

1 **Soil and land use research in Europe: Lessons learned** 2 **from INSPIRATION bottom-up strategic research agenda** 3 **setting**

4

5 **1 Introduction**

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

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

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

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

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

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

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

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

57 **2 Developing the INSPIRATION SRA**

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

64 2014, Levidow & Neubauer, 2012). The INSPIRATION approach, therefore, was to
65 develop the SRA from the bottom up in order to deduce research needs expressed
66 by land and soil stakeholders. It was anticipated that such a SRA also would be more
67 likely adopted by research funders seeking impact from their financial investments.

68 **2.1 INSPIRATION premises**

69 The INSPIRATION project is based on three key premises:

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

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

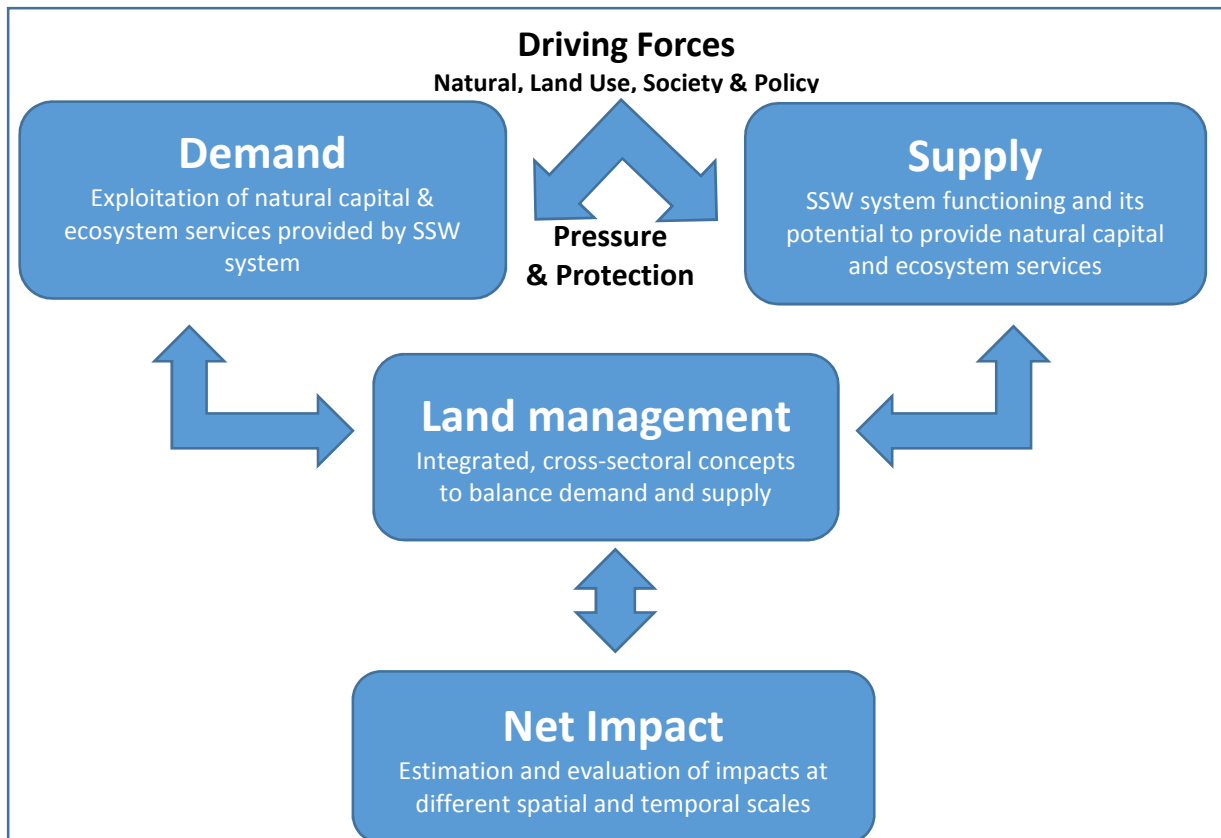
90 Key premise 3 - Establish a transnational network of funding bodies to implement the
91 SRA: The main challenge for INSPIRATION is to prepare the ground for a
92 transnational network of funding agencies and cooperating industries determined to
93 implement this SRA. The strong belief has been that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

