development, and not adequately fostering the critical sciences necessary to investigate the conflicts of goals and interests, the trade-offs between different dimensions of sustainability, decreases not only the capacities of the German science system to cope with global change, but also puts at risk finding suitable coping strategies for humankind as a whole. Continuing with the eco-modernist, technocratic solution orientation of German science policy may thus compromise the German contribution to protecting our world, which would require assuming responsibility for safeguarding the planetary carrying capacities. At the moment, the BMBF's policies for sustainability research do not adequately foster this role of science in its funding practice, even if global responsibility surges as a buzz word in its political strategies.

The depoliticisation of sustainability and its interpretation as mainly technological problem influence the science system in the long run, if instead of multiple disciplines only capacities in those disciplines are fostered that are economically conducive. However, future-proofing Germany entails society as a whole. *Not* respecting planetary boundaries in the end would negatively affect any efforts for economic prosperity, as well. Turning an encompassing concept of sustainable development into the core discourse of science policy instead of economy-oriented innovation would therefore be advisable.

11.3 Global development as opportunity for German science policy

Perceiving sustainable development as *global* development shifts the focus of the concept from sustainable development on the local level towards the global interrelations and responsibilities. Additionally, the previous emphasis on necessary change in so-called developing countries shifts towards an emphasis on the needs of transformation in *all* countries (Horner and Hulme 2017). This discursive reinterpretation of sustainable development is already reflected in the Agenda 2030 and the SDGs and, I argue, should turn into a discursive framing of BMBF policies for research cooperation with developing countries and emerging economies as well.

Considering all nations as developing countries in certain aspects of social, economic, or ecological development, also may be pictured as a *potential* of research cooperation on eyelevel between different international partners that lives up to its name. Specific topics of sustainable development which affect partners on both sides could present starting points for comparative research in international teams. Issues such as social inequality on different scales, carbon-neutral development, sustainable urban development or sustainable production and consumption present challenges in most countries (WBGU 2011; 2016; Horner and Hulme 2017).

Research cooperation on these topics might enhance mutual learning instead of repeating traditional patterns of cooperation; jointly developing pathways might enable sustainable development in partner countries as well as in Germany – thus not catch-up development in the partner countries, but leap-frogging and transformation towards sustainable development. On this basis, the following section suggests some alterations of BMBF policies for cooperation with developing countries and emerging economies. Based on the empirical insights presented in this book, the Megacities initiative and the IWRM initiative function as entry points for policy recommendations. Table 11-2 summarizes the recommendations in view of the mode of cooperation, scale of research as well as level of reflections.

11.3.1 Reflexivity in project set up and knowledge generation

Research into the IWRM and Megacities initiatives shows that the BMBF relied on inter- and transdisciplinary project set up as well as well as cooperation on eyelevel as means of securing effects of the projects, and the funding initiatives in extension. In the light of sustainable development, projects should be further encouraged to reflect about any intended or unintended consequences of their research, including the implications for social, economic and environmental justice:

- Who benefits from the solution proposed?
- For whom is impact created?
- Which larger effects on policy, society or the environment can be foreseen?

An emphasis on process and critical transformation knowledge within research projects for sustainable development is necessary. Framing outputs in a more encompassing way as a part of an ex-ante analysis of potential effects would extend the research projects' scope with a systemic dimension beyond mere problem solving on a local level – and thus would more adequately cover all dimensions of sustainable development.

Projects in both IWRM as well as Megacities funding initiatives delivered a variety of results, including technological as well as non-technological solutions. Capacity development on different levels was part of both funding initiatives and envisaged as a type of impact next to problem solutions. No project participants interviewed in any funding initiative voiced any anti-technology feelings. However, business partners as well as researchers favoured an inclusion at a later project stage in order to ensure that solutions proposed match local realities. From a normative stance of sustainable development, I second this recommendation. A later inclusion of business partners allows projects to carry out a systemic analysis of all potential pathways to solutions in the first project phase without being pressured

into a preset technological direction. For the business partners, later involvement lowers investment risks.

