Soil and land use research in Europe: Lessons learned from INSPIRATION bottom-up strategic research agenda setting

1 Introduction

The use and management of land and soil should be tailored to meet human needs (Otte et al., 2012) while conserving biodiversity and soil ecosystem services. In this paper, we present the work of the INtegrated Spatial PlannIng, land use and soil management Research AcTION – INSPIRATION, a Coordination and Support Action funded under the European funding scheme Horizon 2020. INSPIRATION has developed a strategic research agenda (SRA) for sustainable spatial planning, land use and soil-sediment-water systems management through a novel bottom-up approach.

The need for research action in this area is eminent. It is increasingly recognized that the way in which we manage our soils is central to ensuring a safe and sustainable future (UN, 2014). Several Sustainable Development Goals (SDGs) clearly link to soils. Soil and related science is needed to create, provide and demonstrate the fundamental and applicable knowledge (cf. Keesstra et al., 2016).

Several Strategic Research Agendas (SRAs) have been produced to support achieving European Union policy goals, in particular in the context of environmental policy (for example EC 2010, 2011a, 2011b, 2012), by strengthening structures and networks, knowledge creation, exchange and capacity building as well as pooling of funding resources. In particular, various Joint Programming Initiatives (JPIs), launched by the EC since 2008 (EC, 2008) to foster multilateral research collaboration to tackle societal challenges in strategic areas are based on regularly updated SRAs. These include agriculture, food security and climate change (FACCE-JPI, 2015), sustainable water systems (JPI-Water, 2016), demographic change (McNair, 2014), urban challenges (JPI Urban Europe, 2015) and climate change (JPI Climate, 2011). Most JPIs comprise pure and applied research as well as innovation projects to address specific societal challenges. Typically, these SRAs are formulated by scientists using a rigorous assessment of knowledge gaps based on a meta-

analysis of peer reviewed literature. Later phases involve expert consultation or stakeholder feedback to amend the SRAs.

According to Web of Science, 204 contributions with 'research agenda' in the title were made just in 2016 (2,880 since 1945). Often, a SRA is regarded as an important instrument to inform public funders on where taxpayers' money should be spent most effectively. Additionally, the increased consideration of SDGs provoked the systematic collation of research to close knowledge gaps that impede sustainability. Despite increased awareness of the importance of land and soils, only nine contributions (since 1945) of the research agendas published in Web of Science refer to land and none to soil – nor is there a JPI dealing with soils as such.

INSPIRATION aims at closing this gap and its SRA will help public and private research funders identify research in soil and land they should invest in to innovate and contribute to a greener, more resource efficient, and more competitive Europe. The SRA is envisaged to be the foundation of a network of funding institutions.

However INSPIRATION's starting point was not to undertake a meta-analysis of peer reviewed literature in pursuit of knowledge gaps.

INSPIRATION chose a bottom-up approach, which is critically evaluated in this paper, for the development of the SRA. Research and innovation (R&I) needs were identified by more than 500 European funders, end-users, scientists, policy makers, public administrators and consultants as the baseline for the SRA. The key motivation for this process was to ensure that R&I needs of stakeholders working on societal challenges were identified. We present the concept for this bottom-up approach (section 2), report on its implementation (section 3), provide a critique of our approach (section 4) and draw key lessons learned (section 5) for research agenda setting and provide an outlook.

2 Developing the INSPIRATION SRA

The underlying premise of INSPIRATION has been that understanding and managing land and soil services are fundamental for 1) meeting societal needs for food, drinking water, energy, shelter, infrastructure and 2) overcoming societal challenges of climate change mitigation and adaptation, increasing demands on non-renewable natural resources, environmental justice (cf. EC 2011c). To achieve this goal, broad stakeholder involvement is regarded as a key principle (cf. also Kuhlmann & Rip

2014, Levidow & Neubauer, 2012). The INSPIRATION approach, therefore, was to develop the SRA from the bottom up in order to deduce research needs expressed by land and soil stakeholders. It was anticipated that such a SRA also would be more likely adopted by research funders seeking impact from their financial investments.

2.1 INSPIRATION premises

The INSPIRATION project is based on three key premises:

Key premise 1 - Improving efficient and effective use of knowledge on soil, land-use and land management: Efficient and effective use of existing or new knowledge on soil, land-use and land management will contribute to, but will not be sufficient for, tackling societal challenges. Soil and land are natural resources whose use we need to manage if they are to remain integral parts of meeting societal demand. We believe that efficient use is predominantly enabled by focusing on the needs from the 'demand side'. SMEs, industry and communities need energy, water, food and space to survive and thrive. Establishing end-user needs creates the incentive to invest in knowledge development and stimulate political, industrial and societal innovation. Thus the architecture of INSPIRATION was geared towards thorough understanding and synthesis of the 'knowledge needs' from the demand side.

Key premise 2 - Ensuring success in addressing societal challenges: For the societal challenges to be successfully addressed, it is essential that the 'knowledge demanders' are facilitated in their communication with the 'knowledge producers'. This process is generically called Science-Policy-Practice-Interfacing (SPI), or more appropriate from a demand-driven approach: Policy-Practice Science Interaction (PSI). Therefore, existing experiences of INSPIRATION partners on SPIs were to be reconciled by stakeholder insights on what works and where gaps exist on national levels. Additionally, researchers were to be interviewed as additional category of SRA stakeholders – as a SRA must be attractive for researchers as well.

