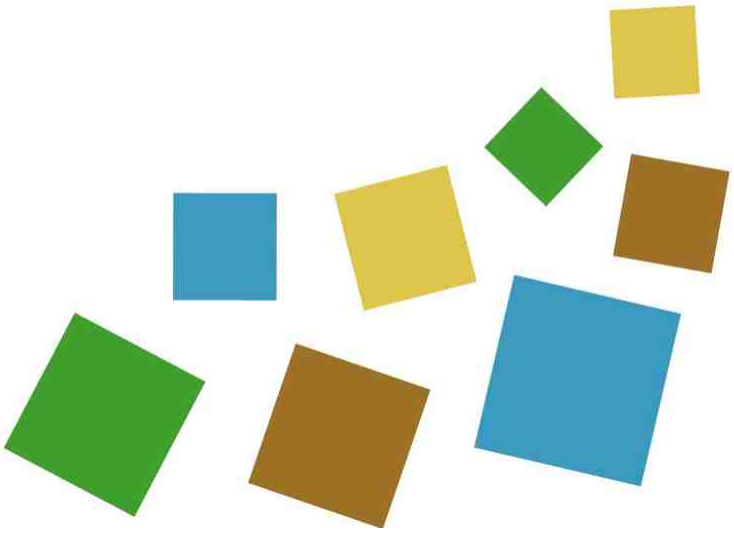
D2.5

National reports with a review and synthesis of the collated information:

The Netherlands

Linda Maring, Jos Brils



Document information

Project acronym:	INSPIRATION
Project full title:	INtegrated Spatial Planning, land use and soil management Research ActTION
Project type:	Coordination and Support Action (CSA)
EC Grant agreement no.:	642372
Project starting / end date:	1st March 2015 (month 1) / 28th February 2018 (month 36)
Website:	www.inspiration-h2020.eu
Document status / date:	Final version as of 01/03/2016
Deliverable No.:	D2.5
Responsible participant:	DELTARES (participant number 14)
Due date of deliverable:	01/03/2016
Actual submission date:	01/03/2016
Dissemination level:	X PU - Public PP - Restricted to other programme participants* RE - Restricted to a group specified by the consortium* CO - Confidential, only for members of the consortium* (* = including the Commission Services)
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To be cited as:
Maring,L and J. Brils (2016): National reports with a review and synthesis of the collated information: The Netherlands. Final version as of 01.03.2016 of deliverable 2.5 of the HORIZON 2020 project INSPIRATION. EC Grant agreement no: 642372, UBA: Dessau-Roßlau, Germany.

D2.5: National reports with a review and synthesis of the collated information

List of abbreviations

ATES	Aquifer Thermal Energy Storage
BOA	BeleidsOndersteunend Advies (Policy supporting research)
CCS	Carbon capture and storage
COP	Community Of Practice
DoA	Description of Action
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EU	European Union
ERANET	European Research Area Network
GHG	Greenhouse Gas
IAB	International Advisory Board
INSPIRATION	INtegrated Spatial PlannIng, land use and soil management Research AcTION
JPI	Joint Programming Initiatives
KIBO	Kennis en Innovatieprogramma Bodem en Ondergrond (Knowledge and Innovation programma Soil and Subsurface)
NFP	National Focal Point
NGO	Non-Governmental Organization
NKS	National Key Stakeholder
R&I	Research & Innovation
RWS	RijksWaterStaat
SDG	Sustainable Development Goals
SME	Small and medium-sized enterprises
SPI	Science Policy Interface
SRA	Strategic Research Agenda
SSW(-system)	Soil-Sediment-Water(-system)
STOWA	Stichting Toegepast Onderzoek Waterbeheer (Foundation for Applied Water Research)
TKI	Topconsortia voor Kennis en Innovatie (Top consortia for Knowledge and Innovation)
Wbb	Wet bodembescherming (Soil Protection Act)
WFD	Water Framework Directive
WP	Work Package

1. Introduction

1.1 About INSPIRATION

The aim of INSPIRATION is to establish and promote the adoption of a strategic research agenda for land use, land-use changes and soil management in the light of current and future societal challenges. Main objectives are:

- **Formulate, consult on and revise an end-user oriented strategic research agenda (SRA);**
- **Scope out models for implementing the SRA;**
- **Prepare a network of public and private funding institutions willing to commonly fund the SRA.**

The proposed methodology is based on a multi-stakeholder, multi-national and interdisciplinary approach that covers the variety of stakeholders (public bodies, business, scientific community citizens and society) and the variety of relevant funders. The vehicle to engage with relevant stakeholders across the Member States is a National Focal Point (NFP) in 17 countries[1]. Between March 2015 and March 2016 The NFP's interviewed National Key Stakeholders (NKS), performed a desk study and organized workshops with national stakeholders of funders, end-users and researchers across the various soil and land management disciplines. The goal of these exercises was to gather information and support the main objectives as stated above.

The collated results will be structured along four integrative themes: 1) resources demand and efficiency; 2) natural capital stewardship; 3) land management; 4) net impact on global, EU and local scale (see section 1.3) and merging into thematic knowledge needs to satisfy the as yet unmet societal challenges and to ensure that knowledge contributes primarily to enable meeting these challenges. Based on these results, a cross-border and cross-discipline dialogue will subsequently be organized among the relevant user communities, funding bodies and scientific communities in Europe in order to reach a trans-national, prioritized SRA as well as a model for execution of this SRA. Thus a SRA will be produced which will give national funders confidence that for each Euro they spend, they will get multiple Euros worth of knowledge in return in order to address their national societal challenges.

Learn more about the INSPIRATION coordination and support action on the project's website: **www.inspiration-h2020.eu** and follow us on twitter: **@inspiration4eu**.

[1] The Swedish Geotechnical Institute (SGI) with support of Formas is currently mirroring the INSPIRATION approach in Sweden. SGI has proposed to act as Swedish National Focal Point and to become a full member of the INSPIRATION consortium. This has been welcomed by the consortium. Currently formal negotiations are in place between SGI, the consortium and the EC to effectively implement this collaboration. This report furthermore contains some information for Denmark and Luxemburg – representatives of both countries joined the Belgium workshop – and for the Republic of Ireland – representatives joined the UK workshop – see below.)

1.2 This deliverable

This report, gives the Dutch results of "Deliverable 2.5 – National reports with a review and synthesis of the collated information". The full deliverable 2.5 (available on http://www.inspiration-h2020.eu/page/deliverables-0) integrates 17 national reports. These 17 countries, in alphabetical order, and the authors of these reports are (the NFPs for each country are in *italics*):

Austria,
Pia Minixhofer, *Sophie Zechmeister-Boltenstern*, Rosemarie Stangl, Andreas Baumgarten, Martin Weigl, Peter Tramberend,
Belgium (including some information for **Denmark** and **Luxemburg**),
Nele Bal, Bavo Peeters,
Czech Republic,
Petr Klusáček, Stanislav Martinát, Bohumil Frantál,
Finland,
Antti Rehunen, Teija Haavisto, Ritva Britschgi, Outi Pyy, Jari Rintala, Petri Shemeikka,
France,
Marie-Christine Dictor, Samuel Coussy, Valérie Guerin, Corinne Merly,
Germany,
Uwe Ferber, Stephan Bartke, Detlef Grimski,
Italy,
Matteo Tabasso, Sarah Chiodi, Giulia Melis,
Poland,
Anna Starzewska-Sikorska,
Portugal,
Thomas Panagopoulos, Vera Ferreira, Dulce Antunes
Romania,
Mihail Dumitru, Sorin Liviu Stefanescu, Andrei Vrinceanu, Valentina Voicu, Nicoleta Vrinceanu,
Slovakia,
Maros Finka, Maria Kozova, Zita Izakovicova, Lubomir Jamecny, Vladimir Ondrejicka,
Slovenia,
Boštjan Cotič, Barbara Mušič, Ina Šuklje Erjavec, Matej Nikšič,
Spain,
Pierre Menger, *Gemma Garcia-Blanco*, Efren Feliu,
Sweden,
Yvonne Ohlsson, Lisa van Well, Kerstin Konitzer,
Switzerland,
Regula Brassel, *Marco Pütz*,
The Netherlands,
Linda Maring, Jos Brils
The United Kingdom (including some information on **the Republic of Ireland**),
Paul Nathanail, Matt Ashmore.

This report concludes the activities of INSPIRATION Work Package (WP) 2 "**Demands of research from industry, end-users and funders (State-of-the-art at national levels)**", task 2.5 "**Review and synthesis of the collated information**".

The WP2 activities were executed in the 1st year of the INSPIRATION project (month 1 – 12), i.e. in the period from March 2015 to February 2016. In the WP2 project description, the final task executed in this period is described in the following way:

> "*The NFPs will organize at national level a 2-day workshop, where the collated information (task 2.4) will be reviewed and synthesized and prioritized under guidance of the NFP by the NKSs. The WP-leader will prepare – in consultation with the INSPIRATION core group – a generic outline for the agenda of the 2-day national workshops. That outline will then be tailored to specific national situations by the NFPs. The results of the workshop – i.e. reviewed and synthesised information regarding topic a-d as mentioned under the WP2 objectives*[2] *– will be described in a national report (in English) by the NFPs. Before finalizing these reports, the NKSs as well as the International Advisory Board (IAB) will be given the opportunity to review the draft report. In these cases where English is not the native language, the national reports will also contain an executive summary (policy brief) of the report in the native language."* (INSPIRATION Grant Agreement - Description of Action - DoA).

This report describes the results of NKS interviews and of the desk-exercise as performed in participating countries aimed at collecting national research demands, science-policy-interface experiences and funding options. This report builds up on the interim results presented in Deliverable 2.4.[3] The methodologies followed for the information collation and synthesis are presented in more detail for each country below. In general, the following approach was applied (see also Figure 1):

1. In each country, national key stakeholders (NKS) have been identified (in a way to ensure broad representation of soil and land-use/management topics and affiliations in research funding / end-use / science or policy making);
2. Interviews (structured according to a common template: see Annex VI and VII) with circa 20 NKS per country have been conducted in order to collect national research needs as well as information on science-policy-interface and financing options (with interim result presented as D2.4);
3. In each country, a national workshop with NKS was conducted. Basis for the workshops was the input provided in the NKS interviews before the workshop. It was presented in order to synthesize the collated info, discuss and review the key national

[2] See section 1.5 for a description of topic a-d.

[3] Brils, J. et al. (2015): National report on collated information following the template. Final version as of 01.12.2015 of deliverable 2.4 of the HORIZON 2020 project INSPIRATION. EC Grant agreement no: 642372, UBA: Dessau-Roßlau, Germany.

research topics. The workshop thus aimed to check, verify and enrich, and in some cases also already prioritize the suggestions provided by the NKS;[4]

4. The results of the interviewing plus workshop process were documented in a report to become the respective final national reports. A draft version was to be send nationally to the NKS for review;
5. The national reports were aggregated in a combined document, on which the International Advisory Board (IAB) of INSPIRATION was asked to give feedback, too;
6. The D2.5 report has been finalised taking into account the IAB recommendations.

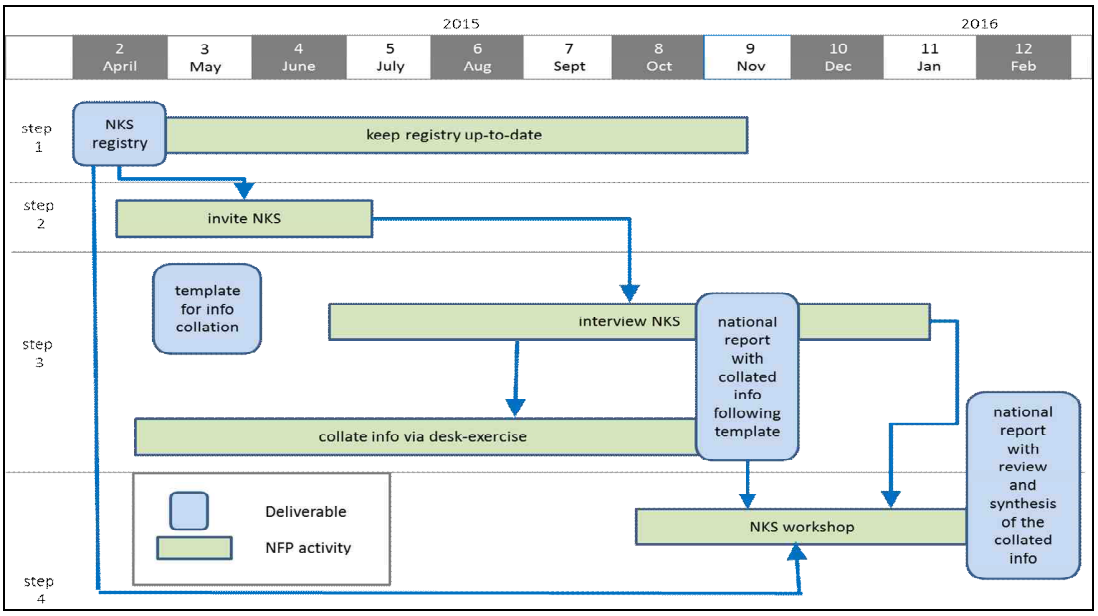


Figure 1: *INSPIRATION's WP2 workflow.*

As the engagement with the stakeholders and their review of the respective national reports collected in this document have been crucial in delivering a qualitative bottom-up overview of national research demands related to soil, land-use and land management in Europe, further details on the number and background of involved stakeholders is provided in annex V.

The information collated in this report feeds into WP3 "Transnational commons aggregated under integrated themes". According to the INSPIRATION DoA, the main objectives of WP3 will be to:

1. Achieve an overview of the transnational shared demands and experiences grouped under common themes based on the national state-of-the-art reports as produced by WP2,

[4] In several countries besides the NKS interviewed also more stakeholders were invited (i.e. it were open events), and participated and contributed to the workshops.

2. Prioritise and elaborate the topics that could be included in the SRA (to be developed by WP4) under specific themes,
3. Elucidate the opportunity to match (to be done under WP4) individual stakeholders (as funders) to specific SRA topics that could be shared transnationally." (INSPIRATION Grant Agreement - Description of Action - DoA).

Visit the INSPIRATION website for the up-coming deliverables of the network!

1.3 The INSPIRATION conceptual model and its themes

In order to identify cross-country and cross-sectorial knowledge gaps and research questions, the national Research and Innovation (R&I) needs will be analysed along four overarching themes identified in the INSPIRATION conceptual model. This model is presented in figure 2. It has been used to structure the information presented in this report on R&I needs following these guiding key-questions for each theme:

- **Demand**:
  What does society demand from natural capital and ecosystem services including the SSW-system?
- **Natural capital**:
  What has nature, including the Soil-Sediment-Water (SSW)-system, to offer and which determinants sustain the system?
- **Land management**:
  What are options for an integrated, cross-sectorial land management to balance societal demands and natural capital?
- **Net-impacts**:
  What are the impacts of different options of managing natural capital, including the SSW-system on global, regional and local as well as temporal scales?

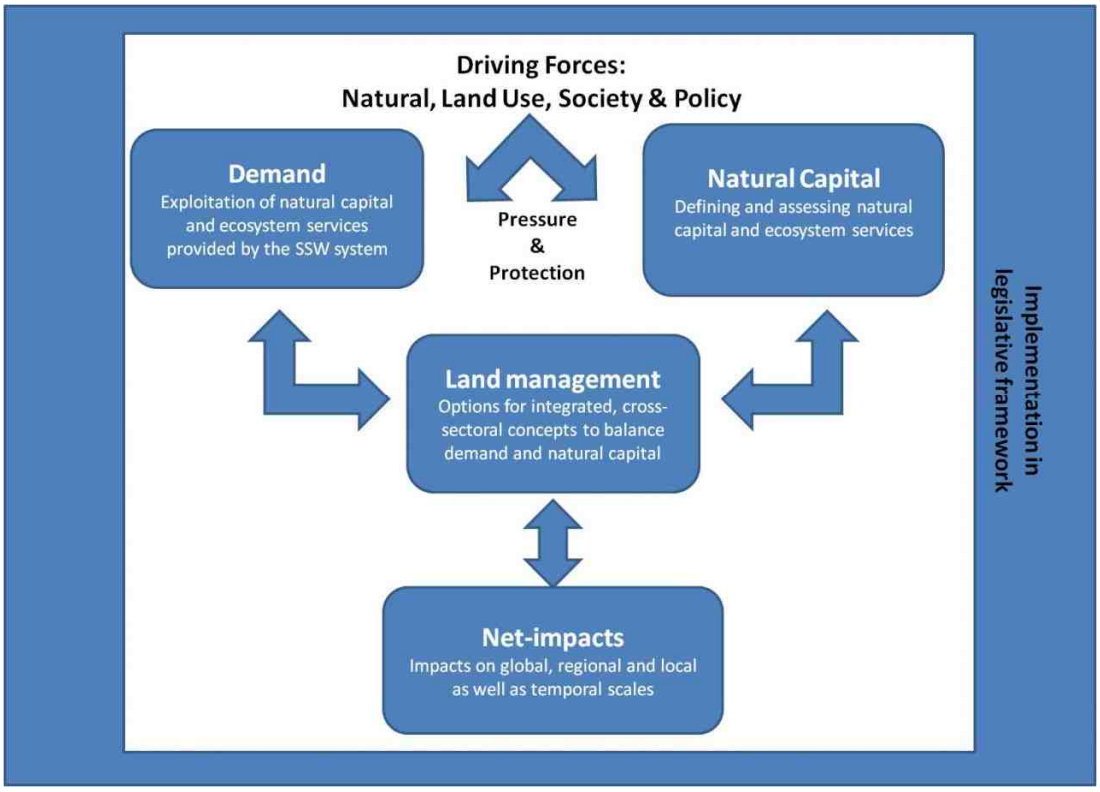


Figure 2: INSPIRATION's conceptual model.

1.4 Guide to the reader: outline of the country chapters

Each subsequent chapter in this report presents the findings for a single country. In general, these chapters follow a comparable outline:

Section 2.1- Executive summary

This section provides an executive summary in English (2.1.1) as well as in the national language (2.1.2).

Section 2.2 - Methodology followed

This section describes the methodology followed in the respective country including information on the stakeholder engagement (see also annex I, IIIa for the Netherlansd and V for an overbview of all countries).

The subsequent sections give a review and synthesis of the main results of the topics as mentioned under the WP2 objectives (see section 1.2).

Section 2.3 Research and Innovation (R&I) needs

- ***Topic a: Demand-driven**** *suggestions for the Strategic Research Agenda (SRA), i.e. suggestions from the perspective of industry, end-users and funders.*
  Related key question to be answered: ***What (new) knowledge do these parties need to tackle societal challenges including the increase of job opportunities)?***

* ***Demand-driven*** *in INSPIRATION means focusing on the demands of those who are responsible or feel committed to tackle the societal challenges related to the INSPIRATION scope and themes, i.e. industry, end-users and funders. These parties could improve their business opportunities and/or take better informed decisions on what measures to take and execute in order to tackle other societal challenges if they would (be enabled to) use the knowledge as resulting from execution of the INSPIRATION SRA.*

This section is divided in the sub-sections:

- Societal challenges and needs (2.3.1);
- Topics / research needs to include in the SRA (2.3.2).

The research questions under the topics in the 2.3.2 sub-sections are divided by themes of the INSPIRATION conceptual model as described in section 1.3 of this chapter.

Section 2.4 - Experiences regarding connecting science to policy/practice

- ***Topic b:*** *Experiences regarding the exploitation of scientific knowledge to improve business opportunities and/or tackle other societal challenges.*
  Related key question to be answered: ***Where to improve the science-policy interface so that (new) knowledge can and will be more effectively exploited by the demand side?***

This section is divided in the sub-sections:

- Use of knowledge (2.4.1);
- Possibilities to set the agenda (2.4.2);
- Science – policy – practice (2.4.3).

Section 2.5 National and transnational funding schemes

- ***Topic c:*** *Predominant, current as well as promising alternative funding schemes / mechanisms / programs for knowledge production and dissemination.*
  Related key question to be answered: ***How to get with one Euro of national/regional funding a multitude of Euro's (from all sources) worth of knowledge in return contributing to EU and national demands? Or even how to get with one euro of EU funding a multitude of euro's (from national, regional, local, and private sector) worth of knowledge in return contributing to the R&I demands on Land and the Soil-Sediment-Water systems.***
- ***Topic d:*** *Experiences regarding the use of any trans-national, common budget for scientific knowledge production related to the scope of INSPIRATION.*
  Related key question to be answered: How to set up/govern the appropriate funding option(s) resulting from INSPIRATION – based on previous learning experiences – so that: (1)the above demands will be fulfilled, (2) knowledge resulting from implementation of the SRA will be taken up and used and (3) funders experience that their invested, national Euros are indeed multiplied?"

This section is divided in the sub-sections:

- Funding schemes and possibilities for research funding (2.5.1);

- Gaps in financial resources for research (2.5.2).

Section 2.6 - Other remarks made by interviewees

This section is optional and is not taken up in all national reports. It contains remarks, points of attention and recommendations for INSPIRATION as given by the NKS.

2. The Netherlands

2.1 Executive summary

2.1.1 English version

INSPIRATION develops a strategic research agenda (SRA) on how land-use, land management and the soil-sediment-water (SSW) system can contribute to address societal challenges and meet societal needs. This is done bottom-up, in 17 European countries by consulting National Key Stakeholders (NKS) in interviews and in a national workshop. NKS originate from different organisations and have various backgrounds. The information provided by the NKS is complemented by a desk-study of the documents that the NKS suggested relevant for the scope of INSPIRATION. This procedure was also followed in the Netherlands. However, the workshop in the Netherlands was public and thus a broader audience then only NKS participated and contributed to that event.

Societal challenges

The Dutch NKS indicated several short or long-term societal challenges in relation to land use and the SSW system. These challenges are: Agriculture and food; Liveability of rural areas; Climate change; Water; Smart and healthy cities; Mobility and transport; Soil quality; Energy supply and Efficient use of resources.

Research needs were defined for each of these challenges.

Research needs

Agriculture and food

For agriculture and food the demand is determined by developments (from local to global) in the agricultural sector and consumer behaviour (trends in diets). Agriculture links directly to natural capital. What “quality of soil is good” for agriculture and what is the role here of biodiversity? Land management relates to “sustainable agriculture” and the possibility to combine functions in the rural area. The effect of land management can be used to shape and define “good soil quality” and “sustainable land-use” in order to support decision making.

Liveability of rural areas

The demand for biomass for different purposes is a main driver that influences the liveability of rural areas. Natural capital can potentially play a role in improving liveability but that role needs to be determined. Land management can add value to rural areas, e.g. by combining functions and by integrating agricultural land, nature and landscape management. The net impact of land management (e.g. on health and wellbeing) needs to be assessed to be able to improve the liveability of rural areas.

Climate change

This is a serious challenge for both urban (flooding, heath stress) and rural areas (salt intrusion, soil subsidence, wetter or dryer land). There are many opportunities to combine climate change with addressing other societal challenges. These opportunities should be investigated and optimized and the role in here of natural capital should be studied. Land management and better use of the SSW system, including soil organic matter (as an indicator), can contribute to climate change adaptation and mitigation. The net impact of climate change on land and different societal challenges as well as the effectiveness of different measures needs to be determined.

Water

Water is a very important challenge in the Netherlands. The current and future demand for different uses of land, surface water, groundwater and natural capital results in many challenges for land management. Research is needed to design and balance area-based groundwater management, management of water levels related to different land uses, water safety and water quality management. The effectiveness of water management and measures should feedback to land-use practices.

Smart and healthy cities

To maintain and design smart and healthy cities is a serious challenge. The demand on our cities depends on different future demographic and climate change scenarios. There is huge potential to use natural capital (green and blue infrastructures) to increase urban resilience and the quality of life in urban areas, but that potential should be further investigated and be applied in practice. Land management research should focus at interactions and combinations between natural and urban systems and 4D-planning. The net impacts of (new) threats and effectiveness of measures (ecoengineering, building with nature) needs to be assessed to be able to improve land management practices.

Mobility and transport

The demand regarding the ‘mobility and transport’ challenge is mainly determined by space availability and suitability of the SSW system to support infrastructure. The role of the subsurface to carry infrastructure, above ground and subsurface, is an important aspect. Spatial planning related research is mainly focussed at asset management methods and possibilities to combine infrastructure and ecosystem services. Net impacts related research should focus at the interactions between (above ground and subsurface) infrastructures and the SSW system.

Soil quality

The quality of soil should be regarded broader than only looking at chemical quality. It also encompasses the quality for a specific use. Soil quality research should try to combine this broader focus with other challenges such as land use changes. The role of natural capital is also a main topic for research: how can the natural system improve soil quality, both chemically, biologically and physically in relation different land use functions**?** Land management questions relate to managing (new) contaminants, governance practice, sustainable dredging, earth moving, and management of brownfields and landfills. Net impacts research should focus on risks for human health and ecosystems.

