After the disastrous 100-year flood event in 2002 and more local flood events in 2006, 2010 and 2012, another extreme flood event with a statistical recurrence period of over 100 years occurred in

[1] Billion = 10^9.

Table 1. Gross comparison of flood losses for the Elbe floods in 2002 and 2013 (adapted from Belz (2013) and LAWA (2014a, b).

Elbe floods	Material damage	Fatalities	Direct federal flood aid
2002	11,710	38	9,000
2013	5,200	15	8,000

All monetary amounts in million euros.

the Elbe River in 2013. Lessons learnt from the 2002 flood event resulted in an efficient flood warning and an information system that prevented the loss of lives (Bundesministerium des Inneren, 2013). However, despite partially improved lead times for flood forecasting, in-time evacuation and a largely improved flood protection, the overall recorded damage to buildings, infrastructure and livelihoods (farms and production sites) surpassed the reported damages of the 2002 flood event.

An analysis of the 2013 floods in the Elbe River showed (IKSE, 2013) that the measures undertaken in the framework of the IKSE Elbe Flood Protection Action Plan have been largely effective, including flood retention measures in the flood plains, flood forecasting and warning, flood preparedness and improved information systems at all levels, with officially mandated organizations and volunteer organizations, and with regard to successfully implemented flood risk awareness programs.

Policy actions taken or not taken

As policy paradigms change from 'flood protection' to 'flood risk management', it is important to recognize that flood risk management should not just aim to protect people from floods but should go much further, aiming to increase the resilience of potentially affected people–the ability to cope with floods and to recover from flooding. Another dimension of risk management is knowledge of possible cascading failures, meaning that if one structure fails, it could cascade into multiple failures (such as the flooding of a power transformer station that leads to the failure of water pumps, which in turn results in further damage to buildings and property) (Zurich Insurance, 2014b). Forward looking policies in flood risk management always carry a measure of uncertainty. The additional adoption of a policy of 'no regrets and flexibility' ensures benefits even when the actual hazard and associated risk is not quantitatively known for a specific time horizon. It also needs to be noted that risk management consists of two major elements: the factual risk analysis that is solely based on physical facts, and the assessment of risk, which is a political process that includes socio-economic values and the acceptance of risk (Deutscher Bundestag, 2013).

Transboundary policy actions: organizational level

Several rivers in Central Europe are transboundary, including the Rhine and Elbe rivers. As a consequence of the large floods in 1988 (CHR-KHR, 1990), 1993 and 1995 (BfG, 1994; CHR-KHR, 1999), the 'Rhine Action Plan' that had been elaborated by the International Commission for the Protection of the Rhine River (ICPR) was adopted in January 1998 (IKSR, 1998). On the level of the Elbe River Basin, the IKSE Agreement was signed in October 1990, with signatory countries being the Federal Republic of Germany and the Czech Republic. Observers are Austria, Poland, European Union, International Commissions for the protection of the Rhine River, the Odra River, and the Donau River and

non-governmental organizations (NGOs). Flood protection has become one of the focal areas of activities of the IKSE (http://www.ikse-mkol.org). Triggered by the Elbe floods in 2002, the IKSE developed and commissioned its Elbe Flood Protection Action Plan in 2003. As with the Rhine Action Plan, this plan is not legally binding. It rather serves as a set of recommendations. However, as the participating organizations are mainly governmental organizations of the signatory states, the plan has served as a basic policy document that was largely drawn in the political decision-making process aiming to implement the plan.

National policy actions: organizational level

In Germany, federal waterways (basically the main stems of all navigable large rivers in Germany) belong to the Federal Government. Flood protection is a responsibility of the German federal states ('Länder'). In the light of the 2002 floods in the Elbe, the 10 'Länder' that are situated in the Elbe River Basin founded the Flussgebietsgemeinschaft–Elbe (FGG–Elbe; Elbe River Basin Community) in 2004 (Pressespiegel, 2014). Since the FGG-Elbe's new Administrative Agreement in 2010, it has been coordinating the implementation of both the EU Water Framework Directive and the EU Flood Risk Management Directive (http://www.fgg-elbe.de/start-en.html). As cited in http://www.lawa.de/About-LAWA.html, the federal states also work with each other in a cooperative framework (Arbeitsgemeinschaft (ARGE) Elbe) and with the German Working Group on water issues of the Federal States and the Federal Government, represented by the Federal Environment Ministry (LAWA). Due to the number of actors involved in decision-making, the decision-making process can be lengthy, based on aiming to achieve best possible compromises and balancing the interests of different groups. The strength of policy making in the German context is 'the obligatory and widespread hearing of experts and interested parties of all relevant groups and in the democratic and constitutional consideration of various interests and viewpoints' (Rudolph & Block, 2001).

Decision-making at national level

In the German context, decision-making is based on commonly agreed objectives in a political framework; this could be termed as 'policy'. Integrated flood risk management includes the integration of different data sources in terms of hydrologic, topographic, hydraulic and socio-economic domains, aggregated in a modeling framework. Policy planning to improve integrated flood risk management is therefore highly complex as different scientific domains and the integration of multiple sources of data need to be considered. To give an example: The VERIS – Elbe project, which aims at the modeling of change and management of risks of extreme floods in large river basins (Figure 3), looks at two dimensions of integration (VERIS – Elbe, 2013; Burek & Rademacher, 2009):

> '*Disciplinary models are coupled in a model system of the flood risk system. Results of the model simulations are put in a planning context that ranges from the ex-post analysis over the formulation of scenarios including development trends and mitigation options to their ex-ante analysis, multi-criteria assessment and implementation*.'