Key premise 3 - Establish a transnational network of funding bodies to implement the SRA: The main challenge for INSPIRATION is to prepare the ground for a transnational network of funding agencies and cooperating industries determined to implement this SRA. The strong belief has been that funders get convinced, and will want to collaborate, only if their challenges can be met and if they will see a return for each Euro they invest. The strength of the bottom-up approach was assumed to fuel

this as individual demands are recognized in the SRA – in addition to pointing out the advantage of pooling scare funding resources (Pérez, 2010).

2.2 Conceptual model enabling a paradigm shifting SRA

The SRA was to be designed in a way that would effectively support sustainable land management. Single-dimensional intra-disciplinary approaches to research have been very successful in building our present understanding of ecosystems and natural resources. However, the challenges we face inherently straddle disciplinary boundaries and changes in one domain can have unwelcome and unforeseen consequences in another.

In recognition of this complexity, INSPIRATION developed a conceptual model (see Fig. 1) identifying four themes through which to analyse the national situations and formulate the SRA. The model considers land and the soil/sediment/water-system (SSW-system) as goods and natural capital stocks that have to be used (demand on natural capital) in a way that maximizes non-depletion of our ecosystems (natural capital supply). There are conflicting interests regarding land use among societal stakeholders, such as farmers, spatial planners, developers, manufacturing industry and residents regarding the productivity of areas and/or protecting natural resources, for instance (land management). Sustainable land management must seek to balance the demand and the supply, with the latter being based on the resources provided by our natural capital. As an integral part of such a sustainable soil management model, the net impact, meaning the local to global footprint of human land management decisions, must be assessed and minimised. This Conceptual Model was the basis for identifying and structuring cross-country and cross-sectorial research demands (see section 3.2).

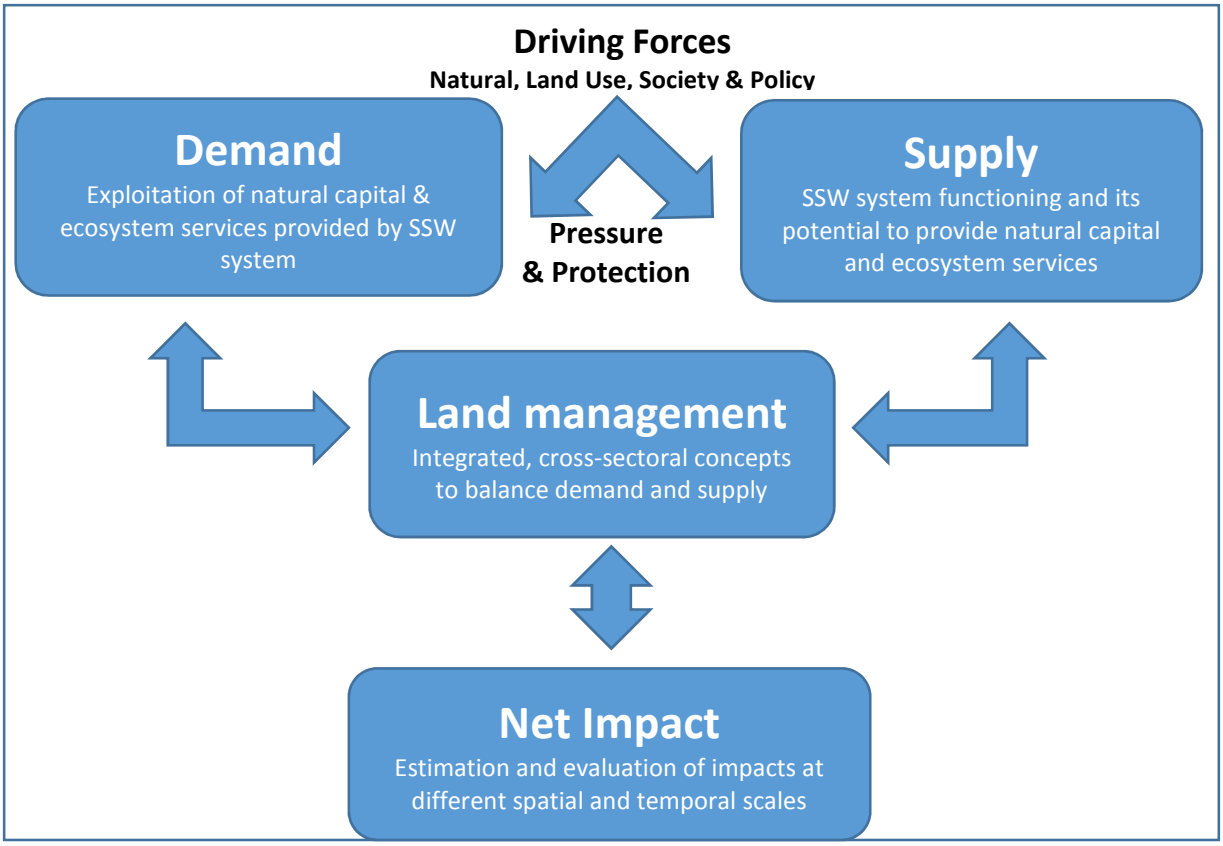

Fig. 1: *Conceptual Model of INSPIRATION research clustering based on Makeschin et al. (2016).*

3 Implementation of the INSPIRATION framework

3.1 Collation of research demands from National Key Stakeholders

National research and innovation needs were collated by a National Focal Point (NFP) in each of the 17 countries represented in the INSPIRATION consortium in a systematic process illustrated in Fig. 2. NFPs identified and interviewed National Key Stakeholders (NKS) using a template for national information collation developed within the project (Brils et al., 2015) in the kick-off meeting and rehearsed in an additional workshop of all NFPs in project month 4 in Vienna. Each NFP also performed a desk study to collect information on spatial planning, land use and soil management publicly available at the national level. Each NFP facilitated a two-day national workshop to review, synthesize and prioritize national R&I needs as well as other information gathered in interviews and the desk study.