Energy supply

The desire for a specific energy mix depends on different scenarios. Natural capital should be mainly regarded for its potential for subsurface, renewable energy provision. Land management research should focus on spatial effects (including subsurface energy storage and transport) as a consequence of the selected energy mix and on the possibilities to combine different functions. Net impacts related research could be targeted towards predicting, mitigating and management of the effects of the use of different energy sources (winning and storage).

Efficient use of resources

The challenges regarding efficient use of resources encompass the societal need for resources (local-global), their availability or scarcity and how this is influenced by a circular economy including the possibilities to reuse materials. Natural capital should be mainly regarded for its potential to use the natural system for addressing these challenges and for closing cycles. Land management research should focus at determining and optimizing of the sediment balance, managing of the impacts of resource extraction on landscapes and at designing (new) land-uses for areas that became available after resource extractions (aboveground and in the subsurface: e.g. salt caverns). Net impacts realted research could be targeted to support decision making and to improve land management.

Cross-cutting topics

Some topics cross-cut the above challenges and thus is research on these topics beneficial for all challenges. These cross-cutting topics are:

- Governance: this relates to research on how to deal with “commons” such as soil. Research should focus on policy making and regulation, development of adaptive policy models, decision making, managing of game changers, dealing with uncertainty and stakeholder participation.
- The knowledge base of stakeholders: this relates to the stakeholder’s knowledge of the SSW system and land-use. A shared knowledge base enables stakeholder to engage in debates between science, policy and practice. Specific research topics are effective learning processes (learn from impacts to improve land management); sufficient information supply; awareness raising and education.
- Systems understanding: understanding of the functioning of the SSW system is a crucial topic to be able to use that system for addressing societal challenges. Specific research topics are the prediction and management of 4D effects of land use; the effects of interferences within the SSW system on different (temporal and spatial) scales; (indicators for) the resilience of the SSW system.
- Valuation of the SSW system: We need research focussed on the potential of the SSW system to provide ecosystem services in order to be able to use the SSW system to address societal challenges. Decision makers will benefit from new knowledge on how to valuate and balance costs and benefits of SSW related ecosystem services.

- Data and information: sufficient, readily available and good quality data are the basis for being able to address societal challenges. Also the role of big data should be explored here.
- Land-use: it is needed to develop a vision on future land-use in the Netherlands. This enables the prediction of land-use demands and this land management to anticipate on that. Specific research question are: what is the role of ecosystem services; what do we consider "optimal / sustainable" land-use, how can ecoengineering and building with nature practices improve land-use? Research should also consider land prices and ownership rights.

Science - policy/practice interaction

The difference between fundamental, strategic and applied research is broadly known and well understood in the Netherlands. The research focus is shifting towards applied research where fundamental research gest less attention. This is expressed as a concern by the Dutch NKS. The ability to influence research agendas varies among the stakeholders. However, many are involved in, or have the ability to join R&I agenda setting debates in the Netherlands. One NKS stated: "*To get something on the agenda is easier than to get it under attention*". Attention can be raised by linking research questions to societal challenges. Good examples and a good story work also very well: "*show & tell*". A research agenda should be coherent and well-designed and should integrate short as well as long-term research. However, unfortunately funding availability lags behind the availability of research agendas.

Funding possibilities

Many national, European and international funding possibilities were suggested by the NKS. There is significantly more budget available for applied research and there is a lot of attention for business cases in the Netherlands. However, designing and establishing of such cases is sometimes perceived cumbersome. There should remain attention for flexibility, innovation and seed money for good ideas.

Topics that are not or insufficiently covered within research programs and by funding possibilities are often the topics that are not directly linked to the primary tasks or core businesses of organisations. If there is no direct ownership, topics remain unaddressed, even though some of these topics may give us interesting insights and impulses for innovations. Such topics need a better "branding" in order to get funding.

Programming and financing of research and research policy in the Netherlands (and also in the EU) is often sectorial. This hampers integrated research and approaches. Active collaboration should be sought to break the silos.

2.1.2 Dutch version

INSPIRATION richt zich op wat landgebruik, landbeheer en het bodem-sediment-water systeem kunnen bijdragen aan maatschappelijke opgaven. Daartoe wordt een strategische onderzoeksagenda opgesteld. In 17 Europese landen hebben bureaustudies, interviews, workshops met stakeholders[5] vanuit bedrijfsleven, overheid en onderzoeksinstellingen plaatsgevonden om de maatschappelijke opgaven en bijbehorende strategische onderzoeksvragen helder te krijgen. Daarnaast zijn vragen gesteld over hoe kennis, beleid en praktijk interacteren en over de beschikbaarheid van financieringsinstrumenten voor onderzoek.

Maatschappelijke opgaven

In Nederland zijn diverse maatschappelijke opgaven voor korte en lange termijn benoemd door de nationale *key stakeholders* (NKS) waarbij landgebruik en het bodem-sediment-water-systeem een rol kunnen spelen. Deze opgaven zijn: Landbouw en voedsel; Leefbaarheid van het landelijk gebied; Klimaatverandering; Water; Slimme en gezonde stad; Mobiliteit en transport; Bodemkwaliteit; energievoorziening en Efficiënt gebruik grondstoffen.

Voor elk van deze maatschappelijke opgaven is ook de onderzoeksbehoefte gedefinieerd.

Onderzoeksbehoefte

Landbouw en voedsel

Bij landbouw en voedsel worden de onderzoeksvragen bepaald door ontwikkelingen (van lokaal tot mondiaal) in de agrarische sector en het gedrag van consumenten (trends in dieet). Landbouw is direct gelinkt aan natuurlijk kapitaal. Wat is een "goede bodemkwaliteit" voor de landbouw en wat is de rol van de biodiversiteit? Landbeheer heeft betrekking op “duurzame landbouw” en functiecombinatie mogelijkheden in het landelijk gebied. De effecten van landgebruik kunnen worden gebruikt om “goede bodemkwaliteit” en “duurzaam landgebruik” vorm te geven. Hiermee wordt besluitvorming ondersteund.

Leefbaarheid van het landelijk gebied

De vraag naar biomassa voor verschillende doeleinden is een bepalende factor bij deze uitdaging en bij landgebruik in het landelijk gebied. Natuurlijk kapitaal kan mogelijk een rol spelen bij het vergroten van de leefbaarheid van landelijk gebied. Deze rol moet nog worden vastgesteld. Met landbeheer kan waarde aan het landelijk gebied worden toegevoegd, bijvoorbeeld door functiecombinaties en door geïntegreerd beheer van landbouwgrond, natuur en landschappen. Het effect van landbeheer (bijvoorbeeld op gezondheid en welzijn) moet worden vastgesteld om zo de leefbaarheid van het landelijk gebied te kunnen beïnvloeden.

[5] Deze exercitie is parallel uitgevoerd met de update van de Nederlandse Kennisagenda Bodem en Ondergrond.

Klimaatverandering

Klimaatverandering is een serieuze uitdaging voor zowel het stedelijke (overstromingen, hittestress) als het landelijke gebied (verzilting, bodemdaling, vernatting en verdroging). Er zijn echter veel kansen om klimaatverandering met andere opgaven op te pakken. Deze moeten worden onderzocht en geoptimaliseerd, net zoals de rol van het natuurlijk systeem. Landbeheer en het betere benutting van het bodem-sediment-water-systeem (inclusief organische stof, als indicator) kunnen bijdragen aan klimaatadaptatie en -mitigatie. De impact van klimaatverandering op land en diverse maatschappelijke uitdagingen, en de effecten van diverse maatregelen moet worden onderzocht en vastgesteld.

Water

Water is in Nederland een belangrijke uitdaging. De behoefte aan verschillende functies van land, grond- of oppervlaktewater, nu en in de toekomst, en de rol hierin van natuurlijk kapitaal, resulteren in diverse uitdagingen met betrekking tot landbeheer. Onderzoek is nodig om goed vorm te kunnen geven aan gebiedsgericht beheer, peilbeheer gerelateerd aan verschillende landgebruiksfuncties, waterveiligheid en waterkwaliteitsbeheer. De effecten van waterbeheer en ingrepen moeten worden meegenomen in de landgebruikspraktijk.

Slimme en gezonde stad

Een slimme en gezonde stad behouden en vormgeven is een serieuze opgave. Wat we van de stad willen, is afhankelijk van diverse toekomstscenario's, waarbij demografie en klimaatverandering belangrijke aspecten zijn. Het gebruik van natuurlijk kapitaal (groene en blauwe infrastructuren) om de veerkracht en de leefomgevingskwaliteit in het stedelijk gebied te verhogen, heeft veel potentie, die onderzocht en benut moet worden. Onderzoek naar landbeheer kan zich richten op de interacties en combinaties tussen het natuurlijke en urbane systeem en 4D planning. Impacts van (nieuwe) bedreigingen en de effecten van ingrepen (eco-engineering, bouwen met de natuur) moeten worden bepaald om daarmee de landbeheerpraktijk te kunnen verbeteren.

Mobiliteit en transport

De vraag bij de uitdaging 'mobiliteit en transport' wordt vooral bepaald door de beschikbaarheid van ruimte en de geschiktheid van het bodem-sediment-water-systeem voor de functie. De rol van de ondergrond om infrastructuur te dragen (boven of onder de grond) is een belangrijk aspect. Onderzoek in verband met ruimtelijke ordening moet vooral worden gericht op 'asset' beheermethoden en mogelijkheden om infrastructuur en ecosysteemdiensten te combineren. Onderzoek naar de netto-effecten moeten worden gericht op de interactie tussen de (bovengrondse en ondergrondse) infrastructuur en het bodem-sediment-water-systeem.

Bodemkwaliteitszorg

Bodemkwaliteit moet breder worden gezien dan alleen chemische kwaliteit, het omvat ook de kwaliteit voor een specifiek gebruik. Bij bodemkwaliteit is het van belang om te kijken of er mogelijkheden bestaan om dit te combineren met andere uitdagingen zoals landgebruikveranderingen. De rol van natuurlijk kapitaal moet ook worden onderzocht: hoe kan het natuurlijke systeem de bodemkwaliteit verbeteren (zowel chemisch, biologisch als fysisch voor verschillende functies landgebruik). Onderzoeksvragen gerelateerd aan landbeheer moeten worden gericht op omgaan met (nieuwe) verontreinigingen, governance, duurzaam baggeren en grondverzet, en beheer van 'brownfields' en stortplaatsen. Onderzoek naar de effecten moet zich richten op de risico's voor de volksgezondheid en ecosystemen.

Energievoorziening

Hoe de energiemix eruit gaat zien hangt af van verschillende scenario's. De rol van natuurlijk kapitaal hierbij gaat vooral over de potentie die de ondergrond biedt voor bodemenergie. Landbeheeronderzoek kan zich richten op ruimtelijke effecten (inclusief ondergrondse opslag en transport) van de energiemix en op de mogelijkheden voor functiecombinaties. Onderzoek naar de effecten moet zich richten op het voorspellen, mitigeren en omgaan met effecten van het gebruik van verschillende energiebronnen (winning en opslag).

Efficiënt gebruik grondstoffen

De opgave efficiënt gebruik van grondstoffen wordt bepaald door de behoefte aan grondstoffen (lokaal-globaal), beschikbaarheid en schaarste en de rol hierbij van circulaire economie en mogelijkheden om materialen te hergebruiken. De rol van natuurlijk kapitaal hierbij gaat vooral over de mogelijkheden om het natuurlijk systeem in te zetten en om kringlopen te sluiten. Landbeheeronderzoek kan zich richten op het in kaart brengen en optimaliseren van de sedimentbalans, omgaan met de impacts van grondstoffenwinning en het ontwerpen van (nieuw) landgebruik op terreinen die beschikbaar komen door winningen (boven en onder de grond, zoals zoutcavernes). Onderzoek naar de effecten van grondstoffenwinning kan helpen bij besluitvorming en verbeteren van landbeheer.

Dwarsverbanden

Daarnaast zijn een aantal dwarsverbanden benoemd. Dit zijn onderwerpen die bij het onderzoek naar alle benoemde maatschappelijke opgaven van belang zijn. Deze dwarsverbanden zijn:

- Governance, hieronder valt onderzoek gericht op het omgaan met "*commons*" zoals bodem. Het gaat hierbij om beleid en regelgeving, adaptieve beleidsmodellen, besluitvorming, het omgaan met "*game changers*", het omgaan met onzekerheden en samenwerking tussen belanghebbenden.

- De kennisbasis van betrokkenen, hier staat de kennisbasis van de betrokkenen bij het bodem-sediment-watersysteem en landgebruik centraal. De kennisbasis is van belang zodat iedereen zijn of haar rol kan spelen in de interacties tussen wetenschap, beleid en praktijk. Effectieve leerprocessen (leren van impacts zodat landbeheer geoptimaliseerd kan worden), voldoende informatievoorziening, bewustwording en onderwijs zijn onderwerpen waaraan gewerkt moet worden.
- Kennis van de werking van het bodem-sediment-water-systeem. Het begrijpen hoe het bodem-sediment-water-systeem functioneert is cruciaal om dit systeem te kunnen benutten voor het aanpakken van maatschappelijke opgaven. De 4D-effecten van landgebruik en ingrepen in het bodem-sediment-water-systeem op diverse (ruimtelijke en temporele) schalen moeten kunnen worden ingeschat en ondervangen. Daarnaast is begrip van (indicatoren voor) de veerkracht van het bodem-sediment-water-systeem van belang.
- Waardering van het bodem-sediment-water-systeem. Onderzoek naar de potentie van het bodem-sediment-water-systeem om ecosysteemdiensten te leveren is nodig om het systeem te kunnen benutten om maatschappelijk opgaven aan te pakken. Kennis over het waarderen en het verdelen van kosten en baten van ecosysteemdiensten helpt bij besluitvorming.
- Data en informatie. Voldoende en beschikbare data van goede kwaliteit zijn de basis om te kunnen werken aan maatschappelijk opgaven. Hierbij moet de rol van "*big data*" worden verkend.
- Landgebruik. Een visie op het toekomstige landgebruik in Nederland is van belang om de wensen en landbeheeropgaven goed te kunnen inschatten. Wat de rol van ecosysteemdiensten hierbij? Wat verstaan we onder optimaal, duurzaam landgebruik? Hoe kan eco-engineering en bouwen-met-de-natuur landgebruik verbeteren? Aspecten zoals grondprijzen en landeigendom moeten worden meegenomen in onderzoek rond dit onderwerp.

Interactie tussen wetenschap en beleid / praktijk

Het verschil tussen fundamenteel, strategisch en toegepast onderzoek is in Nederland welbekend. De focus van het onderzoek verschuift hier in de richting van toegepast onderzoek, waardoor fundamenteel onderzoek minder aandacht krijgt. Dit wordt door de NKS als een potentieel probleem gezien. De mogelijkheid om onderzoeksagenda's te beïnvloeden verschilt per persoon. Echter, velen zijn betrokken en kunnen meepraten over de agendering van onderzoek. Een NKS merkte echter op: "Iets op een agenda krijgen is makkelijker dan iets agenderen". Door onderzoeksvragen aan maatschappelijke opgaven te koppelen krijgen ze aandacht. Ook goede voorbeelden dragen daaraan bij. Een onderzoeksagenda moet coherent en goed worden neergezet, waarbij zowel korte en lange termijn onderzoek een plaats moet krijgen. Echter, er zijn momenteel meer agenda's dan financiering voor onderzoek.

Financieringsmogelijkheden

Er zijn tal van nationale, Europese en internationale financieringsmogelijkheden beschikbaar, waarbij het meeste budget beschikbaar is voor toegepast onderzoek. Er is veel aandacht voor business cases in Nederland. Die zijn echter soms lastig op te zetten. Er moet aandacht blijven voor flexibiliteit, innovatie en “seed money” voor goede ideeën.

Onderwerpen die niet of onvoldoende financieringsmogelijkheden hebben of niet terugkomen in onderzoeksagenda ’s, zijn de onderwerpen die niet rechtstreeks verband houden met de primaire taken of core business van organisaties. Als er geen direct eigenaarschap is, blijven dit soort onderzoeksvragen vaak liggen, hoewel deze vaak "cross-border" onderwerpen interessante inzichten en impulsen voor innovatie kunnen geven. We moeten deze onderwerpen beter “*branden*” om ze gefinancierd te krijgen.

Programmering en financiering van onderzoek en onderzoeksbeleid in Nederland (en ook in de EU) zijn nog vaak sectoraal ingestoken. Dit belemmert integraal onderzoek. Om dit te doorbreken moet proactief samenwerking worden gezocht.

2.2 Methodology followed

This national report is INSPIRATION deliverable 2.5 - The Netherlands. In the Netherlands, the exercise to collate research needs was held in parallel to an update of the Dutch knowledge agenda for soil and subsurface[6]. For this update, societal challenges were defined and research questions were listed by a group of representatives of municipalities, water authorities, provinces, the national authority and research institutes: professionals and policymakers that encounter knowledge gaps in their daily practice.

For INSPIRATION 16 full interviews with NKS and 3 additional interviews (two more NKS and a funding-expert from the national government) wer conducted. The NKS that were interviewed are presented in Annex I. Information on interview questions (in English) is provided in deliverable 2.3[7] and in Annex VI and VII.

The desk-study was based on documents as suggested by the NKS (Annex II).

With the interviews and the desk-study, the discriptions of societal challenges and the research questions under the societal challenges were completed, sharpened and improved.

These research questions were presented and discussed in a 2-day national workshop, held in November 2015. Next to the NKS, a broader group of representatives from end-users, funders, researchers and policy makers from different organisations and fields were invited for the first day of workshop (the overview of attendees and the program are presented in Annex IIIa and IIIb respectively). On the second workshop day, the NKS further elaborated the results of day 1.

All results were combined in a draft for deliverable 2.5 and sent to the NKS for review. In annex I it is indicated which NKS reviewed which parts of the report (4th colom "*reviewed*"). Also two members of the INSPIRATION international advisory board were asked to, and thus reviewed (part of) the draft deliverable.

Al reviews were integrated in this resulting document. The research questions that thus have been obtained are presented (in Dutch) in annex IV.

[6] http://www.rwsleefomgeving.nl/onderwerpen/bodem-ondergrond/ondergrond/kennisagenda/

[7] Brils J, Maring L, Darmendrail D, Dictor MC, Guerin V, Coussy S, Finka M, Bal N, Menger P, Rehunnen A, Zeyer J, Schröter-Schlaack C, Villeneuve J, Gorgon J, Bartke S (2015): Template for national information collation. Update 1 version as of 02.07.2015 of deliverable D2.3 of the HORIZON 2020 project INSPIRATION. EC Grant agreement no: 642372, UBA: Dessau-Roßlau, Germany. Available on: http://www.inspiration-h2020.eu/sites/default/files/upload/documents/d2.3_update1.pdf (Annex IIa).

2.3 Research and Innovation (R&I) needs

INSPIRATION's scope is on land use, land-use changes and soil management in the light of current and future societal challenges. When reading this section it is important to realize that the research topics originating from these challenges and needs are very much interlinked. The soil-water-sediment system[8] reacts on land management and land management is dependent on the soil-water-sediment system. Changes and disturbances have effects on different spatial and time scales (Figure 1).

Figure 1: Societal challenges linked to the soil-sediment-water system, land-use and land management, as formulated by NKS in the Netherlands.

In some cases, research questions are categorized under a specific topic while they would also fit under another topic. To prevent duplication, choices were made.

[8] Soil-sediment-water system or natural system or ecosystem: A dynamic complex of plant, animal, and micro-organism communities and the non-living environment interacting as a functional unit. http://www.inspiration-h2020.eu/page/glossary-0

2.3.1 Societal challenges and needs

Many of the societal challenges that the EU has formulated in Horizon2020 are recognized in the Netherlands. These challenges are becoming more important looking at the future. Therefore research is needed to tackle these challenges. Figure 2 presents the relation between the societal challenges in the Netherlands and the challenges as formulated by the EU.

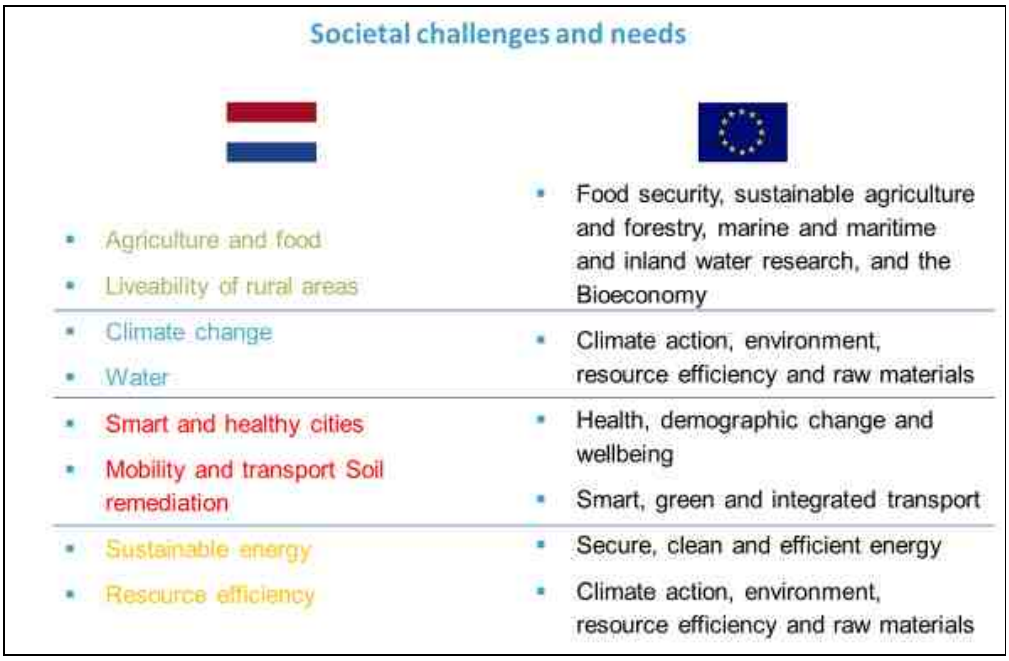


Figure 2: The societal challenges and needs as formulated in the Netherlands and EU

These societal challenges and needs in the Netherlands:

- Sustainable agriculture and food are important challenges in the Netherlands. Agriculture is very intensive and productive in the Netheralnds. This has repercussions on the quality of soil and water and nature. This contributes to the difficulties to be able to comply with regulations such as the Water Framework Directive (WFD). The worldwide need for more food production, together with other land-use functions (including the need for bio-based materials) puts pressure on our resources, including land. Keeping agricultural practice sustainable, i.e. to maintain the production function without damage elsewhere or later, asks for a healthy and well-functioning soil-sediment-water system.
- Liveability of rural areas: By nature the landscape mirros the (qualities of) soil and subsurface. Due to intensified land-use and increased technical possibilities, this is changing. Economic developments and political choices constantly influence land-use in the Netherlands. Landscapes become more alike and people move away from remote, rural areas. Although many positive trends are seen in the rural area, liveability needs to be improved by adding value, using the natural soil-sediment-water system and land management.

- Climate change is a serious challenge in the Netherlands, both for urban areas (flooding, heat stress) and for rural areas (salinization, subsidence, floods and droughts). This asks for solutions in terms of climate change adaptation and mitigation. Land-use planning and the use of the soil-sediment-water system have a high potential to contribute to these solutions.
- Water: Part of the Netherlands lies below sea level. This makes water safety an important challenge. Next to water safety, sufficient water supply for drinking, irrigation and process water, now and in the future, is recognized as a serious challenge. For that reason strategic groundwater reserves are taken up in a Dutch strategy for the subsurface. Quality and quantity aspects are all of importance in water management. It is a constant puzzle where soil-sediment-water system, land-use and (land and water) management interact closely.
- Smart and healthy cities: Urban population increase and climate change pose great pressure on the liveability of cities. The pressure on, and changes in urban areas ask for a vision on smart and healthy cities. Thus to ensure liveability in the future and avoid damage and unnecessary costs. Smart and sustainable urban planning is the key to an economic and ecological vital and attractive city. Therefore, sustainable use of the soil-sediment-water system is needed. It important to know how the soil-sediment-water system functions in, and below urban systems. Smart urban planning pays attention to the metabolism of a city, circularity and the interaction between the urban system and the natural soil-water system.
- Mobility and transport: When transporting people and goods, above and subsurface infrastructure and facilities around them are needed. Important here is the interaction with the soil-sediment-water system to maintain the function of the infrastructure. A different category is the subsurface transport of substances such as gas, (waste) water and oil. These are transported by different kinds of pipes and electricity is transported by cables. A very important challenge here is subsurface spatial planning.
- Soil quality The soil remediation operation of the Netherlands is coming to an end. The next step is the management phase. The major responsibility for soil is being decentralised. Awareness increased about the fact that soil quality is more than complying with standards for chemical substances. Soil quality is also important regarding the sustainable functioning of ecosystems (ecological, chemical and physical quality). Soil remediation not related to spatial development is becoming redundant and is replaced by (area-based) sustainable land management (includes soil protection). A strong and innovative soil (research, consultancy and advice) sector remains significant when dealing with new and historic contamination, complying with national and European regulation and sustainable brownfield regeneration.