Flood risk is calculated as a function of probability × vulnerability on the basis of a series of maps (Figure 4) that allow the quantification of flood hazards and potential damage per unit area (or specific

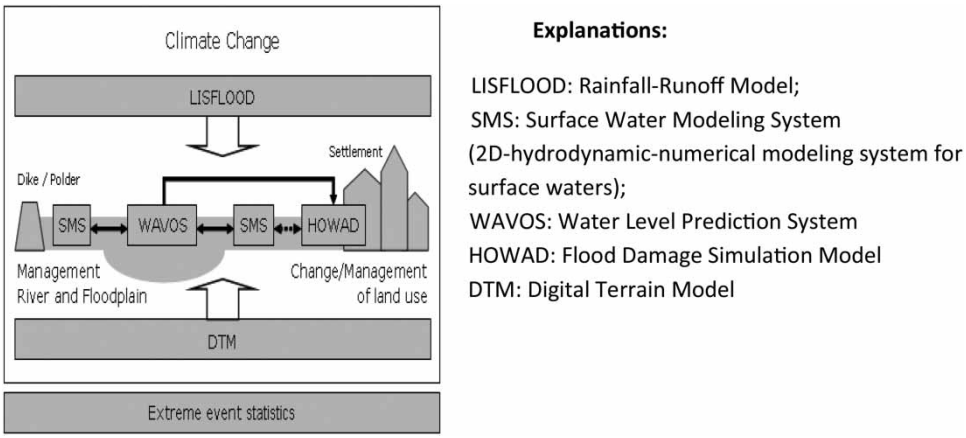

Fig. 3. Schematic view of coupled models.

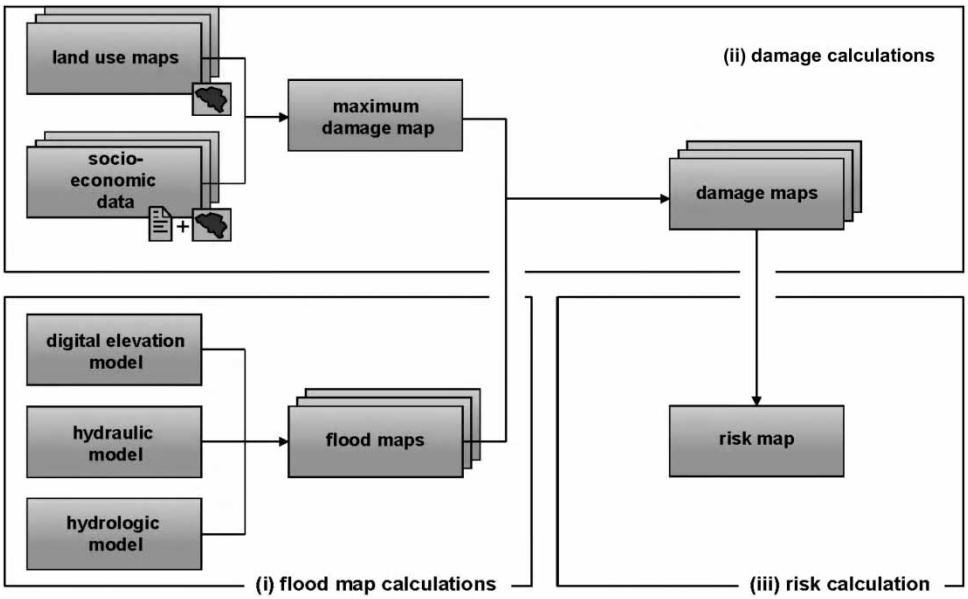

Fig. 4. Schematic view of the development of flood maps and calculation of flood risks.

infrastructure). The calculation of damage and risk consists of three steps, namely: (i) defining probability and extent of flooding; (ii) determining expected damage; and (iii) defining risk. Figure 4, taken from (Vanneuville *et al.*, n.d.), demonstrates this approach.

Under the impact of the 2013 flood events in Germany (BfG, 2013) the environment ministers at Federal and State government levels agreed in June 2013 on the development of a national flood protection program. The national flood protection program was passed by the German conference of state environment ministers in October 2014. The two-pronged approach envisages the amendment and change of relevant administrative procedures with the objective of simplifying and accelerating the planning

and implementation of measures with a focus on preventive flood protection. Federal Government and the State governments see it as an obligation to initialize preventive investments in a national flood protection program.

The Extraordinary Conference on Floods of the Environment Ministers of the German Federal States in September 2013 stated that the recent flood events might be early signs of climate change and decided that a national flood protection program would be developed including:

- review and eventual further development of design-flood and mutually coordinated approaches to assess impacts of potential flood protection measures;
- prioritization of preventive flood protection measures with a focus on supra-regional measures and on the basis of additional flood retention areas that will have a significant effect on the lowering of peak flood levels;
- elimination of deficiencies in existing flood protection measures;
- development of a joint (Federal and State level) financing strategy.

The ministerial conference further decided that as a matter of policy, the national flood protection program should be based on the following concepts that will be underpinned by adequate measures and projects:

- making room for rivers through the backwards re-location of dykes and the establishment of additional polders allowing controlled flooding;
- maintaining and re-establishing the function of flood plains in the future through long-term spatial management;
- this also includes reviewing design-flood criteria.