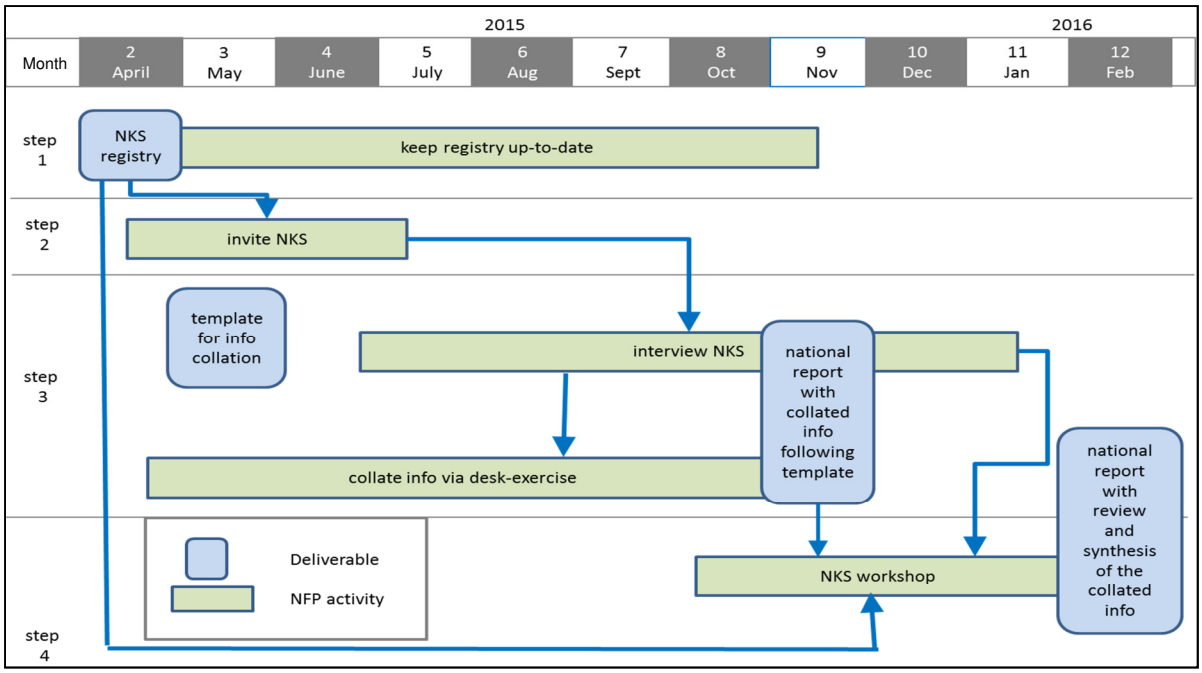

Fig. 2: *INSPIRATION workflow of collating research needs in participating countries – based on Brils et al. (2015).*

NKS play a key role in this process and their representative selection is of utmost importance. For selection of the NKS some conditions were developed and applied (Maring et al, 2015):

- NKS are nationally recognised experts using the current state of knowledge available in their field. They should have a clear vision of and insight in knowledge demands (short & long term); be well positioned and participating in relevant network(s) and – considering the later implementation phase – have the potential to become ambassadors for INSPIRATION
- A comprehensive stakeholder register was to serve for the national interviews and workshops consisting of circa one-third knowledge 'producers' and two-thirds end-users and funders to ensure a demand-driven agenda;
- local/regional/national government authorities, SMEs, industry and business networks, university and scientific networks, NGOs etc. shall all be represented;
- in each country, relevant policy sectors, e.g. construction/building industry, agriculture, finance, energy and drinking water producers, urban planning shall be represented.

Overall more than 370 NKS were interviewed as input for the desk study and more than 460 NKS took part in the national workshops. The division between different working backgrounds of NKS as “funder / end-user / knowledge provider” for the total of all 17 INSPIRATION-countries is depicted in Fig. 3. Further details per individual country are documented in Brils et al. (2016).