- Sustainable energy supply: Sustainable and secure energy supply is high on the political and societal agenda. The Netherlands provide partly their own energy by using subsurface fossil fuels, i.e. natural gas and oil. The winning of natural gas in the North of the Netherlands has adverse effects (earth quakes) which influence societal perception on (deep) subsurface winning activities and the use of fossil fuels. The energy supply is in transition: the amount of renewable energy sources increases. The subsurface can play a role in this transition. The spatial planning of the deep subsurface ((unconventional) winning, storage) will be part of the Dutch strategy for subsurface planning. Using the soil-sediment-water system for energy purposes asks for a thorough understanding of the natural system, to avoid adverse effects. The energy transition also has spatial impacts, aboveground and in the subsurface, that need to be considered when making choices.
- Resource efficiency: Many natural resources are becoming scarce, putting this issue internationally high on the agenda. The Dutch subsurface supplies natural resources such as sand, gravel, clay, salt, fossil fuels and water. The shallow extraction of resources leaves a mark on landscapes and space that can be reused or redeveloped. Resource extraction also highly influences the soil-sediment-water system and its ability to provide ecosystem services. This asks for system understanding. Different parties focus on resource efficiency by investing in circular economy, the 'food-water-energy' nexus and possibilities to enable the re-use of (secondary) building material (soil, sediment). Also companies and industries make their resource use part of their long-term business strategies.
- Cross-cutting themes: several cross-cutting themes need to be addressed when working on the above (and other) societal challenges:
  - Governance;
  - The knowledge base of stakeholders;
  - System knowledge/understanding;
  - Valuation of the soil-sediment-water system;
  - Data and information;
  - Land-use.

  Also for these cross-cutting themes knowledge and instruments are needed.

2.3.2 Topics / research needs to include in the SRA

Different topics and research needs related to the societal challenges are obtained from the interviews, desk-study and national workshop. Hereafter the main topics are introduced and for each topic the main research questions are summarized under INSPIRATION themes “demand”, “natural capital”, land management” and “impact”. The documents, research agendas, research programmes underpinning these topics are presented in Annex II.

NL-1: Agriculture and food

World’s population will grow with more than 2 billion towards more than 9 billion people. This will increase the need for food production. Towards 2050 the agricultural production needs to grow worldwide with 60%. Also urbanisation has taken large quantities of agricultural land. The need for more food, together with other land use functions put pressure on our resources, including land. To keep agricultural practice sustainable: maintain the production function without damage elsewhere or later, asks for a healthy and well-functioning soil-sediment-water system.

The ambition to move to a biobased economy puts pressure as well on agricultural land. In the bio-economy, renewable resources such as algae, crops (residues), organic waste are used as food fodder, building material, chemicals, plastics, energy and fuel. This lowers the dependency on fossil natural resources such as natural gas and oil, lowers CO_2 emissions and contributes to circular economy. This shift to biobased will increase the demand for biomass. This can partly be met by residues and waste but the other part must be delivered by an even higher (global) agricultural production. In the Netherlands, agriculture is already very intensive and productive, so the biomass should come from elsewhere when the Netherlands want to invest in biobased products. This can cause severe shifts in nutrient availability disrupt nutrient cycles worldwide (surplus in importing lands and losses in exporting lands). The current European diet is characterised by a high intake of meat, dairy products and eggs. Livestock production in the EU is the driver of around 80% of the nitrogen losses from agriculture. These losses cause a number of environmental problems, including eutrophication. Halving the current consumption of meat and dairy in the EU would achieve reductions of around 40% in agricultural nitrogen losses and 25% to 40% in greenhouse gas emissions from agriculture[9]. There are different types of farms in the agricultural sector[10]: the specialized rural farm (mainly family farms, agriculture, dairy or horticulture), the semi-industrialized farm (greenhouse farming, intensified cattle farms) and urban oriented farms (multifunctional).

[9] Westhoek et al., 2015
[10] RLI, 2013

A higher demand for biomass asks for higher productivity. This intensifying of production has repercussions on the quality of soil and water and nature. This e.g. contributes to the difficulties to comply with regulation such as the Water Framework Directive[11] (WFD) and the Nitrates Directive[12].

Ground bound agricultural production systems need productive soil: that are fertile, have a good physical structure, can retain water, bind carbon in humus and repel diseases. In the following narrative this is discussed.

Narrative: What is a good soil for sustainable agriculture and how can sustainable agriculture contribute to good soils?

What is a good soil for sustainable agriculture and how can sustainable agriculture contribute to good soils? These questions start many discussions. At the one hand we can look at the natural suitability of soils for a certain agricultural function. At the other hand can land use management and agricultural practices can improve soils. A vital soil can deliver ecosystem services to its full potential. To achieve and maintain a vital soil, sustainable agricultural land use practices are needed.

There is not just one, but multiple models for “doing it right”. Ingredients are:

Knowledge of the soil (processes) and the relation with management practices are indispensable. Both scientific knowledge and knowledge from the farmers’ experience are important here.

Which sustainable agricultural practices and business cases are effective? Circular processes and resource efficiency can contribute here. There is a need to lower emissions and utilize nutrients more efficiently. “Prevention is better than cure”: lower inputs of or alternatives for pesticides.

Insight in (external) drivers: Farmers have to deal with many external influences and boundary conditions, such as regulation and economical drivers. How can they be used in a positive way for long term sustainable productivity instead of short term high economic yields?

Next to the farmers, also other parties in the chain from “soil to mouth” are important: retailers, consumers, the large purchasing agents for supermarket chains. Further stakeholders are the authorities (EU to local), research organisations, seed-producers, NGOs and financial parties such as bank investors,.

[11] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

[12] Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources

Specific research questions:

Demand

- How become stakeholders aware of the importance of good soil quality for food safety and quality and their role in this matter?
- What can we do in the Netherlands to achieve sustainable use of soils and recover soil quality here and elsewhere and, with that, contribute to the UN-Sustainable Development Goals?
- What do trends en developments in the agricultural sector, such as scaling up short-term business cases, agriculture that follows market trends instead of the possibilities of the soil-sediment-water system, entail for soil and subsurface (possibilities and threats for the use of the soil-sediment-water system)?
- What are trends in diets and what do they entail for soil and water use and health. How can people be convinced to change to a diet with less animal proteins?
- Who are the winners and losers in the food chain in the transition to a more healthy (for people and the environment) diet and sustainable agriculture? How to take care of the losers? What can be the role of the common agricultural policy (CAP) in this transition?

Natural capital

- What is a healthy soil? And, more specific: What is the condition of the soil (soil life, structure, quality, amount and quality of the soil organic matter etc., integrated fysical-chemical-biological) connected to the agricultural function and other ecosystem services (water storage, biological control, soil fertility, productivity, etc.)?
- How can natural processes being used to recover degraded soils and maintain healthy soils?
- What is the effect of good soil quality for emissions of nitrogen and phosphate from agriculture and horticulture?

Land management

- How can the soil-sediment-water system being used in an optimal way to make agriculture sustainable?
- What knowledge of the soil-sediment-water system is needed to transform agriculture to a resource efficient sector? Both on a regional and global scale. This is related to closing cycles and the footprint of agriculture products.
- Which factors determine if the suitability of soils for agriculture is taken into account in spatial and economic decisions and which optimizes are possible?
- How can we value soil and biodiversity as natural capital for agriculture and translate this to earning models?

- How can agriculture and other functions such as water and nature management, energy production and climate adaptation and mitigation being combined, using the knowledge of the ecosystem?
- How can farmers being stimulated to implement (new or improved) agricultural methods in such a way that low productivity is avoided, soils are recovered and dependency on external resources is decreased?
    - How to design and/or close nutrient cycles?
    - How to utilize biological residues of production changes in agriculture to contribute to circular economy, and an improvement of soil quality?
    - How to manage soil organic matter effectively?
    - What can precision agriculture contribute to more awareness of soils?
    - How can traditional agriculture such as crop rotation being combined with modern agricultural insights?
- How can we deal with, or avoid threats such as soil compaction, microbial risks from pathogens in the soil, antimicrobial resistance, soil subsidence and salinization?
- How can we translate existing knowledge of soil biodiversity to actions for farmers to improve soil biodiversity?
- How can we implement the Nitrates Directive and the Water Framework Directive in such a way in the Netherlands that farmers are stimulated to manage the soil-sediment-water system in a sustainable way?

Net impacts

- What is, on a short and long term, the result of conscious management of soil fertility?
- The global development of the standard of living (more or less consumption of animal protein, choice for organic food) has effects on agricultural practice. What does this mean for land use in the Netherlands and footprint elsewhere? What are the risks of land degradation? Is policy needed?
- What are effects of agricultural methods on the sustainability of agriculture and improvement of soil quality?
- What are effects of agricultural practice for eutrophication of coastal zones, groundwater quantity and quality and climate on a global scale?

NL-2: Liveability of rural areas

By nature the landscape mirros the (qualities of) soil and subsurface. Intensified land-use and increased technical possibilities alleviate the limitations posed by soil conditions. Economic developments and political choices have always influenced the land use in the Netherlands, but globalisation leads increasingly to uniform production requirements and standard landscapes. In rural areas scale enlargement and intensification of production, e.g. in horticulture and pig farming, is common. Dairy farmers partly intensify and another part d-intensifies. Many agricultural family-farm based businesses are sold to larger enterprises by lack of succession.

In remote rural areas (for Dutch standards), a decrease in facilities and employment is seen. Young people move away, villages are shrinking. Incidents, such as the Q-fever disease even further decline the popularity of rural areas. On the other side, in metropolitan and peri-urban regions, the rural is a very popular area for commuters' residence. Other positive examples can be mentioned as well: farmers investing in sustainable energy production; or a mix of functions such as care or education.

This all influences the liveability of these areas. There is a need to develop a vision on the rural. Rural regions need an attractive mix of land use functions. The liveability needs to be supported by multifunctionality: recreational value, natural value, attractively of the area for residence or business. The main question is here, how can we improve the liveability of rural areas by making optimal and sustainable use of the natural soil-sediment-water system and land management, duly incorporating natural and cultural heritage values and economic and social factors determining the location of a business?

Specific research questions:

Demand

- How can we improve the quality of life in rural areas by making the best use of the soil-sediment-water system and land management, taking into account natural and cultural values and economic and social factors that determine the location of businesses and individuals?
- How can the demand for regional biomass (for bioenergy) offer opportunities to stimulate the construction and maintenance of landscape elements?

Natural capital

- Is it important for the liveability of rural areas (Dutch identity) to show the significance of soil and subsurface as the basis of characteristic landscapes (including geological values, archaeology, geomorphology)? And if so, how do we return the 'readability' of the subsurface characteristics in the landscape?
- How can geological, cultural and biological values above and below ground level being expressed in social and economic values?

Land management

- Can economic and social-cultural scenario studies that combine different land uses to an attractive and livable rural area being developed? How can such multifunctional land use improve economy and ecology?
- What are the true costs and benefits of land use in rural areas, who benefits, who pays the cost, and how can this be fairly distributed?
- How can the Programmatic Approach to Nitrogen (PAN) be utilized to improve land use and the liveability of the rural area
- What is the role soil for health?
    - What is the role of soil, sediment and water in the spread of infectious diseases from animals to humans and to other animals (zoonoses such as Q-fever)?
    - What is the role of soil, sediment, water in the spread of antibiotic resistance?
    - What is the role of soil in the spread and risk of (new) contaminants such as medicines and nanoparticles?
    - What is the relationship with land use and safety in rural areas? How can these risks be reduced by soil management and farming methods?
- To what extent does the development in peri-urban areas to care farms, nurseries, agricultural recreation and therefore potential exposure to different substances, an increase or decrease in public health?
- How can agriculture and other land uses strengthen the soil-sediment-water system in rural areas and allow for sustainable agriculture as a function?
- What knowledge and measures are available when converting agricultural areas to nature, avoiding drastic measures such as excavation (to reach proper nutrient levels, water quantity)?
- How can farmers be stimulated to increase the contribution to the (soil) biodiversity and nature?
- How can we position ambitions for the soil and subsurface in the rural area in the Environment and Planning Act and its instruments (such as the “environmental visions”)? What knowledge of the soil-sediment-water system is needed?
- What factors influence decisions about land use in rural areas and how can the soil-sediment-water system be involved in spatial planning and land use?
- What does the soil-sediment-water system contribute to spatial quality in spatial developments such “Ruimte voor de Rivier” (“space for the river”)?
- How do can the users of land and groundwater in an area be involved in realizing clean groundwater and healthy soil for agriculture and nature?

- How can existing tools be enforced and / or are new tools needed to maintain and improve the liveability of rural areas on the basis of the local natural system and socio-cultural characteristics, focusing on function combinations?

Net impacts

- What land management measures are effective in improving the quality of life in rural areas and achieving sustainable nature (evaluation with pilots, exchange knowledge and experiences in "agro communities")?

NL-3 Climate change

Climate change is seen as a serious challenge in the Netherlands, both for urban areas (flooding, heat stress) as for rural areas (salinization, subsidence, floods and droughts). This asks for solutions in terms of adaptation to and mitigation of climate change. Land use planning and the soil-sediment-water system have a high potential in these solutions.

In urban areas is smart planning, making use of the soil-sediment-water system (blue and green structures), needed to make climate proof and resilience cities. In rural areas it is in some cases needed to change functions to adapt to new circumstances (e.g. saline crops). Spatial planning is an instrument for coping with effects of climate change: such as restructuring canals and rivers, creating use of space for fresh water retention.

Part of the adaptation strategy is awareness. Stakeholders need to be made aware of the chances to make alliances to meet the challenges posed by climate change. This can be done both by using the soil-sediment-water system and by combining them with other societal challenges, such as energy need, a more sustainable agricultural sector, and smart and healthy city development. Stakeholders can take different measures and the question is here how many small scale solutions can contribute on a larger time and spatial scale to climate change adaptation.

Another solution is climate change mitigation. In the Netherlands carbon capture and storage (CCS) in empty natural gas fields is seen as a promising, but still very costly solution.

It is important that public and private parties know their possibilities to act within the climate adaptation and mitigation policy.

There is awareness on climate change as a societal challenge, but the role of the soil-sediment-water system in this discussion can be made more explicit. Organic matter can be the linking theme. This is worked out in a short narrative:

Narrative: The role of soil organic matter (SOM) at climate adaptation and mitigation

Can SOM be used in when speaking about the contribution of the soil-sediment-water system to adapt to and mitigate climate change in the same way as CO_2 does in the climate debate?

When we looking at mitigation: we see that bad land management leads to emissions of CO_2 and other greenhouse gasses. Peat soils degrade, resulting in soil subsidence and a decrease of SOM and water storage potential of these soils. When looking at adaptation, water retention of soils can be improved when the land is managed in the right way. This is important when dealing with dryer summers and more intense and frequent rainfalls due to climate change.

Next to water storage, also water purification capacity, soil fertility and structure are influenced highly by SOM. SOM is also a measure and boundary condition for biodiversity.

The amounts of SOM are highly dependent on land use practice. For example, the use of crop (residues) for biofuels and fibre production for biobased products have as result a decreasing SOM content in soils.

In short: SOM is an important aspect for many soil functions and can be a link between the soil-sediment-water system and societal challenges such as climate change.

By combined research on the role of SOM and its functioning, more than one challenge can be addressed. Choosing SOM as a central theme can be a driver for alliances in research and implementation of the results in pilots in natural and rural areas, improving the role of the soil-sediment-water system and land management practices. Important stakeholders are farmers, industries processing compost and manure, authorities and researchers from different research fields, nature management organisations, fertilizer and chemical industry, banks, food and drinking water industry.

In short: research on SOM as the link between soil-sediment-water system and climate change is relevant. The loss of SOM is mentioned as one of the major soil threats and connects to the UN sustainable development goals[13]. The role of SOM plays on different scales: from parcel to global. Putting it on the research agenda asks for action to improve awareness on the role of SOM when dealing with societal challenges and to link existing research programs to each other.

[13] Eg. UN-SDG 2.4: *By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality*

Specific research questions:

Demand

- What opportunities exist for alliances to tackle climate change challenges together with other societal challenges (such as energy and the smart and healthy city) using the potential of the soil-sediment-water system?

Natural capital

Elaborate how the soil-sediment-water system can contribute to challenges posed by climate change. Specific research questions:

- What opportunities do soil and subsurface offer for climate adaptation and mitigation (optimising land use to lower greenhouse gases, increase organic matter content, decrease the loss of organic matter, increase water storage potential, water safety, stability of soil, etc.)?
- Is organic matter the point of reference for climate change for the soil sector?

Land management

Elaborate the role of land use and management by coping to challenges posed by climate change (for both adaptation and mitigation strategies). Specific research questions:

- What can land use and management of the soil-sediment-water system contribute to tackling challenges related to climate change? Is this contribution fully known?
- What action perspectives for soil and subsurface do public and private parties have for climate adaptation and mitigation policy?
- How can the use (adaptation) of the soil-sediment-water system be adapted to impacts of climate change?
- What measures in the soil-sediment-water system are most effective to comply with the commitments to reduce greenhouse gas emissions (mitigation)?
- What are the costs and benefits of climate adaptation and mitigation policy for the soil-sediment-water system?
- How can many small scale solutions contribute on a larger time and spatial scale to climate change adaptation and mitigation?
- What measures for the soil-sediment-water system and land use are effective under what circumstances in the context of climate adaptation and mitigation?

Net impacts

What are the effects of climate change on the soil-sediment-water system, its functions, and land use and management? Specific research questions:

- What is the effect of climate change on:
    - Soil quality, soil characteristics, soil biodiversity, soil processes, soil subsidence and ecosystem services?
    - The use of the soil-sediment-water system and land?
    - Invasive soilborne pathogens?
    - Pests due to a lacking frost period, resulting in the need for (new) pesticides ?
- How can effects of climate change on the soil-sediment-water system be monitored (natural capital, health, ecosystem)?
- How to avoid / deal with effects of climate change (soil subsidence, water management (flooding, dehydration, salinization), heat stress, changing land use, etc.)?

NL-4: Water

The Netherlands are a “water land”, a low delta, partly situated below sea level. Knowledge of the soil-sediment-water system is for centuries an important key for our economy.

The Dutch are known for their hydraulic engineering against floods. Making use of soil-sediment-water system, natural processes and land management can decrease costs for engineering and leads to better environmental quality and prevention of damage. In the Dutch water management this already is implemented in the program ‘Space for the river’ (‘Ruimte voor de rivier’) and the Delta Program ('Delta Programma').

Apart from managing the water in terms of safety (lowlands versus sea level rise), there are many more water management issues. (Ground)water levels are managed in relation to land use functions. For agriculture, water levels are lowered in many locations in the Netherlands, sometimes with detrimental effects such as soil subsidence and degrading peat areas, leading to CO_2 emissions, or local water shortage and excess. In urban areas low groundwater levels can cause rot on wooden fundaments of houses, while high groundwater levels cause damage and nuisance.

Groundwater is the most important source for drinking and industry water in the Netherlands. It is microbiological reliable and mostly well protected from outside influences. Sufficient water supply for drinking, irrigation and process water is, now and in the future, recognized as a serious challenge. For that reason strategic groundwater supplies are taken up in the Dutch strategy for subsurface planning “STRONG”. How to make decisions between different uses of groundwater (next to drinking water also functions such as irrigation, ATES) is subject of discussion. The quality and quantity of (ground)water directly are important to support land use functions and they also influence the soil-sediment-water system and its capability to deliver ecosystem services. However, (historical and new) contaminations put the quality of the groundwater under pressure, while climate change and soil sealing in urban areas influence the recharge of groundwater.

(Ground)water is a connecting topic, relevant on different scales and a connection between rural and urban areas. Many stakeholders are involved in different ways and dependant on good water management (policy). Therefore, collaboration and knowledge exchange are crucial. The (ground)water in the Netherlands is very decisive and is managed thoroughly. It is a constant puzzle where soil-sediment-water system, land use and (land and water) management interact closely. This topic has a very strong relation with climate change

A short narrative is given to elaborate the connection between themes and the strong link between policy and practice.

Narrative: soil subsidence and groundwater level management

The main driver for this narrative is the question: How can we use pilots during policy-making to avoid mismatches between policy and practice? As example we take soil subsidence and the management of groundwater levels to support specific land use functions. The province wants in this example function agriculture, which asks for a groundwater level of 60 cm below surface level. Even when the water authority wants to facilitate other, more flexible functions, it is obliged to lower the water level for the agricultural function. This practice is not sustainable, causing soil subsidence and oxidation of peat which causes increased CO_2 and methane emissions.

Soil subsidence and salinization by unsustainable land and water management cause continually higher costs to maintain the current land use functions. This situation cannot continue. Costs will become too high or damage will occur because is an end to what the soil-sediment-water system can bear. This tipping point can also become a chance: it asks for an open discussion and adaptive attitude from all stakeholders. This asks for education and awareness, alternative land use functions or land use management and different forms of collaboration. Knowledge from the soil-sediment-water system in relation to land use management practice is essential. Both scientific knowledge as local knowledge from the farmers and water managers should be combined. Stakeholders are water authorities, farmers, municipalities, provinces, NGOs, but also the stakeholders such as the recreational sector, project developers and groundwater dependent industry can be involved. The water authorities can have a leading role in the area process.

Specific research questions:

Demand

- How can water tasks, such as drinking water supply at this moment and in the future, be ensured and what does this mean for the soil-sediment-water system and strategic groundwater resources?

Natural capital

- How can the condition of the soil-sediment-water system in total be determined and / or evaluated? And what does this condition mean for the ecosystem services that can be delivered?

Land management

- What opportunities do exist for public and private parties to involve the soil-sediment-water system in their water tasks? And are they aware of these opportunities?
- How can land and water management be designed starting with the balance between the soil-sediment-water system and water tasks (safety, drinking water, agriculture, nature, industry, Water Framework Directive objectives, etc.) and with all stakeholder taking responsibility?
- How can area-based qualitative and quantitative groundwater management be designed?
- Which factors determine in the Netherlands whether active groundwater level management is administratively, technically and financially promising and to what extent?
- How can essential processes and functions of the soil-sediment-water system be implemented to regulate the hydrological cycle?
- Which measures (including eco-engineering) using the soil-sediment-water system are applicable, when and by whom, to optimise the hydrological cycle?
- What is optimal groundwater level management for a location in relation to land use functions and tasks (such as preventing subsidence and rot of wooden piles versus agriculture)?

Net impacts

- To what extent is the local soil condition determining for the influence of water on the soil-sediment-water system? And can this knowledge be translated into generic measures? Which water characteristics influence local soil conditions and to what degree?
- What is the significance of an intervention in the water system for the sustainability balance of the total soil-sediment-water system?
- How do interventions and the resulting changes in the soil-sediment-water system affect other areas such as agriculture and spatial planning?

NL-5: Smart and healthy cities

The number of people in cities increases worldwide. In 2020, it is expected that 70% of the world's population will live in urban areas. This increase, together with the effects of climate change, poses great pressure on the liveability of cities. The pressure on and changes in urban areas ask for a vision on smart and healthy cities, to ensure liveability in the future and avoid damage and unnecessary costs.

Smart and sustainable urban planning is the key to economic and ecological vital and attractive cities. Urban areas can be characterised as complex systems because they have to house different functions like living, working and recreation that are connected by a good infra and mobility system. These functional systems also need to be considered in the existing social and cultural assets and potentials on the one hand and the contemporary pressures on these systems coming from densification and climate change.

To reach the ambition of a city that performs smart, is health and attractive, sustainable use of the soil-sediment-water system is needed. The pressure of densification and climate change needs special care for the available space for green, water and recreation that competes with space for "hard" uses such as offices, housing and (subsurface) infrastructure. Soil sealing is seen as a serious threat for the soil quality and use of ecosystem functions, such as water storage capacity, cooling of the city, biodiversity, productivity for green. A central question is how sustainable use of the soil-sediment-water system can become a self-evident aspect of urban planning and design. The possibilities of soil-sediment-water system for different urban challenges need to be seen and used. Following the natural geomorphology for spatial planning, is a start: prevent building in spaces that are easily flooded or on the beginning of slopes to allow cool air to flow into the city at night.

The quality of urban soils, nature and green are essential within a healthy and smart city. Building with nature and the implementation of ecological concepts contribute to a liveable city. Therefore it is of importance to know how the soil-sediment-water system functions in and under the urban system, which processes are there, how they interfere, and how ecosystem services can be used in a sustainable and optimal way. This is as mentioned before a very complex system that should be approached as such. We need, while gaining understanding in this complex system, to leave room for now still unknown solutions, strategies and collaborations.

Smart urban planning pays attention to the metabolism of a city, circularity and the interaction between the urban system and the natural soil-water system. The need for a stronger link between soil-sediment-water system and urban planning is described in the following narrative.

Narrative: start with soil-water-green in urban areas

We need to start with soil-water-green in urban planning. The natural and urban systems have a very strong relation and they need to be matched in a better way to make resilient, climate and future proof cities.