Recognizing further that effective flood protection in the general interest cannot be compromised by singular interests, in July 2013 Saxony together with Bavaria brought forward a draft law on the acceleration of flood protection measures (Hochwasserbeschleunigungsgesetz) (Wiederaufbaustab Sachsen, 2013). In its essence, the law will lead to an accelerated administrative and legal process to plan and implement flood protection measures without lengthy administrative procedures.

At the highest national political level, the national flood protection program has been taken into the Coalition Contract of the Federal Government for its 18th legislation period stating that, under the overall coordination of the Federal Government, a national flood protection program will be elaborated in cooperation with the Federal States. As stated above, the thrust of the program aims at the development of supra-regional measures for preventive flood protection as well as the standardization of flood protection criteria in German river basins (Koalitionsvertrag, 2014).

The coalition contract also states that with respect to flood management the Elbe integrated river basin management plan will be implemented with a balance between ecological and economic requirements. Two other policy elements are important to mention as these are indispensable in integrated river basin management in general and integrated flood risk management in particular:

- entering into an intensified dialog with riparian countries on flood protection; and
- considering the repercussions of integrated flood management practices on other sectors (including agriculture, public and private infrastructure) and their own administrative and legislative frameworks;

it is envisaged that a federal spatial management plan with common standards regarding flood hazard areas, polders, etc., will be developed.

Policy at the level of the European Community

Building on the experiences of the Rhine and Elbe action plans and strongly advocated by the Federal Government of Germany together with riparian countries, the European Commission put in force a Directive on the assessment and management of flood risks (EC, 2007).

This Directive builds on policies on flood risk management that were communicated inter alia to the European Parliament in 2004 (EC, 2004). This communication sets out the analysis and approach to managing flood risks at the level of the European Community. The Directive also makes reference to Directive 2000/60/EC (EC, 2000) that established Community action in the field of water policy, requiring river basin management plans. These two Directives (EC, 2000, 2007) are the guiding directives for Integrated River Basin Management in the overall context of Integrated Water Resources Management (IWRM).

The introductory parts of the Directive (EC, 2007) provide a policy framework including:

- space for rivers;
- components of flood risk management plans;
- use of 'best practice' and 'best available technologies';
- coordination with riparian countries in transboundary river basins.

Within this policy framework, sub-policies have been adopted by the Commission including more detailed instructions in the fields of:

- Preliminary Flood Risk Assessment;
- Flood Hazard and Flood Risk Maps;
- Flood Risk Management Plans and policy directives outlining;
- Implementation measures.

It needs to be noted that national and state flood policies and action plans (including the European Flood Action Programme (2014)) and consequently the EC Directives were all triggered by disastrous flood events; the EC (2004) Communication on Flood Risk Management cites as the starting point of its inception that 'Between 1998 and 2002, Europe suffered over 100 major damaging floods, including the catastrophic floods along the Danube and Elbe rivers in 2002.'

Risk governance

The concept of risk governance is important as it involves the rational assessment of risks and adequate administrative, institutional and legislative arrangements. In the case of the European Flood Directive, the initiated planning process resembles the risk governance concept as described by the International Risk Governance Council (Heintz *et al.*, 2012).

Risk governance can consist of the four steps shown in Figure 5 (Heintz *et al.*, 2012); risk evaluation and risk management actions are then documented in Flood Risk Management (FRM) plans.

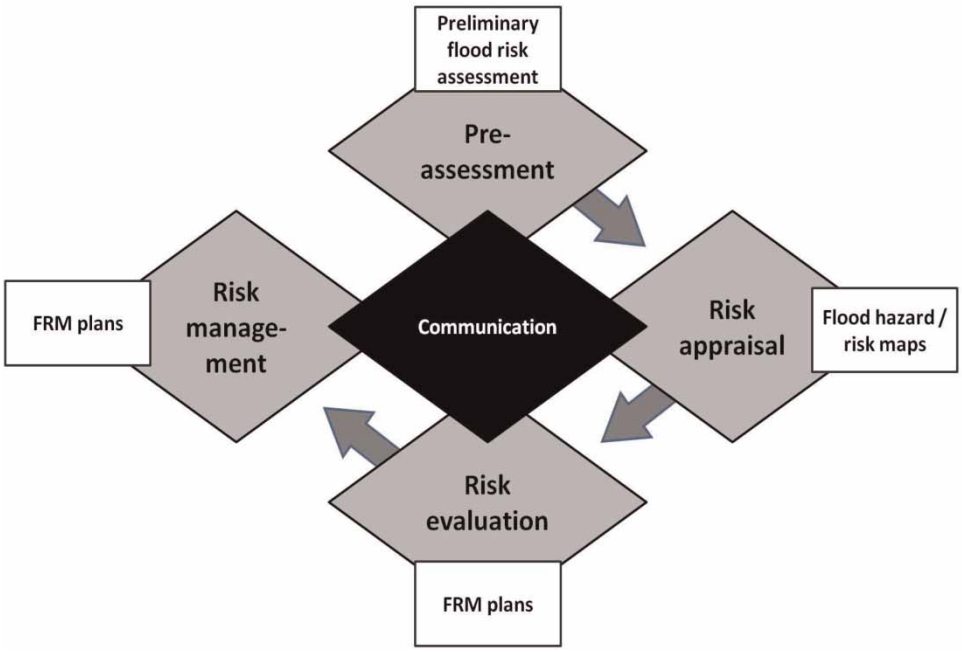

Fig. 5. Risk governance concept in flood management (Heintz *et al.*, 2012).

Communication is the central element of risk governance with a focus on stakeholder participation at the lowest appropriate level.