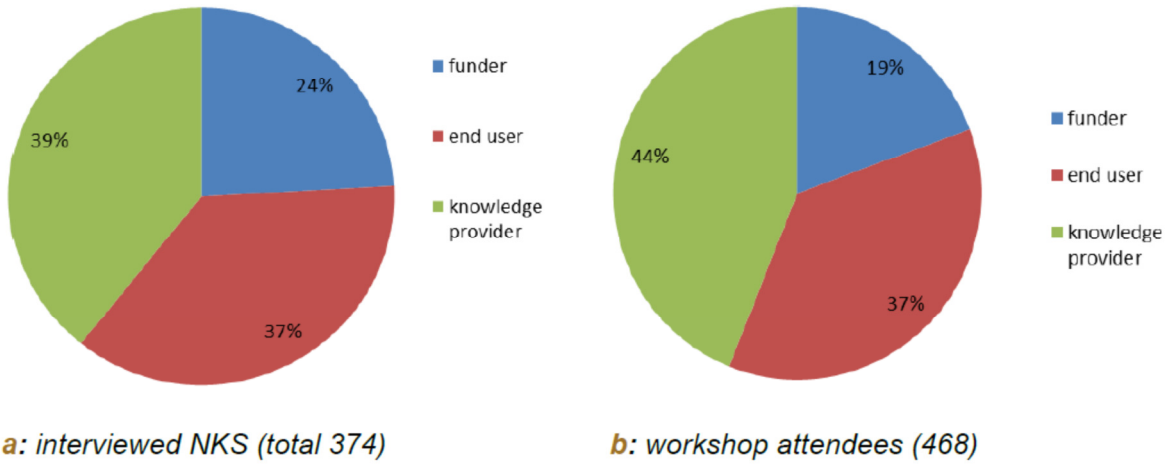

Fig. 3: *Division of background of NKS in “funders / end-users / knowledge providers” for all INSPIRATION countries. Source: Brils et al. (2016): 20.*

The results of the national activities are compiled in country-reports written in English with an executive summary in the national language. These reports contain synthesized and NKS-reviewed state-of-the-art overviews on (1) research & innovations needs linked to the themes identified in the conceptual model (see 2.2); (2) how science is connected to policy/practice; (3) existing national and transnational funding schemes of relevance for the particular country (Brils et al. 2016). The wealth of research needs expressed at this stage of the process was immense and included more than 1,000 questions across 200 research topics. The diversity between countries regarding subjects of research and their presentation in different length as depicted in Fig. 4 mainly corresponds to various levels of aggregation by NFPs.

In parallel, a board of stakeholders and experts (International Advisory Board) was set up to advise on the overarching research interests of EU stakeholders (e.g., networks of regulators or transnational industry associations).

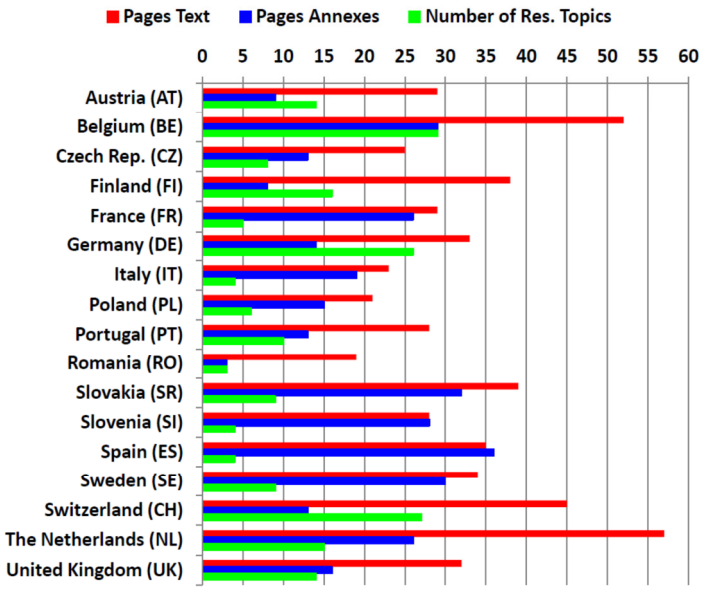

Fig. 4: *Overview about the extent of INSPIRATION country reports and number of research needs proposed. Source: Makeschin et al. (2016): 8.*

3.2 Clustering of national research priorities

In the second phase, national research demands were collated, reviewed and synthesized. Clusters of research questions were developed building on INPSIRATION's conceptual model (see section 2.2). Theme Leaders assessed each research question collated in the national reports and assigned them to at least one of the four themes from the INSPIRATION conceptual model:

- ***Demand:*** *What does society demand from natural capital and ecosystem services, including the SSW-system?*
- ***Natural capital:*** *What does nature, including the SSW-system, have to offer and which determinants sustain the system?*
- ***Land management:*** *What options are there for integrated, cross-sectoral land management that balances societal demands and natural capital supply?*
- ***Net impacts:*** *What are the impacts of different options for managing natural capital on global, regional and local in the short, medium and long term?*

Within each of these themes, the Theme Leaders identified areas of specific research areas and clustered all respective research questions in so called Clustered Thematic Topics (CTTs).

A first draft of these clustered topics was reviewed by the NFPs during a two-day workshop. This workshop also gave the opportunity to check with NFPs any unclear content within the country reports.

A revised draft of the CTTs was presented to and discussed with a selection of more than 60 NKS (4 per INSPIRATION country) and the project's International Advisory Board during a three day project conference in month 13. This meeting also generated the idea to complement the CTTs with what came to be called "Integrated Research Topics" (IRTs) (see Fig. 5). IRTs took up a concern by the Theme Leaders, and heavily echoed by NKS, that some research topics from the national reports were of overarching relevance cutting across the four individual themes. Finally this event –perceived as critical by many participants – raised the awareness for a systematic and truly transparent and continued involvement of stakeholders in the process. As a consequence, next steps more carefully considered NKS and NFP involvement in order to ensure achieving the following two objectives:

1. Information check: Ensure that information provided in the national reports is correctly understood and considered in identifying transnational research topics
2. Relevance check: Ensure transnational and trans-sectoral research issues reflected most pressing national research demands of the stakeholders

The IRTs were elaborated in a way that includes exemplary research questions and contextualizes the fundamental research need (as identified in the CTTs) in a specific societal challenge identified in the national reports, thereby stimulating the partner countries to create multi-national thematic funding programmes. For example, IRT-2 on 'Recognizing the value of ecosystem services in land use decisions' encompasses a range of CTTs, including Demand: 'Food, feed, fibre and fuel', Natural Capital: 'Intrinsic values of soils and landscapes', Land Management: 'Governance, management mechanisms, instruments and policy' and Net impact: 'Developing impact assessment methodology'. Hence, IRTs are relevant for many fields of application. For example, research needs regarding stakeholder participation could have also been put forward for rural decision-making or in the context of climate change adaptation, but has been articulated for urban management as most accessible application field that was endorsed by INSPIRATION's NKS.