When making bad decisions in spatial planning this has in many cases a direct reverse effect: reverse environmental effects, objectives (climate) are not met, direct nuisance or damage, social effects. The effects together can cause a downward spiral, ending up in non-functioning, unattractive, underused urban areas. Even temporary green is better than no land use function at all. It gives value: “Have you ever seen a tree with graffiti?”

To give the soil-sediment-water system a “self-evident” place within urban planning some aspects need to be addressed:

Understanding: considering soil, water and green in urban areas is needed. They are an integral part of cities. Water and green are more than just a place for recreation. They also deliver other services. Show the possibilities of these services.

Valuation of the soil-sediment-water system: the value of the soil-sediment-water system should be made explicit. A lot of money is now spent on fighting symptoms of bad planning or technical solutions. Implementing water and green are not a debit in urban maintenance, but a valuable asset. Next to direct value, also the value of use, perception and future value should be assessed. Benefits also directly contribute to citizens in terms of avoided damage, wellbeing, health, etc

And perspectives for action: how can you use the soil-sediment-water system for more than “just” recreation. Think here in terms of functional green and water. Use the full potential of the services the natural system offers. (Eco-)engineering support redeveloping the city in a better way.

Knowledge of the soil-sediment-water system is needed to be able to use ecosystem services: what do we have and how can we use it.

Also recognition that the soil-sediment-water system is a system. Trees and groundwater flows depend on it.

The soil-sediment-water system is important on different scales. Next to local “solutions”, green and blue structures in a city are improving the cities climate and have a connecting function for flora and fauna. An urban area can be a harbour for biodiversity. Where rural areas have less species, the urban area gives a variety of habitats and contribute to important ecosystem services such as pollination and repression of pests and diseases. A well-functioning soil-sediment-water system adds long-term value to urban areas!

Stakeholders are citizens, authorities including politicians, water authorities, economical and urban development departments of municipality / province (in relation to ground ownership, land as a resource, land recycling, circular economy, SMEs and businesses, research and educational institutes.

Specific research questions:

Demand

- How do stakeholders become aware of the competition between the services of the soil-sediment-water system and the uses of subsurface space and the importance of involving both in decision making?
- How can we use scenario studies to anticipate future developments in urban areas?
- Which functions can be combined (in space / time) or reinforce each other in urban areas and which are competitive or make other functions impossible?
- How do we respond positively in terms of knowledge and innovation in the constantly new challenges that the urban soil-sediment-water system poses?

Natural capital

- What can the soil-sediment-water system contribute to circular cities (design and close cycles)?
- What is the value (monetizing / benefits for society) of the urban soil-sediment-water system and its services?
- Which soil processes are important for the delivery of services by the urban soil-water-sediment system (natural attenuation contaminations, water purification, climate buffering, prevention of heat stress, lower fine particulates in the air) and (how) can the functioning of the urban soil-water-sediment system be improved?

Land management

- What perspectives are there to involve the soil-water-sediment system in finding solutions to the challenges in urban areas?
- What impact have demographic and economic trends (decline and growth, land ownership) on the use and management of the soil-water-sediment system?
- How can soil and subsurface be balanced against other (environmental) topics (such as: water, safety, air, noise, ecology, economy, finance, spatial quality and societal challenges) in the development and management of u rban areas and how do soil and subsurface contribute to those other interests?
- How can the soil- sediment-water system be used when tackling challenges in urban areas? For example by:
    - Contribution of soil and subsurface to the transition of the urban water system
    - Contribution to climate-proof cities
    - Contribution to the energy supply of the city
    - (Ecological) concepts for sustainable land use planning, cycles
    - Better alignment of spatial planning of surface and subsurface

- What are opportunities for geo- and eco-engineering in urban areas?
- How can 4D planning (x, y, z, and t) be achieved with a balance between use of the soil-sediment-water system and the subsurface space in urban areas?

Net impacts

- Which (new) threats to the quality of the urban soil-sediment-water system can be expected in the coming decades and what costs do they involve?
- How does the soil-sediment-water system interact with the (intended) land use?
- What is the impact on health and environment quality of the (non) use of the urban soil-sediment-water system and its quality?
- What are the (measurable) effects of ecological and building-with-nature concepts, spatial planning based on green-blue structures and the use of ecosystem services to the societal challenges in urban areas?
- What are the benefits (to society) of using the urban soil-sediment-water system, how can costs benefits be distributed and is it possible to control costs in time and per stakeholder (mutual gain approach)?
- In what way can trade-offs be made between the soil-sediment-water system and the artificial urban system?

NL-6: Mobility and transport

Increased population density goes hand in hand with increased demand for mobility. This is not just transport of people, but also of utilities and transport of goods. This asks for (above and underground) infrastructure. For transport of people and goods this means railways, roads, waterways and infrastructural facilities around them, such as parking garages, stations and transfer points for goods. Important here is the interaction with the soil-sediment-water system to maintain the function of the infrastructure. A different category is the, mainly subsurface, transport of substances such as gas, (waste) water, oil. These are transported by different kinds of pipes. Electricity is transported by cables. Also these cables and pipes have some aboveground facilities connected to them such as electricity substations. An important challenge here is the subsurface spatial planning. Urban soils are spaghetti of cables and pipes. Old cables are not automatically removed, in many cases their location is unclear and there are not always rules on how to arrange cables and pipes in the subsurface. Also cables and pipes are influenced by the local circumstances of the soil-sediment-water system (both chemical and physical). In terms of asset management this can be very determining.

Specific research questions:

Demand

- What is, in the context of sustainable transport, the role of the subsurface for infrastructure networks (from main to minor infrastructure)?
- What factors and arguments can be used when making decisions on the construction of aboveground or subsurface infrastructure? Is preserving the qualities of the soil-sediment-water system a factor? How can these arguments be used when making trade-offs?

Land management

- What is the condition of subsurface infrastructure and what this mean in terms of replacement and removal of unused cables and wires?
- What techniques can be developed for sustainable civil engineering (building with nature, building on soils with low carrying capacity, nuisance-free civil engineering at the surface and in the subsurface)?
- What innovations are possible for managing, measuring and monitoring of subsurface infrastructures?
- What function combinations in road construction and maintenance and ecosystem services are possible?

Net impacts

- What are interactions between soil-sediment-water system and construction of, and existing, aboveground and subsurface infrastructure, now and in the future?
- Do interventions for the purpose of mobility and transport disturb the balance between the potential of the soil-sediment-water system and societal needs? How can these

disturbances be characterized and what does this mean for the quality of the soil-sediment-water system?

- What are positive and negative interactions between subsurface infrastructural developments and the soil-sediment-water system, and what can we learn from these interactions for future infrastructural developments in the subsurface?

NL-7: Soil quality

In the next few years, the Dutch soil remediation operation comes to an end. Many sites are investigated and remediated, including most of the urgent sites. The next step is the management phase, aimed at contaminations that cannot be excavated, and that have a risk to spread. This phase focuses on innovative management of these sites, e.g. on the application of different in-situ techniques and risk-, area-based management of contaminated groundwater. The soil protection act and all underlying instruments will be integrated in the Environment and Planning Act. Expectations are that the Environment and Planning Act will be empowered in 2018.

Currently, the major responsibility for soil (and soil includes groundwater) is being decentralised. In the Environment and Planning Act, “care for good soil quality” will be integrated in “care for the environment”. There is now more awareness that soil quality is more than complying with standards for chemical substances. It is also a measure for the sustainable functioning of ecosystems (ecological, chemical en physical quality), “fitness for use” and soil protection.

The link with spatial development is vital to the future of soil remediation in the Netherlands, as new ways of soil usage will initiate additional funding for remediation activities, especially if these can be combined with another land use, e.g. aquifer thermal energy storage (ATES). Soil remediation unrelated to spatial development is becoming redundant and is replaced by sustainable land management. The main transitions in soil management and the scope for soil quality are:

- from central (national government) to decentralized (municipality)
- from sectorial (soil) to holistic (environment)
- from protection to sustainable use
- from soil remediation to land management
- from standardizing (comply with standards) to ambitions
- from clean to fit for use
- from chemical quality to “overall” quality
- from controlled and known contaminants to new contaminants and threats
- from current use to future use

This is all work in progress. Although the research needs is changing, it is important to maintain the knowledge base on soil remediation in the Netherlands. A strong and innovative soil sector remains significant. Dealing with historic contamination is still on the agenda, mainly in terms of organisation and financing. Also new contaminants pose possible risks. In practice, it can be very difficult to comply with national and European regulation. Sustainable transformation from brownfield to productive land is a challenging topic. This all asks for research efforts.

Specific research questions:

Demand

- How can soil quality management and care be connected to other topics such as climate adaptation, reuse and redevelopment of brownfields?
- How can soil protection contribute to the protection of strategic groundwater resources?

Natural capital

- Which (new) contaminants remain a (potential) risk to health (drinking water) or ecosystems?
- What entails the presence of substances alien to the system for the quality and resilience (biological control) and other qualities and functions of the soil-sediment-water system?
- How do soil, sediment and water and the substances inside interact (soil-sediment-water system)?
- What is the potential of the soil and subsurface to produce medicine or for natural attenuation of contaminants and how can this potential be deployed?

Land management

- How do we deal with (new) contaminations in groundwater and drinking water (measuring, monitoring and remediating, fitting it into the existing structure of the management of clean and slightly contaminated soils)?
- How can the "governance" of soil quality care be improved in terms of organization, after-care, professional commissioning, organization, law enforcement and supervision?
- What tools are needed to support the new soil quality care (including soil protection)?
- How can contaminated land / remediation be combined with other activities and contribute to area ambitions?
- How can dredging and earthmoving become more sustainable?
- How can the reuse of brownfields (economic, social, cultural) be encouraged?
- How can landfills be considered in land management and regional planning?
- Which (new, innovative, sustainable, (cost) effective) remediation and monitoring techniques can be further developed?

Net impacts

- How to assess risks of changing use of soil, water and land connected with the quality (more unsealed soils, swimming in canals with clean water, but contaminated sediment)? And what do these risks mean in relation to the societal needs?
- How can we integrate risk assessment of soil and groundwater contamination in risk assessment for the overall environment?
- How can results (efforts) of soil quality care (continuous improvement) be monitored (which indicators)?

NL-8: Energy supply

Sustainable and secure energy supply is an important condition for the prosperity in our country and it is high on the political and societal agenda.

The Netherlands provide partly in their own energy through indigenous subsurface fossil fuel production (natural gas and oil). Part of the electricity is produced in the nuclear plant in Borssele. These resources are finite and result in CO_2 emissions to the atmosphere, thus increasing the concentration of greenhouse gasses which has consequences for global climate. For the last 50 years the Netherlands has been self-sufficient in the production of natural gas and also exports a considerable annual volume. This has been very beneficial for the State budget, but most fields are in decline and the expectation is that the Netherlands will be a net gas importer within 5-10 years. In addition, lack of societal acceptance for subsurface activities starts to become more and more dominant in the energy discussion. An example is the impact of tremors in the North of the Netherlands induced by extraction of gas, which causes a further reduction of annual production.

At the moment, the energy supply is in transition, and although the current share of renewable energy is with 5-6% almost the lowest in the EU, the amount of renewable energy sources increases. The aspiration is that in 2030 9- 53% of the energy resources used in the Netherlands are renewable (consisting of wind, bio and solar energy). other sources can be recycled industrial heath, hydro power and energy recovery from waste. Both the 'Renewable Energy Directive' and the development of a biobased economy will lead to an increased demand for biomass as a source for energy. (The consequences are further elaborated under agriculture and food.)

The subsurface can still play a role in the energy transition by supplying sustainable energy. via aquifer thermal energy systems (ATES), and geothermal energy.. These are however not the only opportunities that the subsurface offers. Subsurface storage of CO_2 (CCS), or the storage of natural gas produced abroad in empty gas fields or storage of radioactive waste in salt caverns are subject of investigation. Although momentarily not a popular subject, also unconventional gas winning (shale gas) is one of the alternatives to derive natural gas. The spatial planning of activities in the deep subsurface (winning, storage) will be part of the Dutch strategy for subsurface planning "STRONG".

The Netherlands have an intensively developed near-surface infrastructure for energy transport and has ambitions to become the "gas roundabout" of Europe. This also requires thorough spatial planning, taking into account local chemical as well as physical shallow subsurface conditions (see also mobility and transport).

In short: using the soil-sediment-water system for energy purposes asks for thorough system knowledge, in order to avoid and/or mitigate reverse effects. The energy transition has spatial impacts, both aboveground and in the subsurface, which need to be considered when making choices.

Specific research questions:

Demand

- How can a good discussion be organized on the desirability of the various existing and new energy functions in the (deep) subsurface (geothermal energy, shale gas, gas storage, etc.) and how to create public support?
- How can choices be made between different types of energy production (necessity, sustainability, costs and benefits, risk impact and acceptance)? Which assessment method is suitable and widely applicable?
- How can a positive business case be made for the use of 'new' energy functions that make use of the?

Natural capital

- What potential has the subsurface in the transition towards sustainable energy supply? What does the energy transition entail for the use and functions of and in the subsurface?

Land management

- How can decisions in spatial planning be made in relation to energy functions (production, transport and storage) in the subsurface or aboveground (interference - competition - exclusion of functions and effects of interventions and / or use horizontally and vertically and through time))?
- How can we better employ the potential of the subsurface for sustainable energy?
- What are opportunities for function combinations (eg. ATES - remediation of groundwater)?
- How can energy be stored and transported efficiently and sustainably using the subsurface and which technological knowledge is needed?
- How can negative effects / consequences (renewable, irreversible, manageable) for different types of energy production be mitigated?
- How can the roles and collaboration of the market, governments, research organisations and citizens be optimized for new energy functions in the subsurface?

Net impacts

- What impact has the energy mix on surface and subsurface in terms of land use, effects (earthquakes, soil subsidence), safety, management of groundwater resources, etc.?
- Which interactions between soil-sediment-water system and energy production exist at different spatial and temporal scales (quantity, chemical quality, physical, geotechnical, microbiological)?
- What is the impact of "new" energy functions on the soil-sediment-water system and what does this entail for the soil-sediment-water system and societal challenges?

NL-9: Resource efficiency

Many natural resources become scarce. There is a worldwide trend of increased consumption due to population increase and higher living standards. Because of these developments, sustainable use of resources (including land!) is high on the agenda in in the Netherlands as well as in Europe and the world (examples: UN Sustainability goals[14], Resource efficient Europe[15], Land as a resource[16], Circular Economy Strategy[17]).

The Dutch sub-surface supplies resources such as sand, gravel, clay, salt, oil and natural gas, soil and geothermal energy (see sustainable energy supply) and water (see water). The shallow extraction of resources (peat and brown coal in the past, currently still sand, clay and gravel) influence landscapes strongly. Extractions (shallow and deep extraction such as salt) also leave space that can be reused or redeveloped. Resource extractions highly influence the soil-sediment-water system and its ability to deliver ecosystem services[18]. This asks for system knowledge. The changes in landscape and its effects need to be considered and mitigated.

Authorities on different levels focus on resource efficiency by investing in circular economy, the food, water, energy nexus and possibilities to facilitate the re-use of (secondary) building material (soil, sediment). Companies and industry incorporate their resource use in their long-term strategy by reducing the use of natural resources (re-use resources and technical innovations to lower in- and outputs). Moreover the dependencies of industries on their surroundings (especially water availability) are important factors determining the location of a business. The reuse of building materials is not only interesting for the building sector. The use of secondary building materials reduces waste production and avoids the use of natural resources. Making this cost-effective is the challenge.

The application of sediment a resource needs better regulation internationally. For sediment a short narrative was given.

Narrative: shortage of sediment – so what

Worldwide natural sediment transport is seriously obstructed by human interventions such as damming, river training, dredging and dike construction. Thus some sites are overloaded, while others experience a shortage. Excess of sediment hampers the transport function of river systems (both water and navigation). Moreover, reduction of drainage, results in risks of flooding.. Sediment shortage causes river bed incision and bank erosion, resulting in loss of land and undermining and collapsing of bridges and dikes. It also deteriorates fluvial ecosystems by draining and drying out floodplains and wetlands. Furthermore, delta's, wetlands, lagoons and estuaries need sediment to be maintained. The following research question can be defined for this theme:

[14] https://sustainabledevelopment.un.org/?menu=1300
[15] http://ec.europa.eu/resource-efficient-europe/
[16] http://ec.europa.eu/environment/land_use/index_en.htm
[17] http://ec.europa.eu/environment/circular-economy/index_en.htm
[18] Although rare earth materials and uranium are of importance for the Netherlands, and the demand here has effects on other locations where they are won, they are not taken up in the research questions.

Demand: Describe the role of sediment in river systems and quantify the societal costs and benefits of the amount of sediment present in the system, taking into account cross boundary issues as well as costs and benefits for local communities
Why: This underpins the importance of this issue, i.e. provides the arguments to see sediment management as a true societal challenge.

Natural capital: Gain better insight in sediment related ecosystem services (ES) especially where they can help address societal challenges and thus to raise awareness of the key role that sediment plays (i.e. ES provided) for society.
Why: This is the key to raising awareness of the societal importance of sediment.

Impact: Improving the process understanding – and improvement of sharing of that understanding – of the connectivity of sediments between Land-Soil-Sediment-Water Systems and of the interaction of erosion, sediment transfer, deposition, remobilization and yield (i.e. sediment balance).
Why: The better we understand, share and exploit the available understanding of the functioning of natural river-delta-sea systems – and especially the role of sediments (balance) therein – the more effective our sediment equilibrium restoration measures will be.

Land management: Developing/testing/demonstrating 'Working-with-Nature' kind of solutions to get sediment from overloaded sites (such as reservoirs) to areas where there is a sediment shortage (or use for solving other societal challenges, like soil subsidence).
Why: This is probably one of the most urgent and rewarding challenges to address.

Specific research questions:

Demand

- What is the necessity of resource exploitation for the long term (future scenarios for use of resources taking into account self-sufficiency, geopolitical dependency, national and international scarcity, footprints, circular economy and transition to sustainable energy)?
- How do we contribute to reuse of materials / circular economy?
    - Is a "material passport" effective? For what purposes? What to consider when designing materials for reuse?
    - How can sediment and (fertile) soil be reused in a safe and cost-effective manner?
    - What is the potential from landfill-mining and other waste products in the subsurface?
    - What technological knowledge is required in the recovery of resources from waste and contaminated soil?

- What determines the choice of the use of primary and secondary materials in the construction and civil engineering sector?
    - How can secondary building materials be better used (higher in the chain) to reduce mining of primary building materials?
    - What secondary building materials are released in the future (eg by demolition) and what is their impact on the mining of primary building materials?

Natural capital

- What can the soil-sediment-water system and land use contribute to circular economy, where ecology and economy enhance each other eg. by closing cycles of soil and water?
- What is the sediment balance on different scales? Where are shortages and surpluses? What are the effects on society?
- How can the soil-sediment-water system contribute to lower the input of resources in an urban, industrial and agricultural setting?

Land management

- How do we make spatial trade-offs between different land uses (including extraction of resources) and how can the use of ecosystem services be optimized?
- How can we strengthen the landscape with, or share in revenues from resource exploitation?
- What decisions need to be taken in the soil-sediment-water system, land management and laws and regulation to better cope with sediment quality and quantity?
- How can we salt caverns be used in a safe way?

Net impacts

- What are interactions between soil-sediment-water system, landscape and resource exploitation?

NL-10: Governance

Asking more holistic questions, as is needed when tackling societal challenges, requires for understanding of, and sometimes changes in the governance system. Policies and regulation are currently quite sectorial, although this is changing in the Netherlands with the implementation of the Environment and Planning Act (expected 2018). This requires other or additional arrangements and collaboration.

Dealing with **safety and health** issues is important within the scope of INSPIRATION and poses challenges in the field of governance. For example: new and intensive land use functions in the shallow or deep subsurface can cause risks for the soil-sediment-water system and safety for health and environment. It is important to know who is responsible for which aspects in terms of safety. In some cases this can be the (national or regional or local) authority. In other cases this is the citizen.

Dealing with uncertainties when working with the soil-sediment-water system also poses challenges in terms of governance. The effects of interferences in the soil-sediment-water system are not always predictable and/or known. Also trends as climate change, intensification of agriculture, demographic changes cause insecurities. By listing the insecurities it is possible to anticipate on them. Risk management is an instrument that is suitable for developing robust policy as well as robust spatial plans and management. Risk-based and adaptive practices are valuable here.

Specific research questions can be all clustered under **Land management**:

- Soil as “common”: how can we effectively implement air-water-soil when tackling societal challenges if we do not own them?
- Which policy choices and regulation are impediments to realize sustainable soil and land use in practice?
- How can we convert from a control model to an adaptive model when managing space?
- How do we rank priorities of subsurface activities when they are competing for the same space?
- How to deal with “game changers” (new policy, knowledge, scandal, disaster etc.)?
- What knowledge is needed to develop risk management and related measures?
- How can we effectively work on holistic issues such as area-based groundwater management (with both generic and specific knowledge, “T-shaped knowledge” and with attention for made-to measure activities and the right processes)
- How can we use pilots when making policy to avoid mismatches between policy and practice?
- How can we bring the application of green-blue structures from paper to practice?

NL-11: Knowledge base

This topic includes the knowledge that stakeholders have or need to use land and the soil-sediment-water system in a sustainable way. When working on societal challenges, both specialist knowledge is needed as well as the skills to connect this specialist knowledge to the broader context of the challenges. Both the science-policy-interface and securing and exchanging knowledge are important aspects. Researchers and end-users together need to translate challenges to research questions en science to practice. The client should be able to understand what he/she needs to know, where to find it and how to phrase research questions. Specific research questions can be all clustered under **Demand**:

- How do businesses, governments and citizens keep the knowledge about the soil-sediment-water system and land use at a sufficient level (knowledge management, training, collaboration)?
- How does new knowledge land in policy?
- How can we learn from experiences and knowledge from abroad?
- How to organize effective learning processes?
- How are participants with "bottom-up" initiatives provided with the correct information (eg. urban agriculture / soil quality) and how is ensured that the knowledge from these initiatives reaches others?
- What is needed for awareness and education about the soil-sediment-water system (eg. international year of soil, soil and water education, GLOBE[19])?

[19] http://www.globe.gov/do-globe/globe-teachers-guide/soil-pedosphere

NL-12: Soil-sediment-water system knowledge

The soil-sediment-water system may contribute to tackling societal challenges. System knowledge is needed to know the soil-sediment-water system's potential to deliver services or functions and to maintain and restore the quality of these. System knowledge enables us to predict and assess the effects of disturbances and measures. It is important to be aware that "the system" has besides a qualitative dimension also a spatial and a temporal dimension. Effects can appear (much) later, or on other places than when the disturbance took place. Specific research question are:

Natural capital

- How does the soil-sediment-water system work and what does this mean for different types of land use?
- What is the connectivity within the system Chemical, biological, physical?
- How can the soil-sediment-water system being monitored to obtain a better understanding of the functioning of the system?

Land management

- What is the combined effect of small scale disturbances and measures on the total functioning of (water /subsurface) system. What does this mean for the potential of the soil/water system to contribute to addressing societal challenges?
- How to deal with scales and delineation of systems in relation to system knowledge?

Impacts

- How does the natural system contribute to societal development?
- What are the 4D (x,y,z and t) effects of land use and interferences in the natural system?
- What is the flexibility of the soil-sediment-water system in relationship to disturbances?

NL-13: Valuation of the soil-sediment-water system (ecosystem services)

The subsurface provides goods and services to man and the society and thereby represents a natural capital. Examples of these ecosystem services are clean drinking water, soil fertility and climate regulation. The economic value of these services delivered in and on the subsurface is important in valuation of our natural capital. Ecosystem services are a way to translate the biological, physical, chemical and socio-cultural value of the soil into values that may be used in cost-benefit analyses etc.. One of the research questions that re-appears under the different societal challenges irols how to value this natural capital. Criteria such as scarcity (global and local) and permanent versus temporary damage to the soil-sediment-water system play a role in the discussion. Underneath a short narrative is given on sustainable use of ecosystems.

Narrative: sustainable use of our ecosystems

Ecosystems deliver goods and services that are of crucial value for mankind, and should therefore be managed in a sustainable way. To achieve this, it needs to be explained what natural capital and ecosystem services are and what they mean to us.

Natural capital and ecosystem services can be used in assessing land management options such as functions in groundwater, resource use (sand, gravel etc.). Different scenarios should be investigated for a long term period.

Better understanding of the soil-sediment-water system is the basis. We can make use of the existing knowledge and develop new knowledge where needed. Many stakeholders can benefit of knowing and using natural capital and ecosystem services. National and regional authorities, business and industry (agriculture food, chemical industry, drinking water companies etc), water authorities, NGO's etc.

There are already examples of public-private partnerships that work together and are take care of the environmental quality of an area to ensure continuity of business and interests of other stakeholders.

Using natural capital and ecosystem services pays off and is therefore interesting for many parties. Making the benefits explicit helps to get the focus of stakeholders on this subject.