Successes and inadequacies

Successes

An ex-post analysis of the 2013 floods in comparison to the 2002 floods showed (Rickmeyer, 2014) that, based on findings of the Federal Institute of Hydrology, Koblenz, Germany:

- Peak water levels of the main flood wave in the German part of the Elbe River would have been 20–75 cm above the observed levels, if intended and unintended flood retention actions had not been in effect.
- Breaches of dykes and the controlled flooding of parts of the flood plains lowered the highest water levels at the middle Elbe River between 34 and 46 cm.
- If the reservoirs in the Czech Republic and in the German state of Thuringia had had a higher retention potential at that time, water levels could have been lowered between 20 and 66 cm along the German part of the Elbe River.

Many of the actions envisaged in the IKSE Elbe Flood Protection Action Plan have been implemented since 2003. However, if all measures planned had been implemented by the time of the 2013 flood, an additional lowering of the peak water levels in the middle Elbe could have been realized in the order of 20–40 cm.

IKSE states (IKSE, 2012a, b) that the Elbe Flood Protection Action Plan has been validated as a useful instrument in flood risk management. The implementation included mainly structural and to a lesser degree nonstructural measures in the policy framework of the Action Plan. The subsequently implemented measures have resulted in an overall reduction of flood damages and losses and a significant reduction in direct Federal aid for flood victims (Table 1). This has to be seen against the background that the floods in 2013 were even more severe in the sense that the entire Elbe River Flood Basin was affected.

The overall success story is also due to the fact that legally non-binding policies such as those of the IKSE Elbe Flood Protection Action Plan have been internalized in a political decision-making process with inputs from all levels, from household level upwards through a host of interest groups. The second positive factor has been that all political measures were fully backed within an existing (or amended) legal framework at Federal and State level in concurrence with the EC Flood Directive.

Embedding flood management policies in a legal framework has been an asset in policy implementation. The Federal Act for the Improvement of Flood Prevention (5-Punkte Hochwasserartikelgesetz) (Federal Act, 2004) is an example of progress made in legislation to promote integrated flood management and in particular flood protection measures. The essence of the Federal Act consists of the following five points:

- Joint flood protection program of the Federal Government and the Federal States.
- Cross-state action plans – International Professional Conference.
- Promote European Cooperation.
- Review river training works – develop inland navigation in an environment-friendly manner.
- Immediate actions for flood protection.

A particular point of the Federal Law is the adaptation of sector-laws to confirm with the objectives and directions of the Federal Act. Some of these laws adapted in the Federal Act include:

- Federal Building Code;
- Spatial Planning Law;
- Federal Water Way Law;
- Law of the German Weather Service;
- Law regulating Environmental Assessments.

Some of the policies adopted for Integrated Flood Risk Management can be seen in a wider policy framework to ensure the sustainability of flood protection measures.

In particular, sustainability policies can include (WWF, 2007):

- minimization of damage potential (reduction of value assets in high risk flood plains, removal of high value assets where feasible);
- ensuring improved spatial water retention especially in areas where floods originate from;
- development of new retention areas, especially through the backwards re-location of dykes;
- generating synergies between different policies and laws.

From past flood events, one of the most important lessons learnt is to further improve self-help capabilities of the potentially affected population, including flood risk awareness and best practices to adapt

to and cope with risk. Included in self-help capabilities are flood-proofing of houses, taking flood insurances, and improving community driven evacuation procedures amongst other measures. Best practices can be adapted from experiences in other river basins in Germany, where the population is much more adapted to 'living with floods', such as in the Rhine and Mosel river basins. An important tool to sharpen flood risk awareness is the availability of a flood risk information system (http://www.zuers-public.de) where people can get information about the degree of flood hazards and risks. Such information is meant to sharpen awareness of environmental risks and serve as an incentive for self-help activities. In addition, German insurance companies use a geographical information system that allows the calculation of risks with regard to flooding, backwater storage and extreme precipitation.

The drive to strengthen self-help capabilities is critical in view of the increasing probability of the recurrence of flood events with a high damage potential and the scarcity of public funds and resources to pay for such damage in future.

Some of the successes in flood management during the floods in 2013 were not policy based but opportunity driven. The Task Team Reconstruction, Free State of Saxony (Germany), (Wiederaufbaustab, 2013) reported the outstanding role of social networks in the ad-hoc organization and implementation of flood management actions, and especially the rapid deployment of both government forces and volunteers to flood hot-spots where immediate help had been required. The important role of social networks the organization of flood management actions during flood events is fully recognized and plans are underway to make full use of them in support of information management as an important component of flood management during critical situations.

Interactions at the political level. As outlined above, responsibilities for flood risk management at the political level are distributed on federal, state and communal levels. This makes it difficult to agree on policies, especially as it is necessary to balance different interests and differences in the perception of which risks are acceptable and which are not. The positive side of this cumbersome process is that flood management in Germany is a highly interactive, participatory process involving many governmental and non-governmental agencies, academia, private industries and sector lobbies as well as the media and individual citizens with far-reaching rights to agree or not to agree to planned flood management measures in the planning phase. Often, it is the same people who are represented in different organizations and forums. All of this forms a very diverse community of stakeholders in flood management that allows for lateral thinking beyond sectorial interests and the finding of flood management solutions to which a majority can agree.

Communication and perception of risk. Clear communication of flood risk management is essential. At the local level, the importance of communication has been clearly recognized. Since May 2008, a web-based information service has been made available by the city of Dresden, showing interested citizens potentially flooded areas in high resolution. The maps show flooded areas without showing the effect of existing or planned flood protection structures. Therefore it is possible to also view areas that may be flooded if flood protection structures should fail (Dresden, 2011). On the communal level, 'flood-partnerships' have become more common in several federal states of Germany, where several communities along a stretch of a river align in a partnership to discuss risk awareness, levels of protection and actual measures.