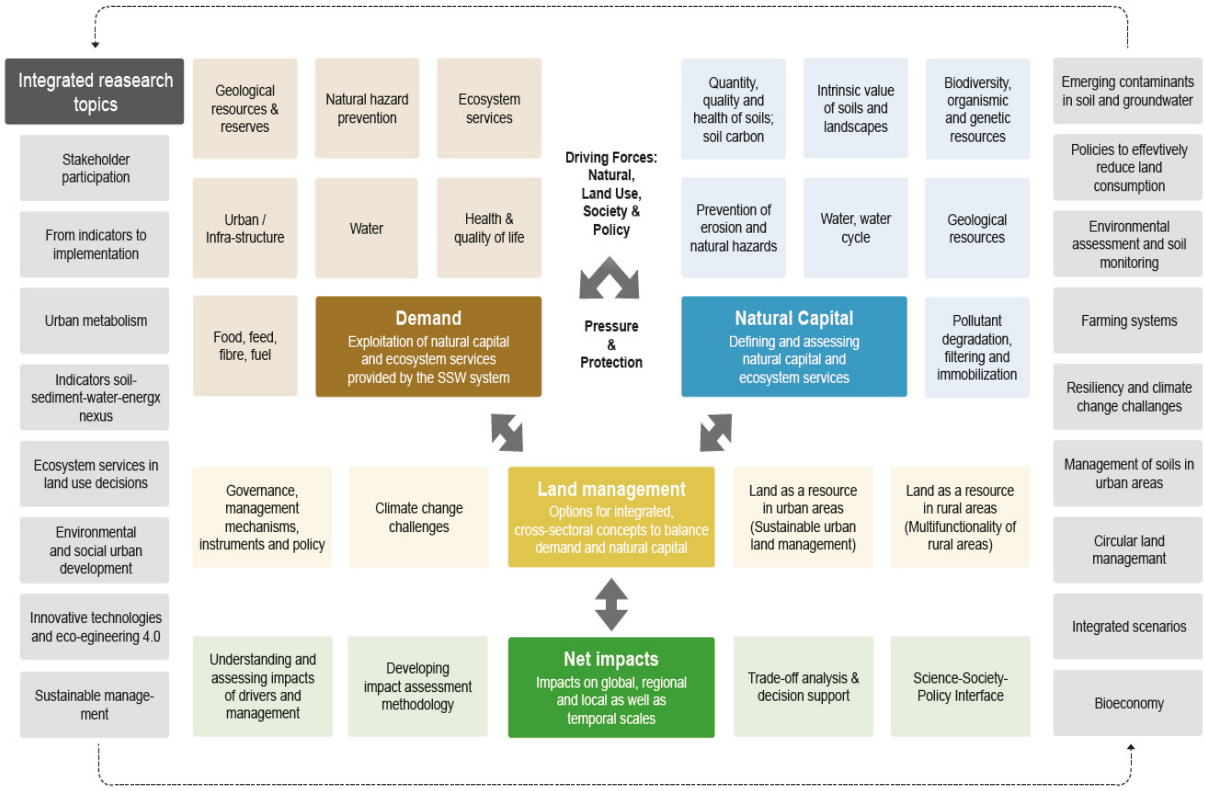

Fig. 5: *Clustered Thematic Topics of the 4 Integrated Themes of INSPIARTION's conceptual model and Integrated Research Topics. – Based on Makeschin et al. (2016): 8.*

The third revision of the CTTs followed an online consultation with our NKS, NFP and IAB, while the IRTs were discussed at another two-day meeting with selected NKS. In essence, these consultations confirmed the CTTs and IRTs as presented above and initiated the transformation of these issues into components of the INSPIRATION SRA.

A final step aimed at prioritizing the topics to be included in the SRA with the ambition to keep only the most relevant. The result of an online-consultation was that no significant difference between the relevance of identified topics was found – all were regarded as important or most important so that all were kept for the final phase.

3.3 Designing the SRA and preparing a network for implementation

The third phase of the process involved scoping out and developing the trans-country and trans-discipline SRA with continuous verification through dialogue and discussion with relevant funding bodies across Europe. While the content of the SRA is based on the evidence gathered, it has to be designed to both attract research funding by public and private parties and ensure that knowledge is widely applied by SMEs and other industries wishing to innovate (Nathanail et al., 2017). Hence, the way of

presentation will influence the ease with which different readers of the SRA will find the information they are after or be convinced of the value of implementing the SRA.