Specific research questions:

Natural capital

- What is the (main) contribution of the soil ecosystem to natural capital and which are the system characteristics determining this?
- How can we optimize or recover system characteristics features?
- Is organic matter such a system characteristic (role of organic matter for soil functions: soil fertility, infiltration, carbon storage, filtration, soil resilience)?
- What is the significance of soil (life) for societal challenges?
- What can be an indicator for good soil quality and can it used for communication, monitoring and threshold value?

Land management

- How can the ecosystem be used in a sustainable way (from "to knowing what it has to offer," implementation through building concepts with nature concepts and eco-engineering, to ending use and recovery)?
- What are the possibilities for ecosystem services and how to value, optimize and cash these possibilities?
- How can companies / industries provide services with their soil-sediment-water system / land surface for the surrounding area?

NL-14: Data and information

The availability of reliable and up-to-date data is crucial when making spatial plans and working on the soil-sediment-water system. The data can be about the state and functioning of the soil-sediment-water system and the functions that are already in the subsurface (ATES systems, cables and pipes, archaeology etc) These data should be enclosed in a way that they are available on the right moment in a format that connects to the tasks of the user (eg. decision making in spatial planning).

With new media and technologies, enormous amounts of data become available. By combining and analysing of these data, it is possible to come to new understanding, concepts and strategies. Big and open data offers for soil and subsurface potentially many opportunities. Use of data has also some points of attention such as privacy, advisability to make data public, formats, reliability, semantics and correct use. Specific research questions are:

Land management

- What means big data for the field of the soil-sediment-water system and land use, for different stakeholders?
- How to get a better match between / unambiguous information within national portals such as the “information houses” at the “avenue of the environment”, and “atlas natural capital” (informatiehuizen aan de laan van de leefomgeving en atlas natuurlijk kapitaal (ANK)?
- How can we improve data(availability) for monitoring and modelling?
- How can we improve recording, exchange and use of data of the soil-sediment-water system on a national and European level?
- How can data of the soil-sediment-water system be translated into information that helps in the decision making process?
- What is the scale of information needed for proper land management?
- What can observatories (landscape observatory, soil observatory) contribute in terms of usable data and knowledge?
- How to enclose the data and information outside the “basis registration subsurface” (BasisRegistratie Ondergrond BRO) (nature, water, climate, soil biology, etc.)?

NL-15: Land-use

Land use aboveground and the biological, chemical and physical status of the subsurface influence each other. This extends to the visible, known or unknown heritage values of the land. It is necessary to get more insight in these influences to be able to make spatial choices and to tune land use and the natural and cultural system in a sustainable way.

On a larger scale, there is a need to investigate how land ownership and economic drivers influence the land use and land management in the Netherlands. For urban areas themes such as “land grabbing”, urban sprawl, and therefore subsurface themes such as soil sealing are of importance. Soil sealing is seen as an important soil threat, which has a substantial degrading effect on the natural subsurface system. For rural areas landownership and economic drivers are largely determining how the land is managed (see topic NL-1 agriculture and food). At this moment a territorial vision of future land use (Omgevingsvisie) in the Netherlands is being prepared. This vision should address the distribution of urban and rural areas, the preferred location of the various land use functions, including farming systems, and the required role of subsurface functions and ecosystem services in relation to land. To develop such a vision, the position of the Netherlands within Europe and the world is of importance, in relation to food, feed and fibre markets, but also in relation to landscape characteristics and attractiveness, both for residents and visitors and newcomers. Specific research questions are:

Demand

- What is the vision on the use of space in the Netherlands (this vision needs to address sustainable urbanization, the future of the agricultural sector, the role of landscapes and the place of subsurface functions (and ecosystem services) in relation to land)?

Land management

- Which (location) specific ecosystem services can be deployed to realize land use functions in an area and what are possibilities here of eco-engineering of building with nature?
- What does “optimal land use” look like?
- How can we give solid input to discussions around sustainable land use, looking across sectorial and disciplinary boundaries and with due consideration of possible futures?
- How to deal with land ownership in relation to our vision on sustainable land use?
- How can we optimise sustainable land use, (also) based on soil qualities on different spatial scales?

2.4 Experiences regarding connecting science to policy/practice

In the following sections are based on 16 interviews with National Key Stakeholders (NKS). They elaborate the experiences that the interviewed NKS have regarding science to policy and practice.

2.4.1 Use of scientific knowledge

'Scientific knowledge' can be defined in different ways:

"K*nowledge that contributes to understand "how things work", "Facts, numbers, statistics, process descriptions and experiences*"; "*Knowledge that is developed on scientific principles, and fundamentally or experimentally determined*"; "*Knowledge to solve problems*" or "*Factual knowledge*".

The difference between fundamental, strategic and applied research is broadly known and used in the Netherlands. The trend is that the focus of research shifts towards applied research, which can cause a gap on the side of fundamental research, which is expressed as a concern.

Many sources for scientific knowledge are used. Especially the more 'personal' ways to get knowledge are mentioned more frequent: own experience in research projects, colleagues, national and international experiences/examples. Knowledge "in people" is very valuable. Also more traditional ways for knowledge dissemination such as scientific articles and conferences, and reports and websites (www.soilpedia.nl, www.natuurlijkealliantie.nl, www.EUGRIS.org, EU portals, websites of research institutes) are mentioned.

It was stressed that knowledge exchange by reports is in some cases out-of-date. Serious gaming is mentioned as an alternative. We can learn here from universities that have knowledge transfer as core business.

Most NKS use (in higher or lower extent) scientific knowledge. They value knowledge to make well-founded choices in practical situation and for policy. Scientific knowledge is in the Netherlands certainly used for policy making. Co-creation between scientists and policy makers is mentioned as an effective method. However, in many cases the link between science and policy can be improved. As obstacles are mentioned:

- The value or credibility that is attributed to research
- Time span of programming. Urgent questions (short-term) get the research money
- "*Knowledge gives the policy maker what a lamppost gives the drunk: no light but support*"
- Difficulty to formulate the right questions. The dialogue between science and policy needs to be improved
- Research attitude is missing "*Policy makers search for answers and not for questions*"

2.4.2 Possibilities to set the agenda

The ability to influence research agendas differs per party. Many parties are involved or have the ability to join the conversation in the Netherlands. But as mentioned: "*To get something on an agenda is easier that to get something under the attention*." The latter is more important. A research program should be well designed, facilitating coherent, long term research. Linking research questions to societal challenges works well to get it on under the attention. For industries it is harder to set the research agenda, because they could be suspected to influence results.

The Dutch national policies/agendas reflect to a reasonable extent specific needs and priorities of different national parties. Sometimes it needs some time. Good examples and a good story work very well: "*show & tell*". However, there are more agendas than there is funding for research.

2.4.3 Science – policy – practice

Many of the NKS have been involved in doing scientific research, the formulation of scientific research questions and synthesizing/wrapping-up of scientific knowledge eg. for policy making. The lessons learned are:

- Practice When science needs to be used in practice, it is advisable to use the practical situation as a starting point, otherwise the scope of research will be too broad.
- Time Also it is important to have sufficient time. It needs investments in terms of time and effort to get knowledge to practice. The time scale between research (long term) and government (short term) is different and should be matched better.
- People The right people need to be involved: experts, visionaries, managers. People are the backbone of the knowledge field. The role of researchers and policy makers in the science-policy interface can be improved. The researchers also need to translate the results of the research to an interpretation that is valuable for policy. They can also help formulating the right question. Policymakers must look beyond the answers they need to do their job. They should adopt a helicopter view, looking over the boundaries of their field and to the problems and challenges behind the "now and here" questions. This enables them to ask the right questions to research.
- Trust To get research in practice, all parties must trust the outcomes of the research

Apart from the above discussion, many NKS emphasize the attention for fundamental research. In the Netherlands the trend is to focus on more short term results, applied research for direct questions. "*There are two knowledge cycles. One to go from nothing to something and one to go from something to something better*." The first cycle gets not enough attention. This has as a result that no new knowledge will be developed.

The Science-Policy-Interface documents that were recommended are listed in annex II.

2.5 National and transnational funding schemes

2.5.1 Funding schemes and possibilities for research funding

	Name*	Research and Innovation funder**	What and/or whom do they fund?***	More info****
Regional				
1	new collaborations /co-creation	public and / or private parties	Many parties have some budget and the same questions. Join forces.	N/A
2	Networks / COPs / living labs	They more facilitate parties to work together (and pile different financial inputs of different parties) than that they have own money to fund research Examples 1* SBRCURnet (on built environment) 2* Platform31 (on cities and regions, spatial planning) 3* Railforum (on knowledge for rail infrastructure) 4* Nudge (on sustainability)	case specific / depending on topic / parties involved	1* http://www.sbrcurnet.nl/ 2* http://www.platform31.nl/ 3* http://www.railforum.nl/ 4* https://www.nudge.nl/
3	research collaboration within regions	They more facilitate parties to work together (and pile different financial inputs of different parties) than that they have own money to fund research Examples: 1* AMS - Advanced Metropolitan Solutions 2* Knowledge centre Healthy Urban Living 3* USI - Utrecht Sustainability Institute	case specific / depending on topic / parties involved	1* http://www.ams-amsterdam.com/ 2* http://www.kchul.nl/ 3* http://www.usi.nl/

4	Public-private collaboration such as:	public-private collaborations	case specific / depending on topic / parties involved	eg: https://www.government.nl/topics/public-private-partnership-ppp-in-central-government
	Citydeals	public-private collaborations between cities and urban regions (also across borders)	case specific / depending on topic / parties involved	http://agendastad.nl/
	Greendeals	public-private collaborations between business and industry, governments, research partners and societal initiatives	case specific / depending on topic / parties involved	https://www.rijksoverheid.nl/onderwerpen/duurzame-economie/inhoud/green-deal
	Name*	Research and Innovation funder**	What and/or whom do they fund?***	More info****
5	Social / sustainability funds / pension funds	These funds are interested in investments that give long term revenues. Examples: 1* ABN Amro Social Impact Fund	case specific / depending on topic / parties involved	1* https://verdermetfinancieren.abnamro.nl/soorten-financiering/abn-amro-social-impact-fonds-investeert-in-sociale-ondernemingen/
6	Crowdfunding	"the crowd": companies, citizens,	Initiator of the (research) project. Crowdfunding is difficult for research projects (easier for development of products). A very clear research question /objective and contact with the crowd is needed	examples on http://www.crowdfunding.nl/
7	Revolving funds	different funds. Examples are: 1* Housing corporations	Labelled money. The investment should give revenues. The difference with an investment fund is that it should serve a public goal.	
8	Project based research	public and / or private parties	Ad hoc/ made-to-measure research	N/A
9	research / innovation budget Industries / large companies	Most industries have own research funding /innovation budgets	case specific / depending on topic	N/A
10	research / innovation budget Decentral authorities	Many decentral authorities have their own innovation / research budgets	case specific / depending on topic	N/A

National				
1	HABIFORUM / BASIC		program for front runner research on spatial planning, area development (1999-2009, program closed). Given as example for financing constructions.	http://kennisbank.platform31.nl/pages/27127/Habiforum.html
2	B-Basic BioBAsed Sustainable Industrial Chemistry	financed with public (natural gas benefits) and other parties (universities and research institutes	program for front runner research on biotechnology (program closed). Given as example for financing constructions.	http://www.tudelft.nl/nl/actueel/laatste-nieuws/artikel/detail/groen-licht-voor-miljoenenonderzoek-industriele-biotechnologie/
3	SKB (Stichting Kennisontwikkeling Kennisoverdracht Bodem) (formerly known as NOBIS (Nederlands Onderzoeksprogramma Biotechnologische In-Situ saneringen))	partly funded by SKB (public money) and for each project cofinancing was needed (=/- 50%)	program for research on soil (1995-12014, program closed), with open tenders, first on remediation, later on broader soil themes (planning, energy, groundwater, agriculture). given as example for financing constructions. this program does not exist anymore.	http://skbodem.nl/
4	KIBO knowledge and innovation program soil and subsurface	public money (ministry of Infrastructure and the environment) and for each project cofinancing is needed (=/- 75%)	open continuous call for businesscases with public and private parties and research parties, on topics that are in the Dutch research agenda for the subsurface	https://www.rijksoverheid.nl/onderwerpen/bodem-en-ondergrond/inhoud/ruimtelijke-ordening-ondergrond
5	Money related to national tasks and dossiers	The ministries have their own innovation / research budgets related to dossiers Such as Soil Protection Act: Wbb transition money, RWS Corporate Innovation Program, Policy supporting research (BOA)	case specific / depending on topic	
6	STOWA (Foundation for Applied Water Research)	Collaboration between water authorities	demand-driven water research. Space for innovative ideas. Open for different parties: case specific / depending on topic	http://stowa.nl/english/

7	Fundamental research of universities	Most of this research is financed by society (public money)	Universities. Back bone for knowledge development: needed to maintain knowledge base	
8	3rd flow of funds (universities)	public, private, with industries and governments	project oriented research for universities: budgets can be substantial	
9	NWO - Nederlandse Organisatie voor Wetenschappelijk Onderzoek (Dutch Organisation for Scientific Research)	NWO finances research projects on universities and research institutes	different subjects and different financing instruments. Eg: universities can finance PhDs en postdocs with NWO	http://www.nwo.nl/
10	Applied research of research institutes	Most of this research is financed by society (public money)	Research institutes Back bone for knowledge development: needed to maintain knowledge base	
11	Topsectors	ministry of economic affairs	Financing of research in "businesscases" to strengthen the Dutch research sectors by excellent research. Government, industry, universities and research institutes work together here on research and innovation (relevant topsectors: Agri&Food, Water and Energy, chemistry, horticulture, Life science and health). The topsectors set the research agendas.	http://topsectoren.nl/ http://topsectoren.nl/documenten/topsectoren/Topsectors-in-the-Netherlands_English_2015-10-27_267.pdf
	TKI - top consortia for knowledge and innovation (under topsector)	ministry of economic affairs	The TKIs are implementing the research agendas of the topsectors in public private collaboration between research organisations and business community	http://www.rvo.nl/subsidies-regelingen/tki-toeslag

	Name*	Research and Innovation funder**	What and/or whom do they fund?***	More info****
12	NKWK - nieuw kennisprogramma water- en klimaatinnovatie (new knowledge program for water and climate innovation)	RWS, business and research organisations	public private collaboration between research organisations, business community and authorities	http://www.rijkswaterstaat.nl/over-ons/nieuws/nieuwsarchief/p2015/05/NKWK-nieuw-kennisprogramma-water-en-klimaatinnovat.aspx http://www.nkwkstartconferentie.nl/
13	Partners for International Business (PIB)	Ministry of economic affairs	Aimed on Dutch parties to work with partners abroad. Funding aimed at: Promotion and matchmaking Knowledge exchange and networks Economic diplomacy	http://www.rvo.nl/subsidies-regelingen/partners-international-business-pib
European				
1	Horizon 2020 (and before EU Framework Programmes).	EU and private investments	EU Research and Innovation programme (2014 to 2020). Open for consortia, with different parties on different topics (eg societal challenges)	https://ec.europa.eu/programmes/horizon2020/
2	JPI - Joint Programming Initiatives	Member States commit to Joint Programming Initiatives (JPIs)	open for consortia of the contributing member states	http://ec.europa.eu/research/era/joint-programming_en.html
3	Interreg	financed by the European Regional Development Fund	helps regions of Europe share knowledge and transfer experience to improve regional policy	http://www.interreg4c.eu/
4	ERANET - European Research Area Network	instrument under Horizon 2020	instrument to support public-public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities as well as topping up of single joint calls and of actions of a transnational nature	http://ec.europa.eu/research/era/era-net-in-horizon-2020_en.html
5	LIFE +	instrument under Horizon 2021	EU's financial instrument supporting environmental, nature conservation and climate action projects throughout the EU	http://ec.europa.eu/environment/life/

6	SNOWMAN	SNOWMAN is a transnational group of research funding organizations and administrations in the field of soil sustainable management in Europe.	calls, open for parties of participating countries	http://snowmannetwork.com/
7	European structural funds	EU	Structural Funds play a substantial role to help all regions build research and innovation capacities corresponding to their situation and priorities.	http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=structural_funds
8	Revolving funds	different funds. Examples: 1* some european structural funds, eg JESSICA (Joint European Support for Sustainable Investment in City Areas)	Labelled money. The investment should give revenues. The difference with an investment fund is that it should serve a public goal.	1* http://ec.europa.eu/regional_policy/index.cfm/en/funding/special-support-instruments/jessica/
9	European subsidies	Eu	Eg. for agricultural sector, European rural development programs	
10	Wetsus, European centre of excellence for sustainable water technology	Wetsus is part of WaterCampus Leeuwarden. Wetsus is a facilitating intermediary and creates an environment and strategic cooperation for development of profitable and sustainable state of the art water treatment technology.	Infrastructure / research facilities are provided. Companies and research institutes from all over Europe that want to innovate join. Also the city and region participate (stimulating economic development of the region)	https://www.wetsus.nl/home/what-is-wetsus
International				
1	European Bank for Reconstruction and Development EBRD			http://www.ebrd.com/
2	Worldbank / Asian development bank etc.		Projects restricted to developing countries, although research organisations worldwide can participate	http://www.worldbank.org/ http://www.adb.org/
3	Rockefeller foundation			https://www.rockefellerfoundation.org

Overall comments:

The gap between fundamental and applied research was mentioned many times. There is more money now available for applied research. The sectorial character of the top sectors is also reason for concern. For some more integrated research it is difficult to get funding.

There is a lot of attention for business cases in the Netherlands. This can be very difficult money and there should remain attention for flexibility, innovation, seed money for good ideas. A lot of attention exists for involvement of small and medium sized enterprises (SMEs), because a lot of money goes on within SMEs: in total. Per organisation the amount is limited. Therefore, the flexibility for them to join a research initiative is also limited. They focus on continuity of their business and money spend should serve a direct goal.

2.5.2 Gaps in financial resources for research

The gaps as indicated in this section are resulting from 16 interviews with National Key stakeholders.

Topics that are not or insufficiently covered within research programs and funding possibilities, are obviously the aspects that are not directly linked to tasks or core business of organisations. If there is no direct ownership, topics are imminent to remain unaddressed, even though these “cross-border” subjects can give us interesting insights and impulses for innovations. We have to “brand” these aspects in a better way to get financing. Shrinking cities and soil subsidence are examples that were left alone for a long time in the Netherlands, but are now on the agenda after much effort. Aspects that need more attention:

- Land use and monitoring
- Landscapes
- Rural development
- Illnesses related to agriculture: e.g. Q fever
- Nature policy and legislation
- How to deal with invasive species.
- Integrated approach eg. needed for eco-Engineering projects
- Landfills in rural areas eg. possibilities for landfill mining / Biomass
- Soils and subsurface
- Radioactive waste (on a European level)
- Revision standards for soil classes
- Emerging contaminants
- Hormones in (drinking) water
- Trans-border issues

Programming and financing of research and policy are in the Netherlands (and also in the EU) still quite sectorial. This obstructs integrated research and approaches. For integrated research, collaboration should be sought. This takes a lot of effort. Ingredients are:

- Involve other fields of expertise
- Search for synergies
- Find ways to spend earmarked money to a broader project
- Make a good analysis in terms of people, planet and profit to communicate the benefits and needs of the research
- Show overall value
- Show who invests and who gets the benefits.

2.6 Other remarks made by NKS

Messages for the INSPIRATION consortium:

- Pay attention to the presentation and communication of the SRA. Pitches and stories work better than a 100 page report (multimedia presentation of the agenda?)
- Show paradoxes (food supply by up-scaled industrial agricultural verses the trend of more biological and local agriculture)
- Agendas can be demand / solution driven, but also inspirational and creative
- Incite the public with the SRA and relate the questions to possibilities for the stakeholders to take action
- Research strategies should be based on a shared vision of a future to be striven for. Such vision cannot be static but should at least allow to define pathways and no-regret measures to achieve the vision
- Pay attention to practical solutions and examples
- It is good to spend attention to innovation. We cannot steer innovation but pay attention to creation of a positive climate for innovation
- Pay attention to the position of women in science. In the Netherlands only 17% of the professors is female
- Make sure the NKS remain involved during the project. A platform where stakeholders can meet on a regular basis and reassess progress and objectives (a lot can change until the end of the INSPIRATION project)
- How can we show our strengths (research, knowledge, practice) on a national basis? Match strengths of countries to questions in other countries

2.7 Annexes

Annex I: NKS interviews and reviews in the Netherlands

Date of interview	Organisation	Interview	Reviewed:	funder	end user	knowledge provider	Nat.reg.loc. authority	Univ. research	SME /consultant	business industry	NGO	Net-work	other	soil	sedim.	water	land use-mngmnt
17-06-15	ProRail	Jeroen ter Meer & Paul van der Voort	Ch 17.3.2: NL-6	1	1					1				1			1
30-07-15	KIBO	David vd Burg	Ch 17.3.1	1			1							1			
30-07-15	IenM	Ruud Cino		1	1		1							1			
04-08-15	Nudge	Tieneke Breemhaar				1			1							1	1
06-08-15	SBR-CURnet	Geert-Jan Verkade	Ch 17.3.2: NL-5	1	1							1		1	1	1	1
06-08-15	Platform31	Jeroen Niemans	Ch 17.3.1		1	1						1					1
13-08-15	Bouw-campus	Han de Wit	Ch 17.3.2, ch 17.4		1	1		1		1		1		1			1
13-08-15	Waternet	Fred de Haan		1	1		1								1	1	
20-08-15	TCB /IenM	Joke van Wensem	Ch 17.3.2: NL-11, NL-12, NL-13	1		1	1							1			
26-08-15	RUG	Rien Herber	Ch 17.3.2: NL-8,			1		1						1			1

			NL-10															
27-08-15	SEDNET / RWS	Pieter de Boer		1	1	1	1					1			1		
31-08-15	VITENS	Johan Driessen	Ch 17.3.2: NL-3, NL-4		1					1						1	
01-09-15	TUD	Fransje Hooimeijer	Ch 17.3.2: NL-5			1		1									1
02-09-15	Nicole / TAUW	Laurent Bakker	Ch 17.3.2: NL7, NL14			1			1					1		1	
09-09-15	WUR	Bas Pedroli	Ch 17.3.2: NL2,NL-15			1		1						1			1

Date of interview	Organisation	Interview	Reviewed:	funder	end user	knowledge provider	Nat.reg.loc. authority	Univ. research	SME /consultant	business industry	NGO	network	other	soil	sedim.	water	land use-mngmnt
15-09-15	Prov Brabant	Jaap Harthoorn	Ch 17.3.2: NL-1, NL-2, NL-3, NL-7	1	1		1							1	1	1	1
11-12-15	Gem. Utrecht	Henk vd Berg		1	1		1							1			1
18-01-16	STOWA	Michelle Talsma	Ch 17.3.2: NL-3, NL-4	1	1		1									1	
28-01-16	IenM	Jan van Schoonhoven		1	1		1										
N/A	Nicole	Paul van Riet	Ch 17.3.2: NL-7	1	1	1				1		1		1			1
N/A	ZLTO	Harry Kager	Ch 17.3.2: NL-1,NL-2	1	1							1	1	1		1	1
N/A	PBL	Maria Witmer	Ch 17.3.2: NL-1,NL-2			1	1							1	1	1	1
N/A	Gemeente Nijmegen	Henk Jan Nijland	Ch 17.3.2: NL-5, NL-6, NL-7	1	1		1							1		1	1

N/A	RIVM	Ton Breure	Ch 17.3.2: NL-8, NL-9			1		1						1		1	
N/A	Provincie Zeeland	Walter Jonkers	Ch 17.3.2: NL-3, NL-4	1	1		1							1		1	1
N/A	Provincie Zuid-Holland	Leo Hamerlinck	Ch 17.3.2: NL-8, NL-9	1	1		1							1			

Annex II: Documents used for the desk study

Documents underpinning societal challenges and related research questions:

Bedrijfstakonderzoek: Gezamenlijke kennisagenda (5 jarenplan) van de drinkwaterbedrijven http://www.kwrwater.nl/BTO/

Bouwcampus 2015 Themakaart bouw (concept 2). Bouwcampus, Argumentenfabriek

CATO programma (CO2 opslag) http://www.co2-cato.nl/

Collegeakkoord provincie Noord-Brabant https://www.brabant.nl/

Dynamische Uitvoeringsagenda (DUA) Brabant van het PMWP, en het bijbehorende uitvoeringsprogramma Vitale Bodem (not published yet)

EDGAR gasprogramma (beta gamma over toekomst gas in NL. biogas tot gasrotonde en CCS) http://www.edgar-program.com/nl/nieuws/enabling-sustainability-with-gas

Energieprogramma wat in november wordt geissued door kabinet (not available yet)

EU COM Land as a resource http://ec.europa.eu/environment/land_use/index_en.htm

Hajer en Dassen, 2015. 'Slimme steden - de opgave voor de 21e-eeuwse stedenbouw in beeld' PBL

Jeuken Ad, Lieselotte Tolk, Lodewijk Stuyt, Joost Delsman, Perry de Louw, Esther van Baaren, Marcel Paalman. (2015) zelfvoorzienend in zoetwater: zoek de mogelijkheden. STOWA rapport 30, Amersfoort NL

Kennisagenda Bodem en Ondergrond (2011)

Kennisagenda geothermie Kennisprogramma ondergrond EZ not published yet (http://www.namplatform.nl/investeren-in-de-regio/educatie/ontwikkeling-kennisprogramma).