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

98 **2.2 Conceptual model enabling a paradigm shifting SRA**

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

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



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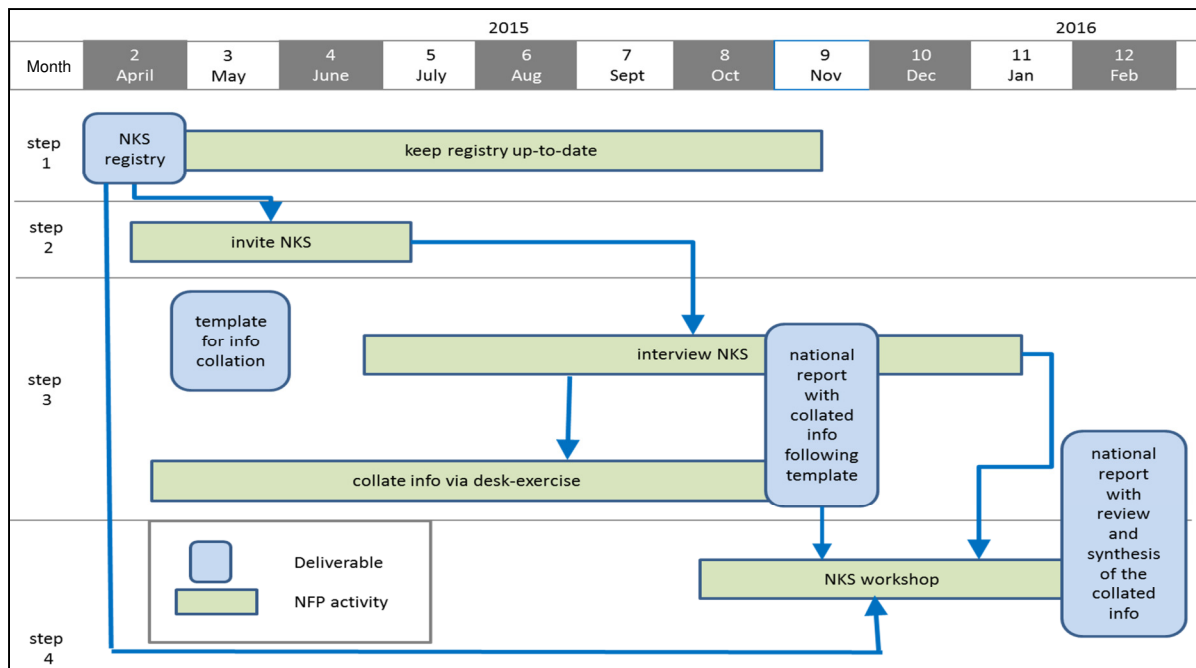
121 **Fig. 1:** Conceptual Model of INSPIRATION research clustering based on Makeschin et al. (2016).

122

123 **3 Implementation of the INSPIRATION framework**

124 **3.1 Collation of research demands from National Key Stakeholders**

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



135

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

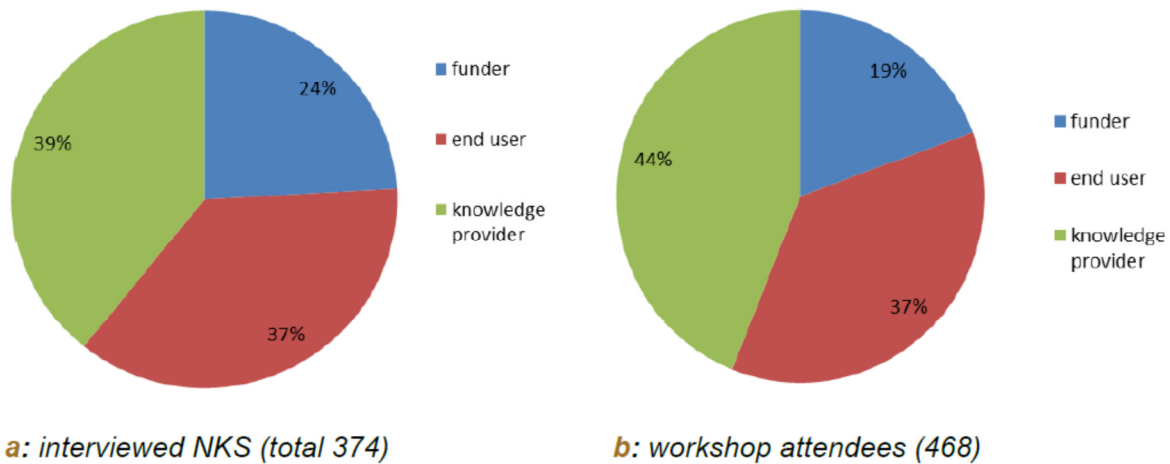
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139 NKS play a key role in this process and their representative selection is of utmost
 140 importance. For selection of the NKS some conditions were developed and applied
 141 (Maring et al, 2015):

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

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

161



162

a: interviewed NKS (total 374)