Four alternative approaches to structuring the SRA to present the 39 research themes (22 CTTs and 17 IRTs) to our intended audiences were debated. These included structuring the SRA along the lines of **different knowledge types** required to meet national R&I needs (e.g. creation of new knowledge, the transfer of existing knowledge, dissemination of good practice) or according to **different policy domains** (e.g. climate, energy, food security, water, transport) that would help those with a specific policy remit find the information most relevant to them, or by highlighting research and innovation needs in **different disciplines** (e.g. in natural and social sciences, engineering or planning, and inter- or multi-disciplinary teams). Three online workshop meetings were held to discuss these alternative structures with NFPs and IAB members. The decision was to structure the SRA in view of their **different recipients.** Funders would have the anticipated returns on their funding investment highlighted; end-users in industry and politics would be pointed to the anticipated benefits of individual research topics being implemented; researchers would be motivated by understanding the impact they would make by devoting their intellectual capital to tackling a specific research topics; and finally, the relevance of research needs to citizens' daily lives would be highlighted. Also based on these discussions, it was decided that the INSPIRATION SRA was to be available as a web-based, electronic version at www.inspiration-agenda.eu accompanied by a physical folder with general background information and a set of specific Briefing Notes for different audiences, describing the research issues in a nutshell and promoting the detailed agenda available online. Project-internal reviews, linguistic polishing as well as graphical processing of the SRA and the policy briefs are underway at the time of writing with final documents being available early in 2018.

The SRA is intended to be used by research funders to identify topics they would like to collaborate in funding. In order to facilitate matchmaking of implementation partners, INSPIRATION organized events where potential national funders can meet and share their common interests and funding priorities. Furthermore, two high-level policy workshops have been organized in Brussels, to spread the word on the INSPIRATION SRA and to better connect national funding bodies at European level and with the European Commission.

As opportunities for joint funding of research activities to address the strategic research and innovation needs in the SRA will be plentiful and joint programming will require preparation time, matchmaking activities will still be needed after the INSPIRATION project will have come to an end in spring 2018. It is agreed among the 17 project countries that the NFPs will serve as a national contact point (NCP) until at least summer 2019 to promote the SRA and facilitate matchmaking.

4 Evaluation of the INSPIRATION approach and lessons for future research agenda formulation

A classical strength, weakness, opportunity, threat (SWOT) analysis (cf. Hill & Westbrook, 1997) has been followed. Our objective is to specify the transferability of the INSPIRATION approach to future research agenda setting.

4.1 Strengths

INSPIRATION envisaged a SRA which funders, end-users and researchers recognize as relevant and take ownership of, thereby ensuring its successful implementation. The **bottom-up approach** based on stakeholder engagement to reveal research needs of a broad group of stakeholders was well received by all stakeholders with whom we engaged and in particular research funders and end-users. It was found to be a promising instrument to ensure the (societal) relevance of the SRA. The bottom-up approach and ongoing involvement of stakeholders, in particular funders, is the basis for a **co-ownership of the SRA** and facilitates its implementation.

The approach started from **societal challenges** and knowledge-related barriers to soil-sediment-water system and land use management contributing to solving these challenges. The identified knowledge gaps helped **differentiate activities**: knowledge creation, knowledge transfer, demonstration, training and education, survey and monitoring, and networking. A problem in practice is not solely due to a lack of scientific knowledge but to the effective and widespread application of preexisting knowledge.

Our **conceptual model** enabled traditional scientific disciplines, policy domains or industry and lobbying areas to be transcended. It facilitated discussions on

systematic, overarching challenges and knowledge needs. It also provided a context for information collation and for discussing the collated research needs.

From a procedural point of view, it was most important for stakeholders to have one project partner as a contact person (NFP) in each country. This helped us **cope with and reflect the diverse national contexts** and to gain access to the respective national stakeholders (not least by addressing them in their native **languages**). The **selection of representative NKS based on a set of clear criteria** was gauged a success. Selection was based on a clear and transparent categorization of stakeholders as end-user (industry, NGO, policy-making, etc.), science and research funding categories. This was sufficient to gain a good diversity of stakeholders. NFPs were provided with **clear task descriptions and guidance**, e.g. templates for interviewing and collection of knowledge needs. Templates ensure systematic and consistent work, e.g. collation of information. Their preparation required considerable investment, but was seen as very effective in the end. A joint understanding of the templates and tasks across the project consortium was reached through several workshops (e.g. NFP workshop on interviewing NKS in Vienna in month 4) and web based briefings.

More generally, **clearly structured stakeholder engagement formats** were appreciated by NKS. A well composed approach is needed, to balance the need for freedom to express opinions and provide insights, with strict formats to collate the input. Devoting resources to preparing stakeholder engagement formats, in particular the workshops and interviews, was clearly rewarded. Finally, the **iterative engagement of stakeholders**, despite the stumbling blocks mentioned below, ensured relevance and completeness of the collected research needs. As a byproduct, the INSPIRATION approach facilitated **exchange and networking between stakeholders** who might otherwise not have met. It helped to **build trust** between actors, who were to become partners in implementing the SRA.

To conclude, the identified strengths are: 1) the bottom-up approach revealed research needs of practitioners 2) being the basis for a co-ownership of the SRA facilitating its implementation, 3) start from practitioner understanding of societal challenges, 4) build on awareness of different types of research activities, 5) a clear conceptual model enables innovative thinking while providing structure and direction, 6) specific project partners, e.g. country NFP, engaging with specific stakeholder

groups in their own language and translating results into English for integration, 7) clear criteria for selection of representative stakeholders, 8) clear task descriptions and guidance for project partners based on a common understanding, 9) clearly structured stakeholder engagement formats, 10) iterative engagement of stakeholders, 11) facilitation of exchange and networking between stakeholders.