Stakeholder involvement in flood risk management has the highest potential to minimize loss of lives and livelihoods and property. Practical measures include – amongst others – awareness and education

programs including risk-based information such as using flood hazard and flood risk maps (Dresden, 2011), promotion of risk-avoidance and practical exercises including evacuation drills.

In the Elbe River Basin (and other river basins in Germany as well) the communication of residual risk is mainly achieved through risk awareness and risk-avoidance programs and training. Increasingly, flood hazard and flood risk maps have been tailored to visually demonstrate to the potentially affected population the areas and the degree of risk and also the residual risk, describing the consequences if (for example) a flood protection dyke fails as a result of an extreme event that is beyond the commonly used 100 years exceedance period.

Especially at community level, the 'As Low As Reasonably Practical' (ALARP) principle (Abhas *et al.*, 2012) provides a useful framework to identify different levels of risk acceptance including acceptable risk, tolerable risk and unacceptable risk from the viewpoint of societal risk perception. It is therefore a valuable component in stakeholder participation in decision-making processes at the lowest appropriate level of intervention. Examples are as follows:

- Acceptable risk: Flooding of extensively used agricultural areas; impaired access to other villages for a given time, impaired mobility of persons and goods.
- Tolerable risk: Flooded roads, minor flooding of houses without major damages to buildings and property.
- Unacceptable risk: Loss of lives, flooding of industrial sites with the danger of spilling chemical, toxic or radioactive substances; flooding of critical infrastructure including hospitals, power switching stations, etc.

However, this includes only 'first-order' risks. The risk perception of cascading risks as mentioned above is not well understood or reflected in flood management policies and practices.

The failure of flood protection infrastructure such as dykes is viewed as unacceptable but cannot be ruled out totally. This is described as residual risk. It needs to be noted, however, that German society in general is highly risk averse and what might be a tolerable risk in other countries may be viewed as unacceptable in Germany.

To ensure coherent risk management amongst riparian countries, appropriate means for communication are addressed in Chapter V, article 10 of the EU Flood Directive.

Inadequacies in policy development and implementation

As was mentioned above, clear communication of flood risk management is essential. In Germany, it is felt that policy makers need to provide clearer guidance as to which flood risk management measures are expected and which direction future protection should take (Zurich Insurance, 2014b).

There is an overall striving to achieve a truly integrated and applicable flood risk management policy in the Elbe River Basin. Much has been achieved, as outlined above. Due to a number of constraints – some of which are mentioned above – there are, however, inadequacies in policy development and implementation. Some of the root causes are outlined below.

One mainly political obstacle in the implementation of nonstructural measures in general, and the extension of flood retention areas in particular, is the widespread local resistance to the establishment of additional flood retention areas, including through the backwards re-location of dykes. This resistance is quite often based on the particular interests of those who would be restrained in their economic activities in areas that are declared as flood plains.

The Elbe Flood Protection Action Plan specifically mentions as a priority the backwards re-location of dykes and the re-activation of flood plains and, in part, this has been achieved. In summing up, however, the main thrust is still in investments in the reinforcement of dykes where some 45% of dykes are being reconstructed or reinforced, while the re-activation of floodplains amounts only to some 4–6% of those currently active (BUND, 2007). As part of the implementation of the IKSE Elbe Flood Protection Action Plan, dykes with a length of 513 km and reservoirs and polders for the improvement of flood retention in the order of 71 million m³ have been constructed or reinforced (Socher, 2014). This shows that the majority of investment was allocated for technical measures in flood protection. In a wider context, the presently available flood plains amount to only 838 km² (14%) of the supposed original active flood plains of the Elbe River, with an estimated extension of over 6,100 km². Even if all currently planned backward re-locations of dykes were actually implemented, only 1% of the original flood plains would be re-gained (WWF, 2007).

Although the existing legislation is forward oriented with the aim to ensure effective integrated flood management practices, inadequacies exist in the applicability of specific laws and standing orders, as the complex legal system has numerous opportunities to avoid actual measures in flood protection and management. The main cause for this situation is that many laws have a wording that is not stringent enough and allows circumventing the actual intention of the laws to improve overall flood risk management. In this regard and in view of the ongoing discussions, positions of different stakeholders are documented. Some of them state that existing legislation is inadequately implemented in part because of an unabated industrialization (and intensification) of agriculture, infrastructure at risk in flood plains and exemptions to land use restrictions including building in high risk areas, etc. These cases are good examples for sector-oriented policies that are counter-productive for improved integrated flood risk management as described above. WWF (2007) stated that many existing laws and regulations are not formulated stringently enough to allow their enforcement. BUND (2007) concluded that inadequate policy integration (in German: *Politikintegration*) is a root cause for an overall deficient flood protection. In particular, the legal framework (such as the Federal Act for the Improvement of Flood Prevention passed in 2005 could not establish legally binding conditions important for flood protection as there are a number of exclusion rules or vague formulations that allow business as usual, such as building activities and intensive land use in denominated flood plains.

With regard to the sustainability of flood protection measures, a particularly critical issue is the heightening of dykes in response to design-flood reviews (which is a policy objective, as shown above) under a changing climate. While the immediate flood risk may be lowered and higher damages mitigated, the residual risk over a longer time horizon as a result of catastrophic extreme flood events increases in the case of a dyke failure. This would put even more lives, livelihoods and property at risk.