Research projects should continue their reflections about impact pathways at all stages. These reflections should be integrated into the projects as social science research questions. Directed at maximizing the public benefits stemming from publicly funded research, research projects should target outputs and innovations at different levels. Adding this dimension to research project would answer questions of benefits and potential disadvantages of the projects' interventions in a more holistic way. Next to different types of innovations as positive outcomes of research projects, as intended consequences, projects should also take into careful consideration which negative side-effects might arise from intended outcomes. Good ideas sometimes have unintended negative effects – or might equally have positive side-effects. Thinking these through would increase research projects positive impacts on the one hand while diminishing negative consequences on the other.

Questions of *reflexive transformation research* include, but are not limited, to the following:

- Which knowledge about the change-process was generated?
- Which hurdles for innovation and transformation were detected, which enabling factors?
- Which knowledge, methods or innovations have potential to be adjusted to/transferred to other contexts; has this already been done?
- Which insights on transdisciplinary research, cooperation methods, and stakeholder processes?

Transformation research should become an integral part of *transformative research*. In doing so, transferable insights would be generated which help to understand change processes towards sustainability, thus further increasing public benefits. Interventions, such as innovations, on lower level of leverage – such as tackling *outcomes* of unsustainable behaviour, end-of-pipe solutions etc – rarely produce change on systemic levels (Meadows 1999; Göpel 2016). Research projects should therefore aim at understanding processes of environmental, economic and social change in the context of sustainability, as well as the systemic barriers which prevent it. Research should thus not only address sustainable development at a local level, but also scrutinize the bigger systemic picture.

It is likely that researchers in past funding initiatives produced transformative and transformation knowledge that the BMBF could have made better use of. Interviews hint at the existence of (implicit) knowledge created in projects in the IWRM initiative as well as in Megacities initiative, including insights about transdisciplinary methods and challenges, and other crosscutting issues. However, so far, the

BMBF did not systematize, edit or publish any insights into these fields of knowledge. For example, the online database generated based on results of the Megacities projects was discontinued shortly after the initiative ran out. Systematically assessing and securing results in longer-lasting formats, relevant to further research, would therefore be recommendable as a research-based activity across projects. Transferable results and transformation knowledge might even best be secured as scientific publications. Encouraging researchers involved in funded projects to reflect and publish their reflections on transferable knowledge and transformation knowledge in scientific journals would be advisable in future funding initiatives.

While academic capacity development continues to be considered as essential, more recently, the idea of unilateral capacity development has been confronted with the idea of *mutual learning* (Bradley 2007; Arocena and Sutz 2010; Upreti 2011; Stöckli et al. 2012). Reasons for reconceptualizing capacity development as mutual learning instead of one-way learning are based on the idea of a mutual partnership. Cooperation on topics of global sustainability provide an ideal opportunity of knowledge exchange in both directions, as partners in all countries are in need of transformative and transformation knowledge for sustainable development.

At the same time, the policy and funding frame should be flexible enough to adequately react to changing realities or unexpected results. Even if research is aimed at application, it should be conceptualized as an open-ended process. New knowledge – transformative as well as transformation knowledge, on local conditions as well as global developments – should be integrated into the funding frame.

Table 11- 2: Reflexive set up of projects and funding initiatives

Mode of cooperation	*Scale*	*Reflections on*
Involvement of relevant stakeholders; Involvement of relevant scientific disciplines for systemic analysis; Respectful international partnership and common ownership; Mutual learning	Local and global level; Transformative research *and* generation of transformation knowledge; Problem-specific and systemic entry points	Potential transferability; Effects (negative or positive) of research; Conditions of transformation and innovation

Source: Own elaboration

11.3.2 Making all types of output count

In addition to the capacities developed among all partners as well as the knowledge on transformation processes generated in research projects, transformative research should produce solutions suitable to specific issues of sustainable devel-

opment. Table 11-3 abstracts the main types of outputs, or innovations, on different levels, based on the overview of results from the Megacities funding initiative and the IWRM funding initiative (App. B-3a, b). Although the BMBF raised different expectations in view of results to be produced, the projects funded in the IWRM initiative as well as in the Megacities initiatives developed a wide range of results and solutions, including technological as well as social and other types of solutions.