4.2 Weaknesses

Being designed as a bottom-up approach with the inclusion of hundreds of NKS in seventeen European countries, INSPIRATION ran the **risk of NKS messages losing clarity**. Capturing the diversity of languages, informal and formal institutional contexts and extracting transnationally shared research needs constituted a huge challenge. Contextualization had to be filtered out in order to distill key issues and certainly some degree of information already got lost in translation when NFP prepared their national reports.

What is more, the **personal professional background of the key INSPIRATION partners** involved (e.g. NFPs, the selected NKSs, the theme leaders (TL) as well as those project partners actually writing the SRA) will have undoubtedly led to biases of identified research needs, their synthesis and prioritization. For example, NKS would have brought up different research issues depending on their own professional background (government, science or industry). So the search for a representative selection of NKS and facilitating an open and constructive atmosphere during the national workshops was a critical precondition for sound conclusions.

NFPs play a particular important role, as they had to be able to select representative NKS, extract all relevant information during the interviews, create an inspiring atmosphere during workshops and set all the gathered national research needs in relation to the scientific state of the art at national and international level when developing the national reports. Moreover, there will also be a bias in what they capture from their NKS, depending on their professional background, as a scientist, policy maker or working as an independent consultant.

While the **conceptual model** was assessed as a strength in the previous section it simultaneously represents a challenge for both INSPIRATION's internal coordination and for promoting the collated research needs. Internally, creating a joint understanding of the usefulness of the conceptual model as the preferred way to cluster national research needs as well as the content of and distinction between the

four pillars of the model required much more time and resources than anticipated. For example, an extra project internal meeting was organized to develop a joint understanding of the conceptual model and different clustering approaches therein; moreover, the conceptual model was also discussed with NFPs at the meeting in month 11. In external communication of the SRA, presenting the main research needs following the conceptual model challenges traditional separation of funding institutions and the respective funding foci, e.g. fundamental vs. applied research. Furthermore, as the research needs collated are inherently inter-, often trans-, disciplinary, extracting disciplinary research needs requires an in-depth reflection of the state of the art in different scientific disciplines that was beyond the resources of INSPIRATION but was felt as a deficiency of our approach by some observers.

The project partners underestimated the interest and willingness of the NKS to deal with the material provided in the course of the project, in particular in the transition phase from collecting national research questions to synthesizing transnationally shared research needs at the three day project conference in month 13. In turn, participants felt not considered with adequate care and that their investment of time and resources may be wasted. It was also challenging for TLs and NFPs to draw out the essential suggestions conveyed in this feedback.

Notwithstanding these weaknesses, it can also be assumed that **stakeholders feedback was biased by the way interim results were presented**, i.e. there is a kind of path dependency in project involvement. Had INSPIRATION adopted a different conceptual model to cluster research needs, stakeholder perception, feedback and discussion then the wording of the SRA might have been different despite the iterative checks.

Lastly, we found that our **bottom-up approach of INSPIRATION** (and soil and land as research issues) **has attracted our stakeholder groups quite differently**. In particular gaining commitment of funders to become active participants of the endeavor was not satisfactory. If there was an option to restart the process, we would have spent even more time and resources in order to keep the issue high(er) on their agenda.

To conclude, the identified weaknesses refer to a 1) risk of messages becoming unclear due to a diversity of backgrounds, languages, informal and formal institutional contexts, 2) potential bias of results due to personal professional background of the

key SRA creators and 3) the team collating the research needs, 4) the underestimation of resources needed to establish a joint understanding of the conceptual model, 5) being appropriately prepared for the engagement events with the stakeholders, 6) bias of SRA creation due to procedure and interim results presentation, 7) insufficient resources available to engage with funders.

4.3 Opportunities and threats

Threats and opportunities represent external factors that might facilitate or hamper INSPIRATION's bottom-up approach of SRA creation in different contexts.

The **availability of funding** (e.g. for soil and land related research issues) is a crucial factor for implementing an SRA. The (increased) limitation of national resources provides (higher) incentives for pooling funds at international level and thus stimulates interest in the process of identifying transnationally shared research demands. On the other hand there is also some reluctance to spend national research budget for international research projects.

T**he resources available for creating the SRA itself** are of course a crucial issue. As mentioned above, time, personnel and financial resources are necessary to create a joint understanding among project partners, e.g. on the selection criteria for NKS or a guiding conceptual model, to set up targeted communication with the NKS based on their (often different) requirements (funders, scientists, industry representatives) as well as for dissemination and networking in project afterlife.

Consideration should be given to the **sponsor of the development of the SRA**, too. The SRA funder could have its own interests in particular topics and may potentially – even unintentionally – bias the SRA design (this was not a case in INSPIRATION).

Our **bottom-up approach for agenda setting** greatly relies on continuity of stakeholder involvement. For example, feedback to the research needs identified, the prioritization of certain topics as well as the willingness to become engaged in implementing the SRA can alter if national governments or responsible actors in funding bodies changed during the course of the process. On the other hand, new faces might join with increased interest in the topics, here intensive stakeholder engagement can be able to early on inform SRA designers and help identify windows of opportunity.