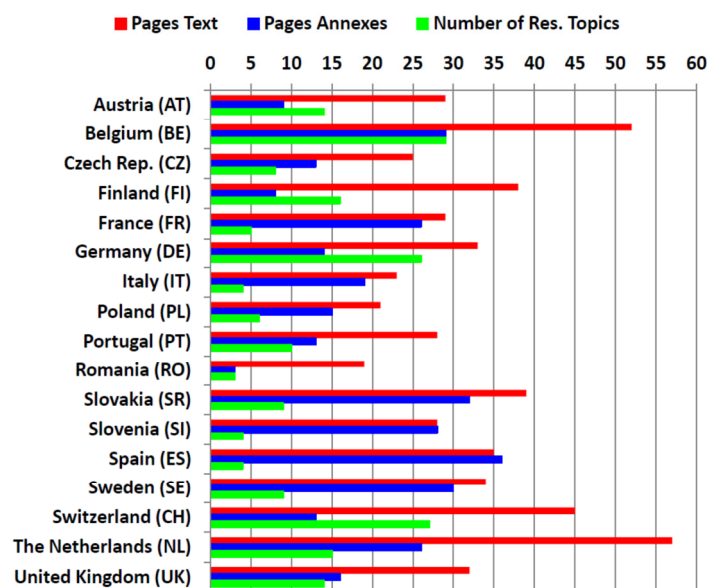
b: workshop attendees (468)

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

165

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

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



179

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

182 3.2 Clustering of national research priorities

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

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

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

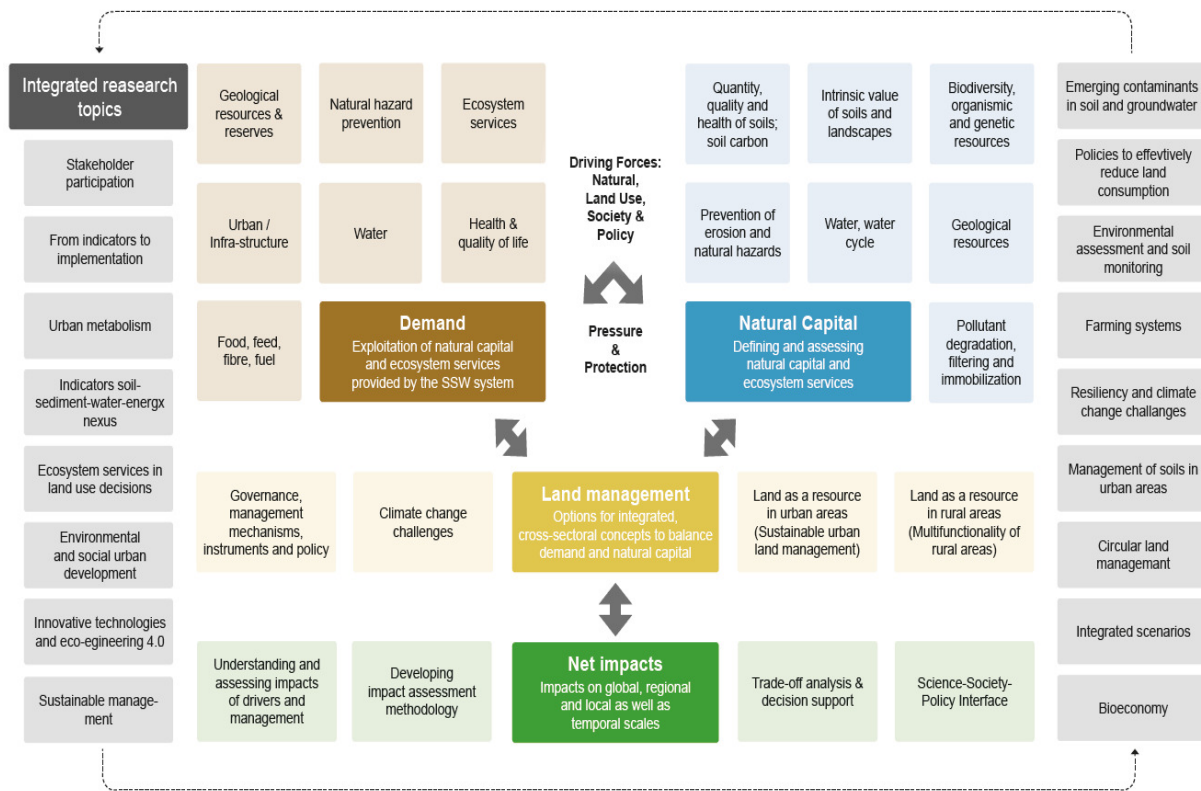
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200 A first draft of these clustered topics was reviewed by the NFPs during a two-day
201 workshop. This workshop also gave the opportunity to check with NFPs any unclear
202 content within the country reports.

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

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

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



232

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

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

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

244 3.3 Designing the SRA and preparing a network for implementation

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

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

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

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

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

290

291 **4 Evaluation of the INSPIRATION approach and lessons** 292 **for future research agenda formulation**

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

296 **4.1 Strengths**

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

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

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

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

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

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

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

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

353 **4.2 Weaknesses**

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

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

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

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

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

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

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

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

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

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

419 **4.3 Opportunities and threats**

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

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

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

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

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

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

451 **4.4 Recommendations**

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

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

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

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

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

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

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

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

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

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

512 **5 Conclusions and outlook**

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

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

543

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