The categories of results, as shown in table 11-3, are idealtypes which overlap in reality. For example, management concepts for public administration might lead to benefits for the public or for individuals later; some practices, such as water-saving irrigation methods, are carried out by individuals but the public is a general beneficiary of increased water availability, etc. Even so, the categories of different results in table 11-3 illustrate that the BMBF's focus on visible, often large-scale technical innovations is very limiting. Applied research produces meaningful knowledge and innovations on a variety of levels that are not routinely in the policy focus and go by unnoticed, even though they bear potential for transformative change. Encouraging a reflection about *all* potential types of knowledge, innovations and other effects of research would be conducive for sustainability-oriented research in its global dimension. Additionally, and this might turn into an incentive in the policy setting coined by rivalries, bringing other types of impacts into the spotlight would also add to the visibility of the BMBF's funding initiatives. Different effects of research projects, on different scales and at different entry points should be visualized and exposed publicly in order to establish them as legitimate objectives of science policy.

The agency of the projects, their power of street-level policy alterations, is an important lever of change towards sustainable practices as well. In SKAD terms, they re-interpreted the policy discourse in order to adapt the BMBF's policy frame to their research interests as well as the partner country's necessities. This presents an opportunity in favour of a global sustainable development, even if discursive stability hinders major changes on the policy level.

Table 11- 3: Potential types of outputs, knowledge and innovations

Outputs for individuals	*Outputs for public administration and policy making*	*Outputs for the larger public*
Technology-based: Technological innovations for individual use (e.g. solar-powered lamps, rain water collection plants, energy-efficient buildings)	*Technology-based:* Decision-support systems, models, (e.g. tools, software); Monitoring systems	*Technology-based:* Large-scale technological innovations (e.g. waste/water treatment plants); Infrastructural innovations (e.g. transportation systems)
Non-technological: Social innovations (e.g. new business practices, new irrigation schemes; Capacity development for a specific technology, vocational training; Capacity development in research, science administration and among university staff	*Non-technological:* Innovations in processes and methods (e.g. participative methods, governance schemes); Institutional innovations (e.g. regulations, laws); Organisational innovations (e.g. establishment of new administration units); Capacity development on individual and institutional level	*Non-technological:* New practices (e.g. waste separation); Institutional innovations (e.g. information offices, environmental protection areas); Capacity development and awareness raising in public, shifting mindsets (e.g. towards sustainable practices)

Source: Own elaboration

11.3.3 Enhancing potentials of discourse change in policy processes

The direction of science policy is not a given fact. Favouring a certain discursive conceptualisation of sustainable development instead of another is debatable. As argued in chapter 11.2, the current policy discourse does not sufficiently enable the German science system to assume its precautionary responsibilities for dealing with global change. Therefore, the current orientation of science policy for sustainability research should be challenged.

Overcoming the policy skew towards economy-oriented, technical innovation in sustainability research requires changes in the processes of discourse actualisation in policy making – in order to overcome the current discourse's stability, which among other factors depends on the exclusion of alternative discourse in discourse production (ch. 11.1). A potential entry point for change is located in the processes of discourse production at different stages of the policy process.

Scholars of different disciplines (ranging from perspectives of democratic accountability to environmental sustainability to social inequality) suggest more de-

liberative, inclusive and democratic approaches to policy making through citizen participation and call for the inclusion of different stakeholders in decision making, which should become a standard practice in reflexive science policy processes. In doing so, potential pitfalls have to be considered, such as the political nature of participation itself, which underlies different interests and power constellations (among others Jasanoff 2003; Fischer 2006; Kersting 2008; Stirling 2009; STEPS Centre 2010; Leach et al. 2010; Arocena and Sutz 2012; van Oudheusden 2014). For the sake of a more encompassing discourse of science for sustainable development, I would like to second these authors and argue for the inclusion of wider spectrum of alternative discourses in science policy making.