Klijn Frans, Maarse Maaike (2015) Wat te doen tegen de toename van overstromingsrisico's inde toekomst? STOWA rapport 33, Amersfoort NL

Kuiper Rienk. (2015) Verkenning omgevingsopgaven voor de Nationale Omgevingsvisie PBL rapport 2268 http://www.pbl.nl/publicaties/verkenning-omgevingsopgaven-voor-de-nationale-omgevingsvisie

Mesters Carleen, Pötz Hiltrud (undated) KAS. de Klimaatactieve Stad. Hoe lokale initiatieven te omarmen, te stimuleren en de samenwerking in de stad te bevorderen. STOWA, Unie van Waterschappen, Ministerie van IenM

NICOLE: document voor NICOLE. (not published, on demand) http://www.nicole.org/

Ovv rapport rond bevingen http://www.onderzoeksraad.nl/uploads/phase-docs/843/33ef77ab629erapport-gaswinning-groningen-nl-interactief.pdf

PBL Toekomst van de landbouw ex ante evaluatie

Platform31 (2015) Maak Ruimte. Manifest ikv Jaar van de Ruimte. https://wijmakennederland.nl/pdf/Manifest2040.pdf

Prorail Innovatie en ontwikkelagenda 2015 (not public).

Prorail (2013) Meerjarenplan Duurzaamheid 2013-2015

Provinciaal Milieu- en Waterplan 2016-2021 (strategisch document) en bijbehorend uitvoeringsplan (in de maak) http://www.brabant.nl/dossiers/dossiers-op-thema/water/waterbeleid/provinciaal-milieu-en-waterplan-2016-2021.aspx

Raad voor de Leefomgeving en infrastructuur (2013) Ruimte voor duurzame landbouw Publicatie RLI 2013/01 http://www.rli.nl/sites/default/files/rli008-1dowwtkbinnenwerkb5170x235metcoverinteractief_0.pdf

Raad voor de Leefomgeving en infrastructuur (2015) VERNIEUWING OMGEVINGSRECHT: MAAK DE AMBITIES WAAR. Publicatie Rli 2015/07 http://www.rli.nl/publicaties/2015/advies/vernieuwing-omgevingsrecht-maak-de-ambities-waar. Publicatie Rli 2015/07

SMART URBAN REGIONS OF THE FUTURE http://surf.verdus.nl/voorpagina

STOWA (2015) goede grond – goed voor landbouw natuur én waterbeheer STOWA brochure 19a, Amersfoort, NL

STOWA (2015) nieuwe neerslagstatistieken voor het waterbeheer – extreme neerslaggebeurtenissen neen toe en komen vaker voor. STOWA brochure 10a, Amersfoort, NL

Wel, van der Nico (2010) Ontdek de stadsbodem TCB en Natuurmedia ISBN 789080815858

Westhoek H., Lesschen J.P., Leip A., Rood T., Wagner S., De Marco A., Murphy-Bokern D., Pallière C., Howard C.M., Oenema O. & Sutton M.A. (2015) Nitrogen on the Table: The influence of food choices on nitrogen emissions and the European environment. (European Nitrogen Assessment Special Report on Nitrogen and Food.) Centre for Ecology & Hydrology, Edinburgh, UK. http://www.pbl.nl/sites/default/files/cms/publicaties/Nitrogen_on_the_Table_Report_WEB.pdf

Vitens innovatieagenda: in de onderwerpen staat waarin Vitens wil innoveren (not public)

Wit, Han de & Zoetbrood Pascal (undated) Formule Leven met Water ook bruikbaar in de toekomst? Evaluatie werkwijze Leven met Water

SPI

Bloemers, T., S. Daniels, G. Fairclough, B. Pedroli & R. Stiles (eds., 2010): Landscape in a changing world. Bridging Divides, Integrating Disciplines, Serving Society. Science Policy Briefing ESF-COST nr 41, Strasbourg / Brussels. 16 p http://www.esf.org/fileadmin/Public_documents/Publications/SPB41_Landscape_ChangingWorld.pdf

Duijn, M., G.J. Ellen, Hooimeijer, F.L. and Alphen, J. van (2014) Kennis voor Deltabeslissingen Grootse Plannen voor waterveiligheid. Water Governance, 03 (2014), pp. 17-26

Herber R. (2011) Kan ook de Diepe Ondergrond Ruimtelijke Geordend Worden? Inaugurele rede 1 maart 2011, Rijksuniversiteit Groningen

Isaacson, de uitvinders (ter inspiratie voor science-policy interface: boek over de ontwikkeling van de it-achtige wereld)

Kahneman Daniel 2013 Thinking fast and slow

van Os HWA, Herber R, Scholtens B. (2014) Not under Our Back Yards? A case study of social acceptance of the Northern Netherlands CCS initiative. Renewable and Sustainable Energy Reviews 2014; 30: 923-942

Rathenau: http://www.rathenau.nl/publicaties/publicatie/wetenschap-als-strijdtoneel.html

WRR: http://www.wrr.nl/publicaties/publicaties/

Annex IIIa: National workshop attendees

The first day a large group of attendees were invited. The second day was specifically for the NKS.

NKS:

Organisation	Name	Funder	end user	knowledge provider	Nat.reg.loc. authority	Univ./ research inst	SME /consultant	business & industry	NGO	network	other	Topic 12 November	Topic 13 November
Waternet	Fred de Haan*	1	1		1								Resources and Energy
Bouwcampus (TAUW)	Han de Wit*		1	1		1		1		1		Water and Climate	Water and Climate
ZLTO	Harry Kager*	1	1						1				Rural area
Gemeente Nijmegen	Henk-Jan Nijland*	1	1		1							Urban area	Urban area
Provincie Noord-Brabant	Jaap Harthoorn*	1	1		1							Rural area	Rural area
SBNS	Jan Fokkens*	1	1					1				Resources and Energy	
VITENS	Johan Driessen*	1	1					1				Water and Climate	
Nicole (TAUW)	Laurent Bakker*			1			1			1		Urban area	Urban area
RWS	Pieter de Boer*	1	1		1							Resources and Energy	
WUR	Saskia Keesstra*			1		1						Water and Climate	
RIVM	Ton Breure*			1		1						Water and Climate	Resources and Energy
Provincie Zeeland	Walter Jonkers*	1	1		1							Rural area	Water and Climate
PBL	Maria Witmer#			1		1						Rural area	Rural area

*National Key Stakeholder INSPIRATION

Advisory board INSPIRATION

Attendees 12 November

Organisation	Name	funder	end user	knowledge provider	Nat.reg.loc. authority	Univ./ res. inst	SME / consultant	business & industry	NGO	network	other	Topic 12 november	Topic 13november
Gemeente Rotterdam	Anton Roeloffzen	1	1		1							Urban area	
ZLTO	Arno Peekel	1	1						1			Rural area	
IenM	Auke Oostra	1	1		1							Urban area	
gemeente Rotterdam / bodembreedforum	Cees Buijs	1	1	1	1			1				Urban area	
RWS	Co Molenaar	1	1		1							Water and Climate	
Witteveen+Bos	Corinne Koot			1			1					Resources and Energy	
IenM	Dick Brand	1	1		1							Resources and Energy	
Grontmij	Dirk Jan Pasma			1			1					Resources and Energy	
RWS	Gerd de Kruif	1	1		1							Resources and Energy	
LandschappenNL	Gerrit-Jan van Herwaarden	1	1						1			Rural area	
RWS	Jan Frank Mars	1	1		1							Urban area	
WUR	Janjo de Haan			1		1						Rural area	
TNO	Jasper Griffioen			1		1						Resources and Energy	
WUR	Joop Okx			1		1						Rural area	
Grontmij	Karen Huijsmans			1			1					Rural area	
provincie Zuid-Holland	Leo Hamerlinck	1	1		1							Resources and Energy	
ImpactReporters	Marianne Heselmans		1				1					Rural area	
Bioclear	Marlea Wagelmans			1			1					Rural area	
RIVM	Michiel Rutgers			1		1						Urban area	
WUR	Peter Kuikman			1		1						Water and Climate	

Organisation	Name	funder	end user	knowledge provider	Nat.reg.loc. authority	Univ./ res. inst	SME / consultant	business & industry	NGO	network	other	Topic 12 november	Topic 13november
MWH	Peter van Mullekom			1			1					Resources and Energy	
RIVM	Piet Otte			1		1						Water and Climate	
Zonnehoeve	Piet van Ijzerdoorn		1				1					Rural area	
PBL	Ron Franken			1		1						Water and Climate	
Deltares	Sophie Vermooten			1		1						Resources and Energy	
Grond RR Adviesbureau	Vincent Grond			1			1					Urban area	

Organisers workshop

Organi-sation	Name	Role	funder	end user	knowledge provider	Nat.reg.loc. authority	Univ./ research inst	SME /consultant	business & industry	NGO	network	other	Topic 12 November	Topic 13 November
Deltares	Linda Maring	Table leader			1		1						Urban area	Urban area
RWS	Geraldien Kok	reporter	1	1		1							Urban area	
RWS	Margot de Cleen*	Table leader	1	1		1							Water and Climate	Water and Climate
TAUW	Mark in 't Veld	reporter			1			1					Water and Climate	
RIVM	Sandra Boekholt	Table leader			1		1						Rural area	Rural area
RHDHV	Dorien Derks	reporter			1			1					Rural area	
Deltares	Jos Brils	Table leader			1		1						Resources and Energy	Resources and Energy
Deltares	Sophie Moinier	reporter			1		1						Resources and Energy	
Deltares	Corrie Lammers	Secretariat												

*National Key Stakeholder INSPIRATION

Annex IIIb: National workshop programme

Programme 12 november

Time	Activity	speaker
12:30	Entrance with coffee / tea	
13.00	Welcom, objectives of the day and programme	Linda Maring
13.10	INSPIRATION	Jos Brils
13.30	State of the art for: • Dutch knowledge agenda • INSPIRATION	Margot de Cleen & Linda Maring
14.00	Elaborating topics (4 groups) • Urban area • Rural area • Water and Climate • Resources and Energy	Urban area: Linda Maring Reporting: Geraldien Kok Rural area: Sandra Boekhold Reporting: Dorien Derks Water and Climate: Margot de Cleen Reporting: Mark in 't Veld Resources and Energy: Jos Brils Reporting: Sophie Moinier
15.00	coffee / tea break	
15:15	Elaborating topics (4 groups) prioritize / actions	
15.45	Results and additions (Plenary)	Table leaders / reporters
16.50	Follow-up and en closure day 1	Linda Maring, Jos Brils
17.00	Drinks	

Programma 13 november

Time	Activity	speaker
09.00	Welcome back for NKS, objectives of the day and programme	Linda Maring
09.10	Looking back at results day 1 ->elaborated example: Resources and Energy: How can we use the ecosystem in a sustainable way?	Urban area: Linda Maring Rural area: Sandra Boekhold Water and Climate: Margot de Cleen Resources and Energy: Jos Brils
09.30	Elaboration of topics in small groups	
10.15	coffee / tea break	
11.15	Results per table	
12:15	Next steps INSPIRATION	Linda Maring
12.30	Closure national workshop with lunch	

The full minutes of the workshop can be found on http://www.inspiration-h2020.eu/sites/default/files/upload/verslag12-13nov_kennisagenda_inspiration_071215.pdf

Annex IV: Research questions (in Dutch)

Agriculture and food / Landbouw en voedsel

bewustwording	1 bewustwording Hoe maken we stakeholders bewust van het belang van een goede bodemkwaliteit voor voedselveiligheid en -kwaliteit en hun rol hierin? DEMAND 2 bewustwording Wat kunnen we in Nederland doen om te komen tot herstel van bodemkwaliteit, duurzamer bodemgebruik hier en elders en daarmee bij te dragen aan de VN-Sustainable Development Goals? DEMAND bewustwording Wat zijn de trends in diëten en wat betekenen die voor bodem en watergebruik, gezondheid, hoe krijg je mensen zo ver dat ze minder dierlijk eiwit gaan eten? DEMAND bewustwording Wie zijn winnaars en verliezers in de voedselketen van een transitie naar gezondere (voor mens en milieu) diëten en duurzame landbouw en hoe vang je de verliezers op? Wat zou de rol kunnen zijn van het GLB voor deze transitie? DEMAND bewustwording Hoe kunnen we komen tot een implementatie van de Nitraatrichtlijn en de Kaderrichtlijn Water in Nederland die agrarische ondernemers uitdaagt om op een goede manier met de bodem om te gaan? LANDMAN
Statusbepaling	3 Statusbepaling Wat is een gezonde bodem? Meer specifiek: Wat is de staat van de bodem (bodemleven, bodemstructuur, kwaliteit, gehalte en de kwaliteit van bodemorganische stof etc., geïntegreerd fysisch-chemisch-biologisch) in relatie tot de landbouwfunctie en andere ecosysteemfuncties (waterberging, ziektewering, bodemvruchtbaarheid, producerend vermogen, etc.)? NATCAP
Systeemkennis	4 systeemkennis Hoe kan het natuurlijk bodem-watersysteem optimaal worden benut voor de verduurzaming van de landbouw? LANDMAN 5 systeemkennis Welke systeemkennis is nodig om van de landbouw een resource efficiënt sector te maken? Dit geldt zowel regionaal als mondiaal en heeft een relatie met het sluiten van kringlopen en de footprint van de landbouwproducten. LANDMAN 6 systeemkennis Hoe kunnen natuurlijke processen worden benut om gedegradeerde bodems te herstellen en gezonde bodems (Zie vraag 3 Statusbepaling) te behouden. NATCAP/ LANDMAN systeemkennis Wat is het effect van een goede bodemkwaliteit op de emissies van stikstof en fosfaat vanuit de land- en tuinbouw? NATCAP
afwegen	7 afwegen Welke factoren bepalen of de geschiktheid van de bodem voor landbouw in ruimtelijke en economische keuzes wordt meegenomen en welke optimalisaties zijn hierin mogelijk? LANDMAN 8 afwegen Hoe kunnen we de bodem en bodembiodiversiteit als natuurlijk kapitaal voor de landbouw waarderen en vertalen naar verdienmodellen? LANDMAN afwegen Kunnen we met kennis van het bodemecosysteem landbouw verweven met andere functies zoals waterbeheer, natuurbeheer, energieopwekking, klimaatadaptatie en - mitigatie? LANDMAN

implementatie	9 implementatie Hoe zijn boeren te stimuleren om (nieuwe of verbeterde) landbouwmethoden zodanig in te zetten dat ze lage productiviteit voorkomen, leiden tot bodemherstel en een verminderde afhankelijkheid van externe grondstoffen? LANDMAN - Hoe nutriëntenkringlopen vormgeven c.q. sluiten? - Hoe kunnen we biotische reststromen in productieketens duurzaam benutten in de landbouw om te komen tot een circulaire economie, leidend tot verbetering van de bodemkwaliteit? - Hoe komen we tot effectief beheer van organisch stof in de bodem? - Wat kan precisielandbouw bijdragen aan bodembewuster boeren? - Hoe kunnen traditionele landbouwpraktijken zoals gewasrotatie en wisselteelt worden gecombineerd met moderne kennis op het gebied van landbouw? 10 implementatie Hoe gaan we om met / voorkomen we bedreigingen als verdichting, microbiële risico's door ziekteverwekkers in de bodem, antimicrobiële resistentie, bodemdaling en verzilting? LANDMAN 11 implementatie Wat betekenen trends en ontwikkelingen in de landbouwsector zoals schaalvergroting, korte-termijn-verdienmodellen, landbouw afgestemd op de marktvraag in plaats van volgend aan de mogelijkheden van het systeem, voor bodem en ondergrond (kansen en bedreigingen voor benutting van het bodem-watersysteem)? DEMAND 12 implementatie Hoe kunnen we bestaande kennis van bodembiodiversiteit vertalen naar praktisch handelingsperspectief voor boeren? LANDMAN
Evaluatie	13 evaluatie De mondiaal veranderende levensstandaard (meer, of juist minder consumptie van zuivel en vlees, hogere energiebehoefte, wel of geen biologisch voedsel) heeft effecten op de landbouwpraktijk. Wat betekent dit voor het bodemgebruik in Nederland en de (landgebruik, water, nutriënten) footprints elders? Wat zijn de risico's op bodemdegradatie? Is beleidssturing gewenst en hoe is deze in te vullen? IMPACT 14 evaluatie Wat zijn effecten van diverse landbouwmethoden op verduurzaming van de landbouw en verbetering van de bodemkwaliteit? IMPACT Evaluatie Kunnen we inzichtelijk maken wat op de korte en lange termijn de invloed is van bewust omgaan met de bodemvruchtbaarheid? IMPACT Evaluatie Wat zijn de gevolgen van landbouwpraktijken voor eutrofiëring kustzones, grondwaterkwantiteit en kwaliteit, klimaat wereldwijd? IMPACT

Liveability of rural areas / Leefbaarheid landelijk gebied

bewustwording	1 bewustwording Is het van belang voor de leefbaarheid van het landelijk gebied (identiteit) om de betekenis van bodem en ondergrond te laten zien als basis van kenmerkende landschappen (inclusief aardkundige waarden, archeologie, geomorfologie)? En zo ja: hoe brengen we de 'leesbaarheid' van de ondergrondkarakteristieken in het landschap terug? NATCAP 2 bewustwording Hoe kunnen we de leefbaarheid van het landelijk gebied verbeteren door optimaal gebruik te maken van het bodem-sediment-water systeem en landbeheer, waarbij natuurlijke en culturele waarden en economische en sociale vestigingsfactoren worden meegenomen? DEMAND 3 bewustwording Hoe kunnen aardkundige, culturele en biologische waarden boven en onder maaiveld worden uitgedrukt in sociale en economische waarden? NATCAP
statusbepaling	4 statusbepaling Kunnen economische / sociaal-culturele scenario's worden ontwikkeld die verschillende vormen van landgebruik combineren tot een attractief en leefbaar landelijk gebied? Hoe kan een dergelijk multifunctioneel ruimtegebruik economie en ecologie versterken? LANDMAN 5 statusbepaling Hoe kunnen we het Programma Aanpak Stikstof (PAS) benutten om het landgebruik en daarmee de leefbaarheid van het landelijk gebied te bevorderen? LANDMAN statusbepaling Welke kansen kan de vraag naar regionale biomassa voor biomassaketels bieden om aanleg en onderhoud van landschapselementen te stimuleren? DEMAND
Systeemkennis	6 Systeemkennis Wat is de rol van bodem bij gezondheid? LANDMAN - Wat is de rol van de bodem, waterbodem, water bij de verspreiding van infectieziekten die van dieren op mensen (of andere dieren) overgaan (zoönosen zoals Q-koorts)? - Wat is de rol van de bodem, waterbodem, water bij de verspreiding van antibiotische resistentie? - Wat is de rol van de bodem bij de verspreiding en risico's van (nieuwe) verontreinigingen zoals geneesmiddelen en nanodeeltjes? - Wat is de samenhang hiervan met landgebruik en veiligheid in het landelijk gebied? Hoe kunnen deze risico's door bodembeheer samenhangend met landbouwmethoden worden verkleind? 7 Systeemkennis In welke mate betekent de ontwikkeling in peri-urbane gebieden naar zorgboerderijen, kinderdagverblijven, recreatie bij de boer en daardoor potentiële blootstelling aan diverse stoffen, een mogelijke toe- of afname van de volksgezondheid? LANDMAN/IMPACT

Afwegen	8 afwegen Hoe kunnen we landbouw en andere gebruiksvormen zoals natuur vormgeven zodat het soil-sediment-water systeem wordt versterkt in het landelijk gebied en duurzame landbouw als functie mogelijk blijft? LANDMAN afwegen Welke kennis en maatregelen zijn er om, daar waar transitie van landbouwgebieden naar natuur aan de orde is, dit plaats te laten vinden zonder ingrijpende maatregelen zoals afgraven (transitie naar juiste nutriëntengehalte, waterkwantiteit)?LANDMAN afwegen Hoe kan de landbouw gestimuleerd worden om de bijdrage aan de (bodem)biodiversiteit en de natuur te vergroten? LANDMAN 9 afwegen Hoe kunnen we ambities voor bodem en ondergrond in het landelijk gebied in de Omgevingswet en afgeleide instrumenten (o.a. omgevingsvisie) een positie geven? Welke kennis van het bodem-sediment-watersysteem is hiervoor van belang? LANDMAN 10 afwegen Welke factoren beïnvloeden beslissingen over landgebruik in het landelijk gebied en hoe het bodem-sediment-water systeem worden betrokken bij ruimtelijke planvorming en landinrichting? LANDMAN
Implementatie	11 Implementatie Wat draagt het bodem-sediment-water systeem bij aan ruimtelijke kwaliteit in gebiedsontwikkelingen zoals Ruimte voor de Rivier? LANDMAN 12 Implementatie Hoe betrekken we de gebruikers van land en grondwater in een gebied bij het realiseren van schoon grondwater en een gezonde bodem voor landbouw en natuur? LANDMAN 13 implementatie Hoe kunnen huidige instrumenten beter worden gehandhaafd en/of zijn nieuwe instrumenten nodig om de leefbaarheid van het landelijk gebied te behouden en bevorderen op basis van de kenmerken van het lokale natuurlijk systeem en sociaal-culturele eigenschappen, gericht op functiecombinaties? LANDMAN
Evaluatie	14 evaluatie Welke landbeheermaatregelen zijn effectief bij het verhogen van de leefbaarheid van landelijk gebied en het realiseren van duurzame natuur (evalueren adhv pilots, uitwisseling kennis, ervaringen in “agrocommunities”)? IMPACT evaluatie Wat zijn de werkelijke kosten en baten van landgebruik in landelijk gebied, wie verdienen, wie dragen de kosten, en hoe wordt dit eerlijker verdeeld? LANDMAN

Climate change / Klimaatadaptatie en -mitigatie

Bewustwording	1 Bewustwording Welke kansen voor allianties zijn er om de opgaven voor klimaat vanuit de potentie van het bodem-watersysteem op te pakken met andere maatschappelijke opgaven (zoals energie en de slimme stad)? DEMAND/INLEIDING 2 Bewustwording Welke rol speelt het landgebruik en het beheer van het bodem- en watersysteem in de opgaven voor klimaat en wordt de potentie van deze rol ten volle gekend? LANDMAN 3 Bewustwording Is, voor de bodemsector, organisch stof het referentiepunt voor de klimaatopgave? NATCAP
Statusbepaling	4 Statusbepaling Wat is het effect van klimaatverandering op IMPACT • bodemkwaliteit, bodemeigenschappen, bodembiodiversiteit, bodemprocessen, bodemdaling en ecosysteemdiensten? • het gebruik van de ondergrond, land en leefomgeving? • invasieve bodemgebonden pathogenen? • Plagen door ontbreken vorstperiode, waardoor nieuwe bestrijdingsmiddelen nodig zijn?
Systeemkennis	5 Systeemkennis Hoe monitoren we de verschillende effecten van klimaatverandering op het natuurlijk systeem (natuurlijk kapitaal, gezondheid, ecosysteem)? IMPACT 6 Systeemkennis Welke potentie heeft de ondergrond voor klimaatadaptatie en-mitigatie (optimalisatie van landgebruik ter vermindering van de uitstoot van broeikasgassen, verhoging organisch stof gehalte, vermindering verlies organisch stof, verhoging watervasthoudend vermogen, waterveiligheid, stabiliteit van grondlichamen et cetera.) ? NATCAP
Afwegen	7 Afwegen Hoe kunnen wij het gebruik (adaptatie) van het bodem-watersysteem aanpassen aan de effecten van klimaatverandering LANDMAN 9 Afwegen Hoe groot zijn de kosten en baten van klimaatadaptatie- en -mitigatiebeleid voor het bodem-watersysteem (de ondergrond)? LANDMAN
Implementatie	10 Implementatie Welke maatregelen en ingrepen op het bodem-watersysteem zijn het meest effectief om aan de afspraken voor vermindering van de uitstoot aan broeikasgassen te voldoen (mitigatie)? LANDMAN 11 Implementatie Welke handelingsperspectieven voor bodem en ondergrond hebben publieke en private partijen voor klimaatadaptatie- en –mitigatiebeleid? INLEIDING / LANDMAN 12 Implementatie Hoe voorkomen / gaan we om met gevolgen van klimaatverandering (bodemdaling, waterbeheer, wateroverlast, verdroging en verzilting), hitte, veranderend grondgebruik et cetera)? IMPACT
Evaluatie	13 Evaluatie Welke maatregelen in het kader van klimaat adaptatie- en mitigatiebeleid voor bodem, ondergrond en landgebruik zijn onder welke omstandigheden effectief? LANDMAN Evaluatie Hoe dragen kleinschalige maatregelen bij aan klimaatadaptatie en –mitigatie op een groter schaalniveau voor de langere termijn?