Public–private partnerships such as those between (local) governments, the private sector, the public and insurers could encourage risk reduction and risk financing (Zurich Insurance, 2014a). Such new alliances would need to be formulated in a policy framework. The actual forming of such alliances is still in its infancy.

Key issues in flood risk management

- The case of flood risk management in the Elbe has shown, from its inception, that a cross-sectorial formulation of an integrated flood risk management policy framework is indispensable to transform policies into action.

- These policies must be underpinned through an adequate legal system to make policies implementable and enforceable.
- The political will for cooperation at all levels and with a multitude of stakeholders, including public, private and academic institutions and organizations as well as riparian countries fosters the development of consensus-based sustainable policies.
- Resource requirements can be huge, which will require a long-term perspective of putting policies into action with multiple milestones established to monitor progress.
- Public flood risk awareness and largely improved flood risk information services including improved flood forecasting are key to keep flood damage to a minimum.
- Policy development is often based on projected future conditions and derived requirements for flood risk reduction. By themselves these policies are difficult to test for *a priori* sustainability and robustness. Likewise, most of these policies, once implemented, cannot be reversed easily because of the high costs involved. It is therefore advisable to verify policies in pilot projects such as those implemented in the ELLA (Elbe-Labe Flood Management Strategy) project (ELLA, 2005; Bundesanstalt für Gewässerkunde, 2006) and LABEL (Labe-Elbe Adaptation to Flood Risk) project (LABEL, 2012).
- Rebuilding efforts after floods without improved flood resilience are straining public resources. Closer linkages with the insurance industry and public–private partnership could improve this situation (Zurich, 2014a, b).

Research is another key issue that is often underestimated and, as a consequence of the Elbe flood in 2002, the national research program 'Risk Management of Extreme Flood Events' funded by the Federal Ministry of Education and Research (BMBF) was initiated (Burek & Rademacher, 2009). Between 2005 and 2010, 38 projects were carried out with a total value of 20 million euros (Peterson, 2009). However, there is a need for further research for flood risk reduction and an improved management of floods in a river basin context (CHR-KHR, 2004). It is astonishing that, to date, there is no clearly communicated 'research policy' addressing research requirements in support of policy development and implementation. Needs for further research include:

- systematic examination and verification of basic data-material including hydrological, meteorological and also socio-economic data;
- statistical analyses of trends and patterns in the hydrological cycle and flood events in particular;
- analysis of historical flood events;
- analysis and detection of changes or variability of weather patterns, cyclone tracks and related precipitation extremes;
- improved modeling of flood events from their genesis down to the propagation of flood waves along river stretches including tributaries;
- water-balance modeling of the catchment;
- scenario-based support to decision-making tools in support of policy development, adaptation and implementation including the effect of changes in areas such as: demographic change, land use (agriculture), infrastructure, climate change;
- analyzing of the retention effects of existing or projected flood retention measures (structural and non-structural) on particular flood events;
- emerging research needs may centre on improved information gathering and utilization of information such as that gathered through crowd sourcing.

Key policy messages for the regional and global community

- Policies need to be developed based on strategic targets and with a time horizon not less than 20 years.
- Policies should be developed building on the consensus of major stakeholders.
- Policy integration is of utmost importance: policies need to be developed and existing policies adapted at different levels across sectors in such a way that those policies are mutually complementary, non-contradictory and implementable to achieve improved integrated flood risk management.
- Flexibility of policies should be maintained so that they can be adapted to overall changing conditions.
- Policies should be anchored in legislative frameworks that can be enforced through by-laws, ordinances (standing orders) and supporting administrative procedures.
- Policies should be implemented through action plans and projects on local, provincial, national and international levels, as appropriate with the river basin as the planning and implementation unit. The long-term availability of critical resources (such as through the development of a joint (Federal and State level) financing strategy as mentioned above) needs to be ensured.
- Failure of policies in flood management can be very costly as a result of high investments and likewise high costs in the reversal of implemented actions on the basis of a failed policy. It is therefore advisable to 'experiment' with policies, such as through scenario-based impact studies and through dedicated pilot projects in sub-basins to ensure the sustainability and robustness of policies to be chosen.
- Development of policies to strengthen public private partnerships could go a long way to synergize efforts by the public and private sectors towards risk reduction approaches. Likewise, in this respect, a greater self-help capability (especially with a focus on a greater insurance penetration rate in the potentially affected population), if set as a policy, would aim towards alleviation of public expenses for flood damages while encouraging private partners to invest in building flood resilience through adequate measures (such as flood-proving houses).

In a FLOOD-ERA Report for England and Scotland on the 'systematization, evaluation and context conditions of structural and nonstructural measures for flood risk reduction' (CRUE, 2008), the authors came up with two main lessons. From their study on policy contexts their conclusions are cited *verbatim* as key policy measures, as these conclusions are fully applicable to the context of this paper with regard to the Elbe flood policies:

> '*The key lesson is that to fully comprehend flood risk management policy, and key policy decisions concerning flood measures, it is necessary to 'back up' into higher, broader level policies of Government where the roots of these policies exist and where the commitments to particular policy drives are formulated. High level Government policies may reflect grass-roots ideas and initiatives, but the strongest policy drive usually comes from the top downwards. Policies are translated into lower level policies via policy documents and signals emanating mainly from Government, with Government seeking to detect lower level concerns which may influence the policy agenda. A second key lesson is that in order to promote non-structural flood measures, it is often necessary in the first instance to inject germane ideas at much higher levels of policy*.'