If the BMBF takes global responsibilities seriously, as stated in FONA, it should therefore continue its reflections about participatory processes. Yet, it is questionable if the BMBF is genuinely interested in opening agenda processes, and thus potentially allowing discourse change, given the current tendencies that favour discourse stability. The actors within the alternative discourse coalition (Box 7-1) therefore play an important role. In the past, change within the ministry was often triggered as a reaction to public discourse. If actors within the alternative discourse coalition raise public awareness about the importance of science policy processes for future proofing our society, the BMBF might feel incentivized to change.

Although the participatory FONA Fora can be considered as a first step towards opening agenda setting towards actors outside of the usual scope, real processes of opening up would require a willingness to transfer *decision-making power* to those actors involved in the agenda-setting process as a prerequisite (ch. 7.3.3). Reflecting on past participatory processes, the format of neither the FONA Fora nor of the audit of selected funding initiatives before FONA3 were appropriate. In the FONA Forum 2013, the range of participants was not balanced, and the preset format, based on pre-established topics, rather contributed to reify and stabilize the past policy discourse than to inspire change (ch. 7). In case of the FONA audit (ch. 10), the actors, all of them in perceived or actual dependency from the BMBF, adjusted their self-representation and withheld critique out of fear of negative consequences. It is unlikely that outcomes of the agenda processes, self-evaluations and audits as in the past will be critical of the status quo of the Sustainability Subdepartment's policies. Different forms of evaluation and feedback would be more conducive: Participants in agenda-setting and feedback activities need to be sure about the absence of any negative consequences in case of critique – through anonymized participation or other mechanisms that sufficiently inspire trust. However, this would require interest in *obtaining* critical feedback or in learning about alternative discursive assumptions in the first place.

In addition to participatory processes on the level of agenda setting for research *programmes*, opening up policy processes on the level of designing concrete *funding initiatives* is equally necessary. As analyzed in chapter 7.3, decisions on pro-

grammes and funding initiatives take place independently on different levels. In view of funding initiatives for research cooperation with developing countries and emerging economies in sustainability research, I would like to endorse the routine involvement of *actors from other policy fields*, such as of BMU or BMZ, as well. Empirical data has shown that the lack of connection and cooperation of science policy funding initiatives with those of other policy fields, such as environmental and development policy, as well as the lack of involvement of partner countries, had negative consequences for the implementation of research projects as well as their effects (ch. 10).

In view of funding initiatives for research cooperation with developing countries and emerging economies, the BMBF's recent practice of designing *bilateral* (or multilateral) initiatives instead of unilateral initiatives, as still was the case in IWRM and Megacities funding, is a very positive development in view of a balanced, respectful cooperation with partner countries. This is a necessary turn away from a mode of agenda setting exclusively within Germany. Abandoning paternalistic patterns of cooperation means basing cooperation on jointly defined agendas and topics of interest. This *mutual ownership*, and not necessarily a financial contribution, should turn into the basis of *cooperation on eyelevel*. A cooperation on eyelevel with partner countries, to speak with the BMBF's terms, begins at the policy level, not at the project level. Joint policy making – starting with the joint definition of research topics for cooperation, is thus necessary.

Jointly pursuing a science for sustainable development in cooperation with others may trigger further *ethical* questions. If partners from developing countries and emerging economies are enabled to prioritize research problems independently of German priorities, the German side may have to learn to deal with diverging agendas, different pathways and solutions, and different problem framings. While allowing such a diversification would be desirable from a normative standpoint favouring global equality and post-colonial cooperation patterns, partners might attribute less importance to questions of sustainable development and prioritize other issues of cooperation. In view of reaching an overall goal of global sustainability, negotiating objectives and solutions and sensitizing all partners for global sustainable development may thus become necessary.

11.4 Further research questions

In empirically dealing with the research questions that guided the PhD thesis as a basis of this book, further research topics emerged, which could not be covered in its frame, but which pose interesting subjects of further research. Further research questions emerged in the following areas. *First*, further research should address the distribution of roles within research cooperation between Germans and inter-