Water

Bewustwording	1 Bewustwording Welke handelingsperspectieven hebben publieke en private partijen om het natuurlijk systeem te betrekken bij hun wateropgaven? En zijn / hoe worden zij zich van deze handelingsperspectieven bewust? LANDMAN
Statusbepaling	2 Statusbepaling Hoe kan de conditie van het natuurlijk systeem in zijn totaliteit worden bepaald en/of beoordeeld? En wat betekent deze kwaliteit voor de ecosysteemdiensten die kunnen worden geleverd? NATCAP
Systeemkennis	3 Systeemkennis Wat is de betekenis van een ingreep in het watersysteem voor de duurzaamheidsbalans van het totale natuurlijk systeem? IMPACT 4 Systeemkennis (toegevoegd) In hoeverre is de lokale bodemgesteldheid bepalend voor de invloed van water op het natuurlijk systeem? En is deze kennis te vertalen naar generieke maatregelen? IMPACT 5 Systeemkennis Welke waterkenmerken zijn van invloed op de lokale bodemgesteldheid en in welke mate? IMPACT
Afwegen	6 Afwegen Hoe geef je landmanagement en waterbeheer vorm binnen gebieden uitgaande van de balans tussen het natuurlijk systeem en wateropgaven (veiligheid, drinkwater, landbouw, natuur industrie, KRW-doelstellingen enz) en waarbij eenieder zijn verantwoordelijkheid neemt? LANDMAN 7 afwegen Hoe kunnen we gebiedsgericht kwalitatief en kwantitatief grondwaterbeheer vormgeven? LANDMAN 8 Afwegen (klimaat) Wat bepaalt of in Nederland actief grondwaterpeilbeheer bestuurlijk, technisch en financieel kansrijk is en in welke omvang? LANDMAN
Implementatie	7 Implementatie Hoe kunnen essentiële functies en processen van het bodem-water-sediment systeem worden ingezet om de hydrologische cyclus te reguleren? LANDMAN 8 Implementatie •Welke maatregelen (inclusief eco-engineering) zijn bij het gebruik van het bodem-water-sediment systeem door wie en wanneer in te zetten om de hydrologische cyclus te optimaliseren? LANDMAN 9 Implementatie Wat is optimaal peilbeheer gezien het natuurlijk systeem op een locatie in relatie tot gewenste functies en opgaven zoals tegengaan bodemdaling en paalrot naast ontwateringsbehoefte landbouw? LANDMAN
Evaluatie	10 evaluatie Hoe kunnen we wateropgaven zoals de (drink)waterlevering nu en in de toekomst, veilig stellen en wat betekent dit voor het natuurlijk systeem en strategische grondwatervoorraden? DEMAND 11 evaluatie Hoe werken ingrepen en de daaruit voortvloeiende veranderingen in de bodem, het grondwater of het water door naar andere domeinen, zoals de landbouw en de ruimtelijke ordening? IMPACT

Smart and healthy cities / Slimme gezonde stad

Bewustwording	1 Bewustwording Welke handelingsperspectieven zijn er om het natuurlijksysteem te betrekken bij het vinden van oplossingen voor de uitdagingen in stedelijk gebied? LANDMAN 2 Bewustwording Hoe maken we partijen bewust van de concurrentie tussen de diensten van het natuurlijk systeem en de gebruiksfuncties van de ondergrondse ruimte en het belang beiden te betrekken in afwegingen? DEMAND
Statusbepaling	3 Statusbepaling Wat is de rol van het bodem-watersysteem voor de realisatie van de circulaire stad (kringlopen vormgeven c.q. sluiten)? NATCAP 4 Statusbepaling Wat is de waarde (monetariseren / maatschappelijk rendement) van het stedelijk bodem-sediment-watersysteem en de diensten die het levert? NATCAP 5 Statusbepaling Welke impact hebben demografische en economische ontwikkelingen (krimp en groei, landeigendom) op het gebruik, de bestemming en het beheer van het natuurlijk systeem? LANDMAN Statusbepaling Welke functies gaan goed samen (in ruimte/tijd) of versterken elkaars werking in de stad en welke zijn concurrerend of maken andere diensten onmogelijk? DEMAND 6 Implementatie Welke (nieuwe) bedreigingen voor de kwaliteit van het natuurlijk bodem-watersysteem in de stad worden in de komende decennia verwacht en welke kosten zijn daarmee gemoeid? IMPACT
Systeemkennis	8 Systeemkennis Op welke wijze interacteert het natuurlijk systeem met het (beoogde) gebruik? IMPACT 9 Systeemkennis Welke bodemprocessen zijn belangrijk voor het leveren van diensten door het stedelijke bodem-water-sediment systeem (afbraak verontreinigingen, filteren water / lucht, bufferen van lokaal klimaat, tegengaan hittestress, fijn stof invangen) en (hoe) kunnen we het functioneren van het stedelijke bodem-water-sediment systeem verbeteren? NATCAP 10 Systeemkennis Wat is de impact van het (niet) benutten van het natuurlijk systeem en de kwaliteit hiervan op gezondheid en leefomgevingskwaliteit in de stad? IMPACT
Afwegen	11 Afwegen Hoe wegen we de bodembelangen evenwichtig af tegen andere (milieu)belangen (als: water, veiligheid, lucht, geluid, ecologie, economie, financiën, ruimtelijke kwaliteit en maatschappelijke opgaven) in de ontwikkeling en het beheer van stedelijke leefomgeving en hoe draagt bodem bij aan die belangen? LANDMAN 12 Afwegen Hoe kunnen we scenariostudies inzetten om in te spelen op de toekomstige ontwikkelingen in de stedelijke omgeving? DEMAND Afwegen Op welke manier kunnen er ‘trade-offs’ gemaakt worden tussen het natuurlijke en het artificiële systeem? IMPACT

Implementatie	13 Implementatie Hoe kan men het natuurlijk systeem inzetten voor op opgaven in het stedelijk gebied? Bijvoorbeeld door: LANDMAN - Bijdrage bodem en ondergrond aan transitie stedelijk waterketensysteem - Bijdrage aan klimaatbestendige leefomgeving - Bijdrage aan de energievoorziening van de stad - (Ecologische) concepten voor duurzame inrichting, kringlopen - Betere afstemming boven en ondergrond 14 Implementatie Waar liggen kansen voor geo- & eco-engineering in het stedelijk gebied? LANDMAN 15 Implementatie Hoe is 4D ruimtelijke ordening (x,y,z, en t) met een balans tussen benutten en gebruiken van het natuurlijk systeem en de ondergrondse ruimte in het stedelijk gebied te realiseren? LANDMAN 16 implementatie Hoe spelen we positief in qua kennisontwikkeling en innovatie op de voortdurend nieuwe uitdagingen die de ondergrond in de stad ons stelt? DEMAND
Evaluatie	17 Evaluatie Wat zijn de (meetbare) effecten van ecologische en building-with-nature concepten, inrichten op basis van groen-blauwe structuren en inzet van ecosysteemdiensten op de maatschappelijke opgaven in een stad? IMPACT 18 Evaluatie Wat zijn de baten (maatschappelijk rendement) van het benutten van het natuurlijk systeem in de stad, hoe verdeel je de lusten en de lasten en kun je met ontwerpen ook de kosten in tijd en per stakeholder regelen (mutual gain approach)? IMPACT

Mobility and transport / Mobiliteit en transport

Bewustwording	1 bewustwording Wat is –in het kader van duurzaam transport- de rol van de ondergrond bij het duurzaam verbinden van hoofdwegen met “aders” en “haarvaten”? DEMAND
Statusbepaling	2 statusbepaling Wat is de staat van ondergrondse infra en wat betekent dit met betrekking tot de vervangingsopgave en saneringsopgave van loze kabels en leidingen? LANDMAN
Systeemkennis	3 systeemkennis Waaruit bestaan interacties tussen ondergrondsysteem en aanleg van en bestaande boven- en ondergrondse infra, nu en in de toekomst? IMPACT 4 systeemkennis Treden er als gevolg van ingrepen ten behoeve van de mobiliteit en transport verstoringen op van de balans tussen de potenties van het natuurlijk systeem en de behoeften van de maatschappij? Waardoor kenmerken deze verstoringen zich en wat betekent dit voor de kwaliteit van het natuurlijk systeem? IMPACT
Afwegen	5 afwegen Welke factoren en argumenten spelen een rol bij de duurzame afweging tussen de aanleg van boven- of ondergrondse infrastructuur? Speelt behoud van de kwaliteiten van het natuurlijk systeem daarbij een rol? En hoe kunnen we met deze argumenten sturen op de afwegingen? DEMAND
Implementatie	6 Implementatie Welke technieken zijn te ontwikkelen i.k.v. duurzaam en hindervrij GWW (building with nature, bouwen op slappe bodem, hindervrij bouwen in en op de ondergrond)? LANDMAN 7 Implementatie Welke innovaties zijn mogelijk voor beheer, meten en monitoren van ondergrondse infrastructuren? LANDMAN 8 Implementatie Welke slimme functiecombinaties bij wegenbouw en – onderhoud en ecosysteemdiensten zijn mogelijk? LANDMAN
Evaluatie	9 Evaluatie Waaruit bestaan positieve en negatieve wisselwerkingen tussen ondergronds infrastructurele ontwikkelingen en het natuurlijk systeem en wat kunnen we leren van deze wisselwerking voor toekomstige infrastructurele ontwikkelingen in de ondergrond? IMPACT

Soil quality / Bodemkwaliteitszorg

Bewustwording	-
Statusbepaling	1 Statusbepaling Welke (nieuwe) verontreinigingen blijven een (potentieel) risico voor de gezondheid (drinkwater) of het ecosysteem? NATCAP 2 Statusbepaling Wat zijn nieuwe bedreigingen voor de bodem- en grondwaterkwaliteit? NATCAP/IMPACT
Systeemkennis	3 systeemkennis Hoe interacteren bodem, sediment en water en de stoffen daarbinnen (bodem-sediment-water-systeem)? NATCAP 4 systeemkennis Wat is de potentie van de bodem en ondergrond voor het produceren van medicijnen of het afbreken van verontreinigingen en hoe kan die potentie worden benut? NATCAP 5 systeemkennis Wat betekent de aanwezigheid van systeemvreemde stoffen voor de kwaliteit en de veerkracht (ziektewering) en andere kwaliteiten en functies van het natuurlijk systeem? NATCAP
Afwegen	6 afwegen Hoe kunnen de risico's worden bepaald van veranderend gebruik van bodem, water en land i.r.t. de kwaliteit (meer "open" bodems, zwemmen in grachten met schoon water, maar verontreinigd sediment)? En wat betekenen deze risico's in relatie tot de maatschappelijke behoeften? IMPACT
Implementatie	7 Implementatie Hoe gaan we om met (nieuwe) verontreinigingen voor het grond- (en drink)water (meten, monitoren en aanpakken, inpassen in de bestaande structuur van beheer van schone en diffuus verontreinigde bodems)? LANDMAN 8 Implementatie Hoe kunnen we de risicobeoordeling van bodemverontreiniging integreren in een risicoafweging voor het totale milieu? IMPACT 9 Implementatie Hoe verbeteren we de "governance" van bodemkwaliteitszorg in termen van organisatie, nazorg, professioneel opdrachtgeverschap, organisatie, handhaven en toezicht? LANDMAN 10 Implementatie Welke tools zijn er nodig om de nieuwe bodemkwaliteitszorg (inclusief bodembescherming) te ondersteunen? LANDMAN 11 Implementatie Hoe kan bodemkwaliteitsbeheer /-zorg (bodem en grondwater) worden verbonden met andere ondergrondthema's? DEMAND Implementatie Hoe kan bodembescherming bijdragen aan bescherming strategische grondwatervoorraden? DEMAND 12 Implementatie Hoe kunnen verontreinigde terreinen / saneringen met andere activiteiten worden gecombineerd en bijdragen aan gebiedsambities? LANDMAN Implementatie Hoe kan hergebruik brownfields (economisch, sociaal, cultureel) gestimuleerd worden? LANDMAN Implementatie Hoe kunnen stortplaatsen mee worden genomen in land management en een gebiedsaanpak? LANDMAN 13 Implementatie Hoe kan het grondverzet en de baggeropgave verder worden verduurzaamd? LANDMAN 14 Implementatie Welke (nieuwe, innovatieve duurzame en (kosten)effectieve) sanerings- en monitoringstechnieken kunnen worden doorontwikkeld? LANDMAN
Evaluatie	15 evaluatie Hoe kunnen de resultaten (inspanningen) van bodemkwaliteitszorg (gestage verbetering) worden gemonitord (welke indicatoren)? IMPACT

Energy supply / Energievoorziening

bewustwording	1 bewustwording Hoe wordt een goede discussie over de wenselijkheid de diverse bestaande en nieuwe energiefuncties in de (diepe) ondergrond georganiseerd (geothermie, schaliegaswinning, gasopslag etc) en indien wenselijk, hoe wordt draagvlak gecreëerd? DEMAND
statusbepaling	2 statusbepaling Welke potentie heeft de ondergrond in de transitie naar een duurzame energievoorziening? En wat betekent de energietransitie voor het gebruik en de functies in/van de ondergrond? NATCAP 3 statusbepaling Hoe komen we tot een gunstige businesscase voor toepassing van 'nieuwe' energiebronnen en –voorzieningen die gebruik maken van de potenties van de ondergrond? DEMAND
systeemkennis	5 systeemkennis Waaruit bestaan interacties tussen ondergrondsysteem en winning van brandstoffen / toepassing bodemenergie op verschillende ruimtelijke en tijdschalen (kwantiteit, chemische kwaliteit, fysisch, geotechnisch, microbiologisch)? IMPACT
afwegen	6 afwegen Hoe maken we keuzes tussen verschillende soorten energiewinning (nut en noodzaak, duurzaamheid, kosten en baten, risico-impact en acceptatie)? Welke afwegingssystematiek is geschikt en breed toepasbaar? DEMAND 7 afwegen Hoe maken we ruimtelijke afwegingen in relatie tot energiefuncties (winning, transport en opslag) in de onder of bovengrond (beïnvloeding – concurrentie – uitsluiting functies en effecten van ingrepen/gebruik in horizontaal en verticaal vlak en door de tijd)? LANDMAN
implementatie	8 implementatie Hoe kunnen we de potentie van de ondergrond voor duurzame energievoorziening beter benutten? LANDMAN 9 implementatie Welke kansen voor efficiënte functiecombinaties liggen er (zoals WKO – sanering van grondwater)? LANDMAN 10 implementatie Hoe kunnen we met behulp van de ondergrond energie efficiënt en duurzaam opslaan en transporteren (realiseren van warmtenetten, sluiten energieketens) en welke technologische kennis is daarvoor nodig? LANDMAN 12 implementatie Hoe kunnen negatieve effecten / gevolgen (hernieuwbaar, onomkeerbaar, beheersbaar) van verschillende soorten energiewinning worden gemitigeerd? LANDMAN 13 implementatie Hoe kunnen de rolverdeling van en samenwerking tussen markt, overheden, kennisinstellingen en burger worden geoptimaliseerd bij nieuwe energiefuncties in de ondergrond? LANDMAN
evaluatie	14 evaluatie Wat is de impact van 'nieuwe' energievormen op het natuurlijk systeem en wat betekent dit voor het systeem en de maatschappelijke opgaven? IMPACT evaluatie Welke impact heeft de energiemix op boven- en ondergrond in termen van ruimtebeslag, gevolgen (aardbevingen, bodemdaling), veiligheid, beheer van grondwatervoorraden etc.? IMPACT

Resource efficiency / Efficiënt gebruik grondstoffen

bewustwording	1 bewustwording Wat kunnen ondergrond en landgebruik bijdragen aan circulaire economie, waarin ecologie en economie elkaar versterken, zoals het sluiten van kringlopen en hergebruik van grond en water? NATCAP
statusbepaling	2 statusbepaling Wat is nut en noodzaak van grondstoffenwinning voor de lange termijn (Toekomstscenario's voor gebruik van grondstoffen bij het samenspel tussen zelfvoorzienendheid, geopolitieke afhankelijkheid, nationale en internationale schaarste, voetafdrukken, circulaire economie en transitie naar duurzame energievoorziening)? DEMAND 3 statusbepaling Hoe ziet de sedimentbalans op verschillende schalen eruit, waar is teveel / te weinig sediment en wat zijn gevolgen voor maatschappij? NATCAP / DEMAND
systeemkennis	4 systeemkennis Waaruit bestaan interacties tussen ondergrondsysteem, landschap en winning van grondstoffen? IMPACT
afwegen	5 afwegen Hoe maken we ruimtelijke afwegingen tussen verschillende gebruiksfuncties (inclusief winning grondstoffen) en hoe kan de inzet van ecosysteemdiensten daarbij (ook bovengronds/landschappelijk) worden geoptimaliseerd? LANDMAN 6 afwegen Hoe kunnen we het landschap versterken door, of mee laten delen in baten van grondstofwinning? LANDMAN 7 afwegen Welke beslissingen moeten we nemen in het systeem en in wet- en regelgeving om beter om te kunnen gaan met baggerkwaliteit en -kwantiteit ? LANDMAN
implementatie	8 implementatie Hoe geven we vorm aan hergebruik / dragen we bij aan circulaire economie? DEMAND - Kan een "materialenpaspoort" werken? Voor welke doelen? Ontwerpen voor hergebruik: waar rekening mee houden? - Hoe kunnen we sediment en grond (en vruchtbare teelaarde) op een veilige en kosteneffectieve manier hergebruiken? - Wat is het mijnbouw-potentieel (landfill-mining) van vuilstorten en andere afvalproducten die in de ondergrond beland zijn? - Welke technologische kennis is er nodig bij terugwinning grondstoffen? 9 implementatie Wat bepaalt de keuze voor de inzet van primaire en secundaire bouwgrondstoffen in de bouw/utiliteit en GWW-sector? DEMAND - Hoe kunnen secundaire bouwgrondstoffen nog beter (hoger in de keten) worden ingezet om winning primaire bouwgrondstoffen te reduceren? - Welke secundaire bouwgrondstoffen komen in de toekomst vrij (door sloop o.a.) en wat is de invloed hiervan op de winning van primaire bouwgrondstoffen in de toekomst? 10 implementatie Hoe kunnen we zoutcavernes op een veilige manier hergebruiken? LANDMAN 11 implementatie Hoe kan het natuurlijk systeem helpen om inputs van grondstoffen verlagen in een stedelijke, industriële en agrarische setting? NATCAP
evaluatie	

Cross-over themes / Dwarsverbanden

Governance including Safety and health and Dealing with insecurities / Governance inclusief veiligheid en gezondheid en omgaan met onzekerheden

- Bodem als “common”: hoe kunnen we lucht – water - bodem effectief inzetten om maatschappelijke opgaven op te lossen als we ze niet in eigendom hebben? LANDMAN
- Welke beleidskeuzes en regelgeving vormen een belemmering om duurzaam bodem- en landgebruik in de praktijk te bewerkstelligen? LANDMAN
- Hoe gaan we van een controlemodel naar een adaptief model voor het beheer van de ruimte? LANDMAN
- Hoe gaan we om met “game changers” (nieuw beleid, kennis, schandaal, ramp etc)? LANDMAN
- Welke kennis is nodig voor het ontwikkelen van risicomanagement en daaraan gelieerde maatregelen? LANDMAN
- Hoe kunnen we effectief werken aan integrale opgaven zoals gebiedsgericht grondwaterbeheer (met zowel generieke als diepgaande specifieke kennis, ruimte voor maatwerk, “T-shaped knowledge” en met aandacht voor de juiste processen)? LANDMAN
- Hoe zetten we pilots in bij beleidsontwikkeling om mismatches tussen beleid en praktijk te voorkomen? LANDMAN
- Hoe brengen we de toepassing van groen-blauwe structuren van papier naar praktijk? LANDMAN

Knowledge base / Kennisbasis en vaardigheden

- Hoe houden bedrijven, overheden en burgers de kennisbasis rond het natuurlijk systeem en landgebruik op een voldoende niveau (kennismanagement, scholing, samenwerking)? DEMAND
- Hoe komt nieuwe kennis bij overheden terecht? DEMAND
- Hoe kunnen we leren van ervaringen en kennis uit het buitenland? DEMAND
- Hoe organiseer je effectief leerprocessen? DEMAND
- Hoe voorzien we deelnemers aan “bottom-up” initiatieven van de juiste informatie (bijv. i.r.t. stadslandbouw / bodemkwaliteit) en hoe zorgen we dat de kennis vanuit deze initiatieven ook bij anderen terecht komt? DEMAND
- Wat is er nodig rond bewustwording en onderwijs rond ondergrond (bijvoorbeeld jaar van de bodem, bodemdierendag, -bodem in onderwijs, GLOBE)? DEMAND

System knowledge / systeemkennis

- Hoe werkt het natuurlijk systeem en wat betekent dit voor verschillende landgebruiksvormen? NATCAP
- Wat is de connectiviteit binnen het systeem (chemisch, biologisch, fysisch)? NATCAP
- Hoe kan het bodem-sediment-water systeem worden gemonitoord om meer begrip te krijgen van de werking van het systeem?
- Welke invloed heeft het bodem-sediment-water systeem op maatschappelijke ontwikkelingen? IMPACT
- Wat zijn de 4D (x,y,z en t) effecten van landgebruik en ingrepen in het natuurlijk systeem? IMPACT
- Wat is de flexibiliteit van het natuurlijk systeem onder invloed van ingrepen? IMPACT
- Wat is het gecombineerde effect van kleinschalige ingrepen en maatregelen op het functioneren van het gehele bodem-sediment-water systeem? Wat betekent dit voor de potentie van het bodem-sediment-water systeem om bij te dragen aan maatschappelijke opgaven? LANDMAN
- Hoe gaan we op de juiste manier om met schaalniveaus en afbakening van systemen irt systeemkennis? LANDMAN

Valuation of the SSW-system (ecosystem services) /waardering van het natuurlijk systeem

- Wat is de (belangrijkste) bijdrage van het bodemecosysteem aan natuurlijk kapitaal en welke systeemkenmerken zijn hiervoor bepalend? NATCAP
- Hoe kunnen we deze systeemkenmerken optimaliseren of herstellen? NATCAP
- Is organisch stof dit kenmerk (betekenis van organisch stof voor bodemfuncties:bodemvruchtbaarheid, infiltratie, carbon storage, filtering, soil resilience)? NATCAP
- Wat is de betekenis van bodem(leven) voor maatschappelijke opgaven? NATCAP
- Wat is de NATCAP
- Is er een graadmeter aan te wijzen voor goede bodemkwaliteit en kan deze worden uitgewerkt tot communicatiemiddel, monitoring-onderwerp en herstelmaatstaf? NATCAP
- Hoe kunnen we het ecosysteem op een duurzame manier benutten (van “weten wat het ons te bieden heeft”, implementatie via building with nature concepten en eco-engineering, tot beëindigen van gebruik en herstel)? LANDMAN
- Wat zijn mogelijkheden van ecosysteemdiensten en hoe optimaliseren, waarderen en verzilveren we die? LANDMAN
- Hoe kunnen bedrijven / industrieën bepaalde diensten leveren met hun bodem/oppervlakte om diensten te leveren voor de omgeving ? LANDMAN

Data and information / data en informatie

- Wat kan (big/open) data betekenen voor omgaan met natuurlijk systeem en landgebruik voor verschillende stakeholders? LANDMAN
- Hoe krijgen we betere afstemming / eenduidigheid binnen informatie van 'landelijke' portals (bijvoorbeeld informatiehuizen aan de laan van de leefomgeving, atlas natuurlijk kapitaal)? LANDMAN
- Hoe verbeteren we data(beschikbaarheid) voor monitoring en modellering? LANDMAN
- Hoe verbeteren we vastlegging, uitwisseling en gebruik van ondergronddata op nationaal en Europees niveau? LANDMAN
- Hoe kan data vertaald worden naar informatie die gebruikt kan worden in de besluitvorming? LANDMAN
- Welke schaalgrootte voor informatie is benodigd voor landbeheer?
- Wat kunnen observatoria (landschapsobservatorium, bodemobservatorium) bijdragen aan bruikbare data en kennis? LANDMAN
- Hoe ontsluiten we de kennis en informatie die buiten de BasisRegistratie Ondergrond (BRO) valt (natuur, water, klimaat, bodembiologie, andere GOAL informatie: (Gegevensvoorziening Omgevingswet voor Activiteiten in de Leefomgeving, uitvoeringsprogramma digitalisering ikv de omgevingswet))? LANDMAN

Landuse / Landgebruik

- Hoe ziet de toekomstvisie (omgevingsvisie) op het gebruik van de (ondergrondse) ruimte eruit in Nederland? DEMAND
- Welke (locatie)specifieke ecosysteemdiensten zijn in te zetten om bepaalde functies te kunnen realiseren in een gebied en wat zijn de mogelijkheden van ecoengineering of building with nature hierbij? NATCAP
- Hoe ziet optimaal landbeheer er uit? LANDMAN
- Hoe geven we input aan de discussies rondom duurzaam landgebruik over secorale grenzen heen en met medeneming van verschillende toekomstbeelden? LANDMAN
- Hoe kunnen we omgaan met landeigenaarschap in relatie tot de visie op duurzaam landgebuik? LANDMAN
- Hoe is duurzaam landgebruik te optimaliseren, mede op basis van bodemkwaliteiten, op verschillende schaalniveaus? LANDMAN

Annex V: Overview on engagement with National Key Stakeholders

Under lead of the NFPs (see section 1.2), in each country a selected group of National Key Stakeholders (NKS) have been contacted and interviewed in order to collate the information needed for being able to achieve the objectives of WP2. These selected groups of NKS (approx. 20 per country) represent for each country a balanced distribution of stakeholders deriving from the research funding and industry/business communities (including SMEs), the scientific, consultancy, policy-making, management arena as well as NGOs. Thus, it is a mix of knowledge 'producers', 'consumers/end-users' and 'funders' (cf. also deliverable 2.3)[20].