In summary, we identified as key opportunities and threats 1) a high ranking and attentiveness on the political agenda, in press and media or in public awareness, 2) availability of funding for research, 3) the resources available for creating the SRA itself, 4) the role of the sponsor of the SRA development, and 5) the continuity of stakeholder engagement as bases for identify windows of opportunity, creating ownership for the SRA and facilitating its implementation.

4.4 Recommendations

When setting up a bottom-up SRA, firstly, clarity about the SRA objective is important. This starts from a **clear definition of the area for which the SRA is to be developed and for the targeted user**, e.g. an SRA to inform researchers vs. an SRA to prepare a pool of funding for research calls. Moreover, it should also be as specific as possible for the type of research activity. By distinguishing a 'research agenda' from a 'practice knowledge needs agenda', the acceptance of the process can be increased as stakeholders to be involved are better to be identified. Research gaps are targeted to inform researchers/funders of research. An SRA should clearly delineate the agenda area to enable funders' identification of which areas to invest regarding research, transfer, demonstration activities and so forth.

Secondly, a **conceptual model** is needed, but needs proper investment in preparation, e.g. workshops for co-development or adaptation of an existing framework and buy-in of project partners, to ensure a shared understanding and co-ownership.

Involvement and communication with the NKS requires significant awareness of their roles, tasks, and input requirements. This again requires sufficient resources and preparation. It allows safeguarding equal treatment of stakeholders and fair consideration of the different topics suggested – limiting the risks for any bias. In particular templates and clear guidance of NFPs, facilitated by joint workshops to ensure a common vision and shared understanding, is important. This point clearly emerged during INSPIRATION, where being exposed to the discontent of NKS in the first European level workshop (in month 16), project partners augmented their efforts to **provide NKS (in as much as all project partners) with sufficient guidance and information on their role in the process** at later stages.

It is important to be aware of the critical role of the persons responsible for creating the SRA as interviewers or collators of research topics according to the conceptual

model. A risk of biased formulations of SRA topics remains due to individual backgrounds of the responsible persons: We tried to reduce the risk by incorporating iterative checks of SRA contents for completeness and relevance by the NKS. Only a sufficient number of iterations and checks can ensure that the outcome is accepted by the addressees – their involvement in the process being critical for the fundament of co-ownership of the SRA as such.

Notwithstanding, we believe that the national reports with their manifold research questions and the establishment of networks between national stakeholders developed during the collection phase represent valuable project outputs on their own.

INSPIRATION envisaged a SRA which funders, end-users, and researchers recognize and take ownership of thereby ensuring its successful implementation. A SRA based on strict stakeholder specific design needs to consider this also in the way the results are presented – in particular if so diverse groups are targeted at. The format needs to respond to the diversity and heterogeneity of backgrounds, context, countries and disciplines being addressed. This is the more the case the less clarity was obtained in the first step, it is to clarify the SRA objective and topic. In the INSPIRATION case, we decided late to focus on funders while providing other stakeholders also with specific dissemination material in form of executive summaries and policy briefs.

Any SRA will be only as successful as the network implementing it. Therefore, from the earliest moment possible, prepare the implementation and think on means to improve perpetuation of stakeholder engagement and networking to facilitate SRA implementation. In this regard, think about and invest in networking infrastructure. Last not least, invest in a systematic search for windows of opportunities for implementation.

Hence, our derived key recommendations are 1) a clear definition of the area for which the SRA is to be developed and for the targeted user, 2) a conceptual model to structure the SRA, 3) making clear the expected roles, tasks, input formats regarding the involvement and communication with the stakeholders and project partners, 4) a sufficient number of iterations and checks of the SRA with stakeholders to insure completeness, relevance and creation of co-ownership for the SRA, and last not least

5) from the beginning prepare the infrastructure for the network to implement the SRA.

5 Conclusions and outlook

A deliberative bottom-up approach has been used to determine a research agenda related to sustainable soil management, land use and spatial planning. This approach enabled a broad group of stakeholders from across Europe to identify knowledge gaps to plug in order to respond to societal challenges. The gaps were contextualized through a conceptual model showing the relationship between natural capital supply and demand, land use management and the net impact of such management. Nationally identified research needs were gathered into transnational clustered and integrating research topics.

This approach lends itself to the development of research agendas in the future. The process of finalizing INSPIRATION's Strategic Research Agenda was ongoing when this article was submitted. The potential impact of this SRA can be, as assessed based on the analysis here, tremendous. A broad variety of stakeholders identified their research needs as input for the SRA. Therefore, the scope of research topics and the questions that were collected will shape a truly multi-stakeholder-based research agenda. It will merge individual requirements of European Countries and bottom-up collected research demands of stakeholders into a consistent SRA. The level of integration of soil and land use related topics is remarkable. The SRA will blend research on soil quality, land use and land management issues, both in urban and in rural areas. This is unique, particularly because of its ambition: Structuring research areas towards balancing the demand for and supply of resources and natural capital and reducing the ecological footprint by proper land management methods and tools. With the final public release of the SRA forthcoming, matchmaking with national funding institutions and elaborating implementation models for the SRA are the most challenging remaining tasks for the project. However, the final SRA is expected to be the first milestone in a paradigm shifting process of land and soil-based research policy towards multi-national and stakeholder-oriented research funding. In conclusion, we believe that future soil policy should focus, in addition to the protection and restoration of soil quality, on an innovative use of the soil-water-sediment-system in order to contribute to addressing the societal challenges.

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