Conclusions

The case of the Elbe River flood risk management efforts demonstrates that the development of coherent policies on the basis of stakeholder consultations is a promising way forward to transform policies into actions. Based especially on the relative success of the IKSE Elbe Flood Protection Action Plan, it can be shown that the development of flood risk management policies has to be seen as a process that includes international cooperation with riparian countries as well as cooperation between the German Federal States and the German Federal Government on one side and policy development at the level of the European Community on the other. The concept of policy integration in a cross-sectorial manner as well as embedding polices in a legal framework are key to make policies actionable. Non-structural measures have largely been left behind in policy implementation, in particular the 'room for the rivers' policy and backwards re-location of dykes in synergy with the environmental policy of ecologically healthy rivers and flood plains. Policy integration is of utmost importance: policies need to be developed and existing policies be adapted at different levels across sectors in such a way that those policies are mutually complementary, non-contradictory and implementable to achieve improved integrated flood risk management. Research policies are not visible in a way that research results would influence the development of policies and their implementation. Lessons learnt from the 2002 and 2013 Elbe floods also show that legal frameworks need to be more stringent at Federal and States level to improve policy implementation.

References

Abhas, K., Bloch, B. & Lamond, C. (2012). *Cities and Flooding – A Guide to Integrated Urban Flood Risk Management for the 21st Century*. The World Bank, Washington.

Belz, J. U. (2013). The German Elbe River Basin. Presentation at the MRC '*Extreme Flood Events – Past, Present And Future*' Conference, Bangkok (Thailand), 13–14 November 2013.

BUND (Bund für Umwelt und Naturschutz – Deutschland; Friends of the Earth, Germany) (2007). Hochwasserschutz an Donau, Elbe und Oder – aus den Fehlern nichts gelernt? Eine Bilanz des BUND im August 2007.

Bundesanstalt für Gewässerkunde (BfG) (1994). *The 1993/94 Flood in the Rhine Basin*. BfG Report No. 833 BfG, Koblenz.

Bundesanstalt für Gewässerkunde (BfG) (2006). Modellgestützter Nachweis der Auswirkungen von geplanten Rückhaltemaßnahmen in Sachsen und Sachsen-Anhalt auf Hochwasser der Elbe, Bericht BfG-1542, Koblenz.

Bundesanstalt für Gewässerkunde und Deutscher Wetterdienst (Hrsg.) (2013). Länderübergreifende Analyse des Juni-Hochwassers 2013. BfG-Bericht BfG-1797. Koblenz.

Bundesministerium des Inneren (2013). Bericht zur Flutkatastrophe 2013: Katastrophenhilfe, Entschädigung, Wiederaufbau, StabFH-51004/24#2.

Burek, P. & Rademacher, S. (2009). Veränderungen und Management der Risiken extremer Hochwasserereignisse in großen Flussgebieten – am Beispiel der Elbe (VERIS Elbe). Schlussbericht des Teilprojektes: Hydrodynamische Berechnung des Wellenablaufes der Elbe. BfG-1637. Bundesanstalt für Gewässerkunde.

Cash Online – Finanznachrichten, 23. July 2013; http://www.cash-online.de/versicherungen/2013/hochwasser-kostet-versicherern-fast-zwei-milliarden-euro/129.

CHR-KHR (International Commission for the Hydrology of the Rhine Basin) (1990). *Das Hochwasser 1988 im Rheingebiet*. Report No. I-9.

CHR-KHR (International Commission for the Hydrology of the Rhine Basin) (1999). *Eine Hochwasserperiode im Rheingebiet*. Extremereignisse zwischen Dezember 1993 und Februar 1995, Report No. I-17.

CHR-KHR (International Commission for the Hydrology of the Rhine Basin) (2004). *Development of Methodologies for the Analysis of the Efficiency of Flood Reduction Measures in the Rhine Basin on the Basis of Reference Floods*. Report No. I-21.

CRUE (2008). *Systematization, Evaluation and Context Conditions of Structural and Non-structural Measures for Flood Risk Reduction; FLOOD-ERA Report for England and Scotland*. CRUE Research Report No. I-1.

Deutscher Bundestag (2013). Bericht zur Risikoanalyse im Bevölkerungsschutz 2013; Deutscher Bundestag Drucksache 18/208 18. Wahlperiode 16.12.2013.

Dresden (2011). Potenzielle Überschwemmungsflächen der Elbe jetzt online im Themenstadtplan verfügbar. Press Release. City of Dresden (5 May 2011). See: http://www.dresden.de/de/02/035/01/2011/05/pm_020.php (accessed 29 August 2014).

EC (European Commission) (2000). Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (EU Water Framework Directive).

EC (European Commission) (2004). Communication from the commission to the council, The European Parliament, The European Economic and social committee and the committee of the regions flood risk management flood prevention, protection and mitigation.

EC (European Commission) (2007). Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.

ELLA (2005). *ELBE – LABEL Preventive Flood Management measures by transnational spatial planning (ELLA)*. Saxon State Ministry of the Interior; http://www.bafg.de/DE/08_Ref/M2/03_Fliessgewmod/elbe_rueckhaltem_hw.pdf?__blob=publicationFile.

European Flood Action Programme (2014): http://ec.europa.eu/environment/water/flood_risk/com.htm.

Federal Act (2004). Gesetz zur Verbesserung des vorbeugenden Hochwasserschutzes Deutscher Bundestag – 15. Wahlperiode Drucksache 15/3168.

Heintz, M. D., Hagemeier-Klose, M. & Wagner, K. (2012). Towards a risk governance culture in flood policy—Findings from the implementation of the 'Floods Directive' in Germany. *Water*, *4*, p135–156. doi: 10.3390/w4010135

IKSE (Internationale Kommission zum Schutz der Elbe; International Commission for the Protection of the Elbe River) (2003). Aktionsplan Hochwasserschutz – Elbe (The Elbe Flood Protection Action Plan). Internationale Kommission zum Schutz der Elbe, 39006 Magdeburg Germany.

IKSE (Internationale Kommission zum Schutz der Elbe; International Commission for the Protection of the Elbe River) (2012a). Abschlussbericht über die Erfüllung des Hochwasserschutzplans Elbe 2003–2011 (International Commission for the Protection of the Elbe River). IKSE, 39006 Magdeburg, Germany. http://www.ikse-mkol.org/index.php?id=758&L=0%2220onfocus%3D%22blurLink.

IKSE (Internationale Kommission zum Schutz der Elbe; International Commission for the Protection of the Elbe River) (2012b). Länderübergreifender Hochwasserschutz an der Elbe - Ein Abschlussbericht 10 Jahre nach der Flut. IKSE, 39006 Magdeburg, Germany. http://www.ikse-mkol.org/index.php?id=1&L=2.

IKSE (Internationale Kommission zum Schutz der Elbe; International Commission for the Protection of the Elbe River) (2013). Das Hochwasser im Juni 2013 und der internationale Hochwasserrisikomanagementplan im Einzugsgebiet der Elbe, workshop (21 November 2013). IKSE, 39006 Magdeburg, Germany. http://www.ikse-mkol.org/index.php?id=852&L=.

IKSR (Internationale Kommission zum Schutz des Rheins; International Commission for the Protection of the Rhine) (1998). *IKSR – Aktionsplan Hochwasser*. (Rhine Flood Action Plan) Report No. 156. See: http://www.iksr.org/index.php?id=123.

ILRI (International Livestock Research Institute) (1995). *Livestock Policy Analysis*. ILRI Training Manual 2. ILRI, Nairobi, Kenya. pp. 264.

Koalitionsvertrag (2014). Deutschlands Zukunft gestalten: Koalitionsvertrag zwischen CDU, CSU und SPD, 18. Legislaturperiode, Kapitel 4.2, „Umwelt' p. 120; http://www.bundesregierung.de/Content/DE/_Anlagen/2013/2013-12-17-koalitionsvertrag.pdf;jsessionid=BE45E5D27F84A05F7B6594747EFE0CD6.s1t1?__blob=publicationFile&v=2.

LABEL (2012). *LABE-ELBE Adaption for Flood Risk (LABEL)*. Saxon State Ministry of the Interior. http://www.label-eu.eu/uploads/media/EN_LABE-ELBE_2012plus.pdf.

LAWA (2014a). German Working Group on Water Issues of the Federal States and the Federal Government. http://www.lawa.de/About-LAWA.html.

LAWA (2014b). *Zusammenfassende Analyse der Ergebnisse der vom Hochwasser 2013 betroffenen Flussgebietsgemeinschaften*. Bund/Länderarbeitsgemeinschaft Wasser (LAWA).

Peterson, D. (2009). Sustainable sanitation and water management, Creating Policies and a Legal Framework. Seecon international GmbH; http://www.sswm.info/print/1605?tid=596.

Plate, E. (2011). In: Large-Scale Floods Report, ICHARM Book Series No. 1.

Pressespiegel (2014). Elbe-Anrainer fordern mehr Raum für Gewässer. http://www.mdr.de/nachrichten/elbe-anrainer100.html.

Raadgever, G. T. (2005). Transboundary River Basin Management Regimes: The Elbe Basin Case Study, Background Report to Deliverable 1.3.1. of the NeWater project, RBA Centre, Delft University of Technology, Delft.

Rickmeyer, A. (2014). Konsequenzen aus den Hochwasserereignissen 2013 Niedersächsisches Ministerium für Umwelt, Energie und Klimaschutz 23. April 2014 - BWK Hannover.

River Basin Community – Elbe (http://www.fgg-elbe.de/start-en.html).

Rudolph, K. U. & Block, T. (2001). *The German Water Sector – Policies and Experiences*. Federal Environmental Agency, B., Germany.

Socher, M. (2014). Informationsveranstaltung 'Hochwasserschutz an der Elbe'; 1 | 5. Juni 2014 Bad Schandau, Presentation.

Vanneuville, W., Deckers, P., Van Eerdenbrugh, K. & Mostaert, F. (N.N.) Flood Risk Scenario Calculations as a Decision Support and Evaluation in Water Management Plans. www.vliz.be/imisdocs/publications/135615.pdf (accessed 9 September 2014).

VERIS – Elbe (2013). Changes and Management of Risks of Extreme Flood Events in Large River Basins – The Case of the Elbe River. http://www.veris-elbe.ioer.de/template-en.php?bereich=projekt (accessed 30 August 2014).

Wiederaufbaustab (Reconstruction Team), State of Saxony (2013). Der Wiederaufbau im Freistaat Sachsen nach dem Hochwasser im Juni 2013.

WWF (World Wildlife Fund) (2007). 5 Jahre nach der Elbe-Flut; Editor: WWF Germany, Frankfurt/Main.

Zurich Insurance (2014a). European Floods: Using Lessons Learned to Reduce Risks; www.zurich.com/_/.../european-floods-using-lessions-learned.pdf?la=en.

Zurich Insurance (2014b). Risk Nexus – Central European Floods 2013: A Retrospective.