In total:

- **374 individual NKS were interviewed, and**
- **468 individuals participated in the national workshops.**

The following figures present some statistics in order to provide further insights on the background of the interviewed NKS and on the workshop participants:

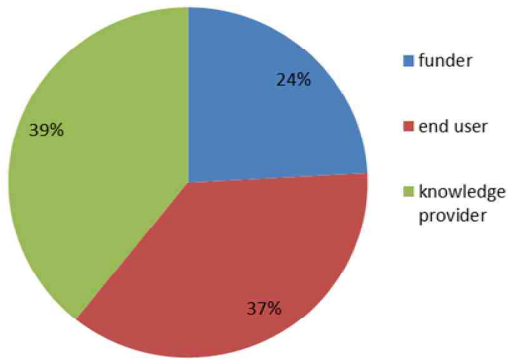
Overall (all INSPIRATION countries pooled together):

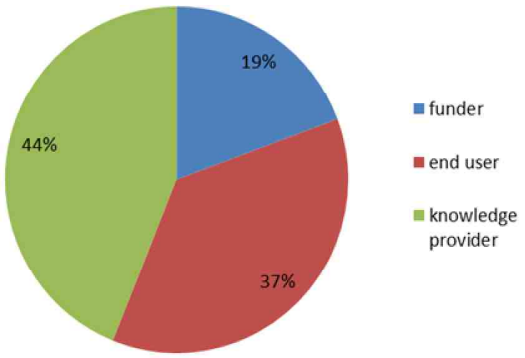
- Figure 3: Division "funders / end-users / knowledge providers",
- Figure 4: Interviewed NKS and workshop attendees per stakeholder category,
- Figure 5: Interviewed NKS and workshop attendees per expertise domain,

Per county (countries presented individually besides each other in one graph):

- Figure 6: Individuals participating in the interviews and workshops,
- Figure 7: Division of "funders / end-users / knowledge providers",
- Figure 8: Division in stakeholder categories,
- Figure 9: Division per expertise domain.

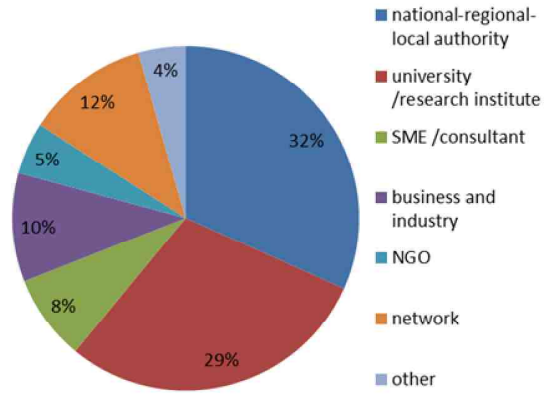
[20] Maring L, Ferber U, Dictor MC, Starzewska-Sikorska A, Klusáþek P, Panagopoulos T, Bal N, Tabasso M, Cotiþ B, Nathanail P, Garcia G, Pütz M, Finka M, Zechmeister-Boltenstern S, Dumitru M, Rehunen A, Brils J (2015): Registry of National Key Stakeholders cooperating in INSPIRATION. Update 1 version as of 30.06.2015 of deliverable D2.2 of the HORIZON 2020 project INSPIRATION. EC Grant agreement no: 642372, UBA: Dessau-Roßlau, Germany.

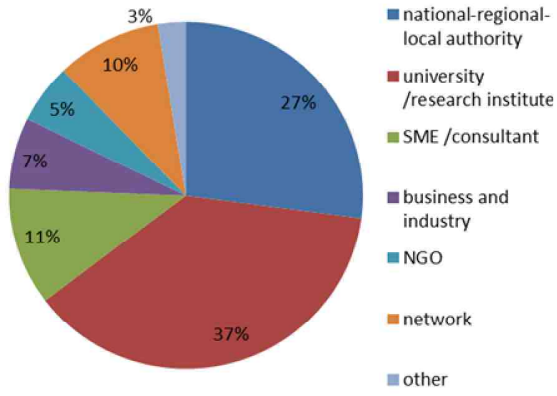




***a**: interviewed NKS (total 374)* ***b**: workshop attendees (468)*

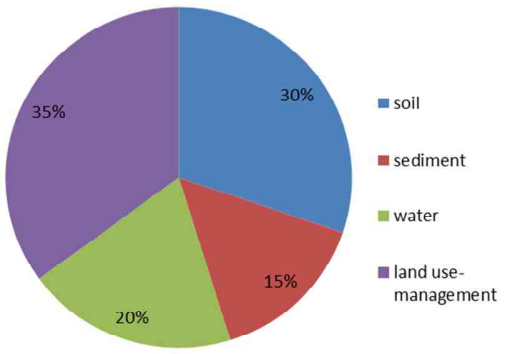
***Figure 3**: Division "funders / end-users / knowledge providers".*

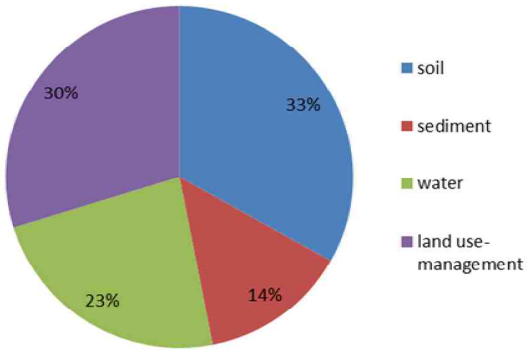




***a**: interviewed NKS (total 374)* ***b**: workshop attendees (468)*

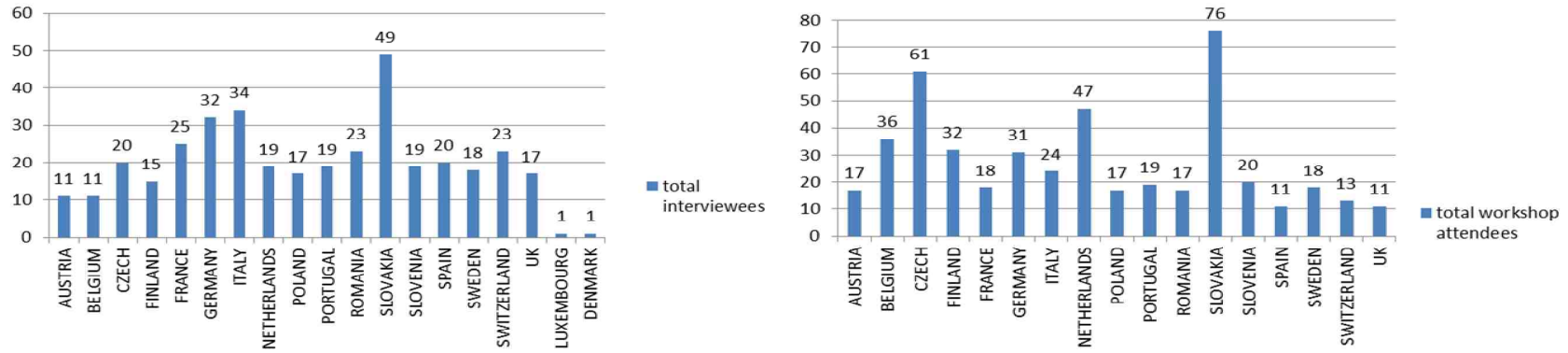
***Figure 4**: Interviewed NKS and workshop attendees per stakeholder category.*





***a**: interviewed NKS (total 374)* ***b**: workshop attendees (468)*

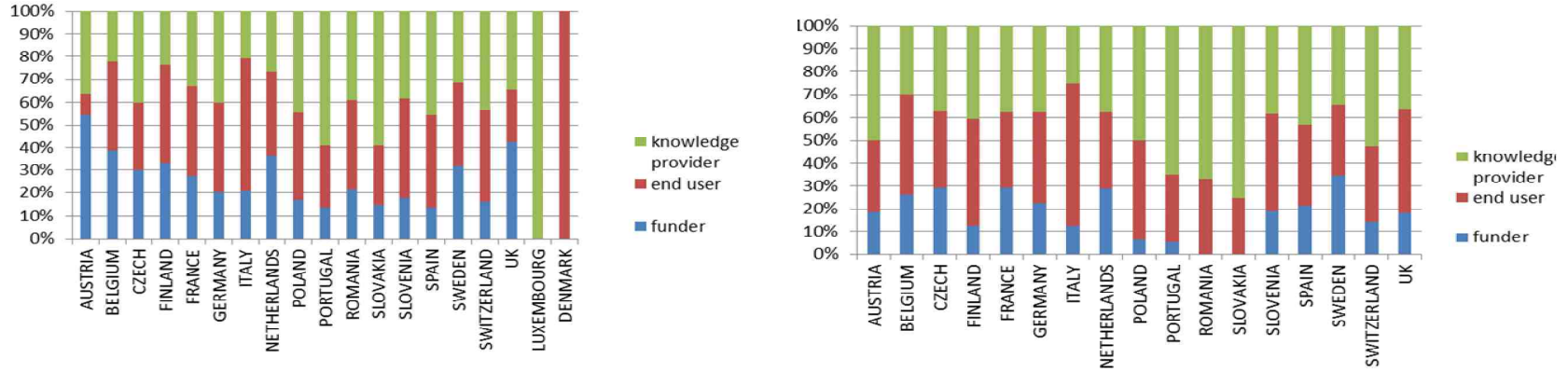
***Figure 5**: Interviewed NKS and workshop attendees per expertise domain.*



***a**: interviewed NKS*

***b**: workshop attendees*

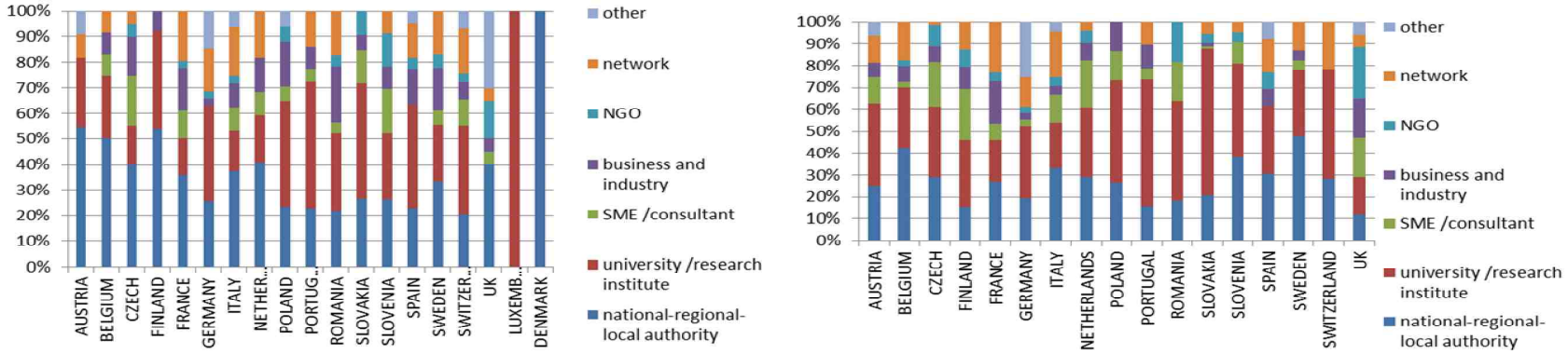
***Figure 6**: Individuals participating in the interviews and workshops.*



***a**: interviewed NKS*

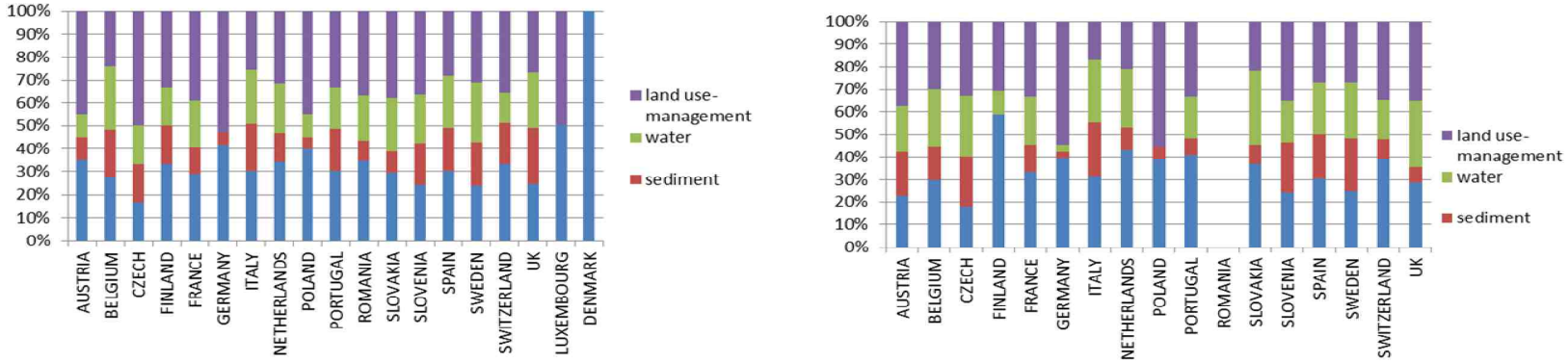
***b**: workshop attendees*

***Figure 7**: Division of "funders / end-users / knowledge providers".*



***a**: interviewed NKS* ***b**: workshop attendees*

***Figure 8:** Division in stakeholder categories.*



***a**: interviewed NKS* ***b**: workshop attendees*

***Figure 9:** Division per expertise domain.*

Annex VI: NKS questionnaire template

This is the updated version of the questionnaire - reflecting inputs from the IAB and discussions at the NFP training in Vienna on 22nd – 23rd June 2015.

Note: this questionnaire template is meant to help National Focal Points (NFPs) to facilitate the interview/conversation with the National Key Stakeholders (NKS). Some questions are relevant to one NKS, other questions to another NKS. Hence, not all questions are relevant to each single NKS. The NFPs are required to adapt the template accordingly – keeping in it as many as possible of the issues to be addressed. If needed, the NFPs also translate the questionnaire into their national language.

The questionnaire (see next pages) has the following outline:

A. **Interview information:**
   To be filled out by the interviewer

B. **Introduction:**
   That the interviewer can use to start the NKS interview

C. **Background information of the NKS interviewed:**
   Mostly 'tick-boxes'

D. **Strategic Research Agenda (SRA):**
   NKS preferred topics, overarching themes and scope for the SRA and national state-of-the-art on research agendas that the NKS is aware of

E. **Science-Policy-Interface:**
   NKS experiences regarding the exploitation of scientific knowledge to: improve business opportunities; tackle other societal challenges; assist policy-implementation and/or policy revision

F. **Funding:**
   Predominantly used as well as promising alternative funding schemes / mechanisms / programs for knowledge production and dissemination that the NKS is aware of

G. **Other:**
   At the end there is some time advised to let the NKS give us their advice, some nice quotes (that we can use anonymously in our communications), examples etc.

H. **Ending the interview:**
   Explain follow up and if/how NKSs will be involved in the next steps of INSPIRATION

Questionnaire template

A. Interview information
Country: Name of INSPIRATION researcher: Date of Interview: How does the NKS wish to be referred to: *[Anonymous, personal opinions, company's opinion. Choose when it is a good time to discuss this. In the beginning or later on.* *SHOW the interviewed NKS the ENGAGEMENT CONSENT FORM and ask him/her to fill it out. Please introduce the engagement consent form (available in 'D2.1 MoU' and editable by yourself) and hand a copy to the interviewee to read and fill in – make sure that you take this away with you and keep for your own records]*
B. Introductions
[Please introduce your selves, the project and the purpose of the interview. You can use the handout as provided at the end of this template. This can also be sent beforehand to the NKS. Agree on a time span: approximately one and a half hour.]
C. Background information on the interviewee
1. Name of NKS interviewed: 2. Institution: 3. Role:
4. Are you a (multiple answers possible): o National-regional-local authority o University/research institute o Small or Medium sized Enterprise (SME, i.e. < 500 employees) / consultant o Business and industry o Non-Governmental Organisation (NGO) o Network representative / leader o Other, specify: …
5. Fields of expertise (multiple answers possible): *[Ask to specify background regarding the selected item(s) in order to understand expertise background of interviewee]* o Soil o Water o Sediment o Urban / spatial planning o Landscape design o Land management o Other, specify: …..

6. Does your organisation provide external research funding?
   - o Yes. Please specify: ...
     [e.g. as programme holder, public, private, …]
   - o No

D. SRA

7. Which societal challenges do you regard as important?

   [*If needed, you can use the European Commissions (EC) list of societal challenges here. These EC themes are*:]

   - Contribute to food security and food safety;
   - Ensure secure supplies of safe drinking water;
   - Secure energy supply and distribution;
   - Reduce raw material and resource consumption, Ensure efficient use of natural resources;
   - Contribute to climate change mitigation and societal adaptation;
   - Contribute to a healthy living environment;
   - Ensure secure infrastructure

   [Explain that these challenges may be used as bases for defining of the overarching themes for aggregating the research topics of our SRA.]

   a. If applicable, what additional, other or alternative challenges would you suggest/prefer?

   [When needed, you can mention challenges as nature conservation, sustainable use of ecosystem services, halting the loss of biodiversity]

8. Starting with your own experience: which <u>specific topics</u> (research needs) should be included in the SRA?

   [For each single topic mentioned by the NKS, use the following follow-up questions. The a, b and c sub-questions are mandatory. The other sub-questions are optional]:

   a. Explain – elaborate the topic
      - *Who will be affected?*
      - *Who is responsible?*
      - *Is it a topic of concern of your organisation / department*
      - *Is it only a national topic, or a shared topic by multiple countries?*
      - *Where are we now, where do we want to be in x years (point on the horizon)?*
      - *How can the newly gained knowledge be effectively used?*

   b. Priority:
      1. *High priority*
      2. *Some priority*
      3. *Neutral priority*
      4. *Low priority*
      5. *No priority*

      - What is the urgency, i.e. what goes wrong if we do nothing?

   c. Who wants to/should fund this kind of research?

[Optionally: check the following WP3 key-words for relevance, i.e. if they raise any additional topics by the NKS. The key-words can be used as support / check list

Be sensible as interviewer if this is needed.]

- *Assessment of land resources*
- *Potential productivity of land and soils*
- *Demand for soil/land resources, imports and exports*
- *Competition between land uses (land-use conflicts)*
- *Concepts to identify and quantify relevant impacts*
- *Instruments to avoid / minimize impacts (feedback to decision-making process)*
- *Opportunities of innovative land-use technologies*
- *Resource-oriented land management systems]*
- *Soil regeneration*
- *Soil and groundwater remediation*

9. Linked to topics mentioned by the NKS:
   a. What are the important / relevant documents, research agendas, research programmes underpinning these topics? (state-of-the-art)
   b. Related to these agendas and programmes: what are timelines of programming and windows-of-opportunities to influence agendas / programmes?

   [Note: question 9b is input for work package 5]

E. Science-Policy-Interfacing (SPI)

10. How would you define 'scientific knowledge'?

11. For what do you use scientific knowledge in your job?

12. Which sources of (scientific) knowledge do you use for doing your job?

    [Open question and you can mention some of the sources underneath as examples]

- *scientific paper*
- *consultants*
- *reports*
- *colleagues*
- *experiences /examples within my own country*
- *experiences /examples abroad*
- *newspapers*
- *television*
- *conferences Involvement in research projects*
- *data (bases)*
- *websites, such as: …..*
- *other, specify: …..*

13. To what extent do you use most recent/new scientific knowledge (i.e. state-of-the-art scientific insights/findings) for doing your job?

14. To what extent are you able to influence (and how) the setting of scientific research policies/agendas in our country?

15. To which extent do our national policies/agendas reflect your specific needs and priorities?

16. To what extent has been made use of the state-of-the art in scientific research for the formulation of existing policies in our country?

[Questions only for NKS from the non-science sector (business and policy):]

17. Have you ever been involved in:

    a. the formulation of scientific research questions?
    b. doing scientific research (i.e. knowledge co-creation)?
    c. synthesizing/wrapping-up of scientific knowledge, e.g. to feed into policy making or to increase business opportunities?

[When yes: Follow-up questions]

- How successful/satisfying was this, on a scale of 1-5?
    1. *Very successful/satisfying*
    2. *Successful /satisfying*
    3. *Neutral*
    4. *Unsuccessful/unsatisfying*
    5. *Very unsuccessful/unsatisfying*
- What went well
- What could be improved?
- What to avoid/not to do?
- Additional remarks?

[Question only to NKS who are likely to have insights here (e.g. research funders)]

18. (How) is the societal impact of scientific research related to the scope of INSPIRATION being assessed in our country?

[If they know: Follow-up questions:]

- How successful/satisfying is this, on a scale of 1-5?
    1. *Very successful/satisfying*
    2. *Successful/satisfying*
    3. *Neutral*
    4. *Unsuccessful/unsatisfying*
    5. *Very unsuccessful/unsatisfying*
- What indictors are used?
- What goes well?
- What can be improved?
- What to avoid/not to do?
- Additional remarks?

19. Which national Science-Policy-Interface documents do you know of / can you recommend?

F. Funding

20. Which experiences and expectations in funding schemes (public / private) do you have in your own field that could offer opportunities for future research on land-use and -management and related impacts to Soil-/Sediment-/Water-systems:

    - Sub-nationally/regionally?

- Nationally?
- European? [*e.g. H2020, Interreg, multi-lateral such as the Joint Programming Initiatives*]
- International? [*e.g. Belmont Forum, Foundations.*]

[For all R&I questions aiming at achieving policy targets in the Land & SSW related system (like e.g. Sustainable Development Goals on soils, existing EU directives such as the Environmental Liability Directive, etc.) consider all Public and Private funding sources. Please ask to provide details and give most important references (documents, website) that could be relevant for explaining the answer]

21. How to increase the added value of different financial resources (i.e. achieve a multiplier) for doing research that contributes to EU and national demands, in particular to the R&I demands on Land and the SSW-system?
[*CONSTRUCTIONS that (could) work. PP, PPI, etc. Just ask for, as open as possible for suggestions, ideas, experiences, good examples*]

22. Are there areas of research and innovation (R&I) that you are aware of that are not (yet) covered by current funding mechanisms and which would need new/different funding schemes / infrastructures?

23. Integrated approaches (necessary for addressing particular societal challenges related to the use and management of land and related impacts to SSW systems) are usually difficult to fund / get recognized by the research funding communities. What would be necessary to improve this?

24. Based on previous learning experiences that you are aware of: how to best set up / govern funding option(s), so that societal demands will be fulfilled, knowledge resulting from execution of the SRA will be taken up and used; and funders experience that their invested, national Euros are indeed multiplied? *[if they know: follow-up questions]*

- How successful/satisfying was this, on a scale of 1-5?
  1. *Very successful/satisfying*
  2. *Successful/satisfying*
  3. *Neutral*
  4. *Unsuccessful/unsatisfying*
  5. *Very unsuccessful/unsatisfying*
- What went well?
- What could be improved?
- What to avoid/not to do?
- Additional remarks?

G. Other (remarks, suggestions, examples):

H. Ending the interview

Thank you for taking the time to participate in this interview:

- Would you like us to keep you updated about INSPIRATION progress?
- Would you suggest anyone else who we should be interviewed by us?
- Do you have further questions arising from this interview, or would you like to add anything else?
- What information are you interested in, and willing to give feedback on?

  [Discuss the feedback mechanism and if they have expressed their opinions as a person or as a representative of their organisation/network. Checklist:]

  a. Information to exchange / willingness to give feedback on:

     - o (complete interview, not recommended)
     - o summary of main conclusions
     - o national report, national contribution to D2.4
     - o complete D2.4, all countries

  b. Preferred level of feedback:

     - o no feedback
     - o informal feedback
     - o formal feedback (e.g. on behalf of represented organisation)

[Check: have you discussed consent form / how to refer to interviewee]

INSPIRATION acknowledges the received funding from the European Community's HORIZON2020 Framework Programme under grant agreement no 642372

Annex VII: NKS hand-out: INSPIRATION interview at a glance

INSPIRATION interview at a glance

Aim of INSPIRATION:

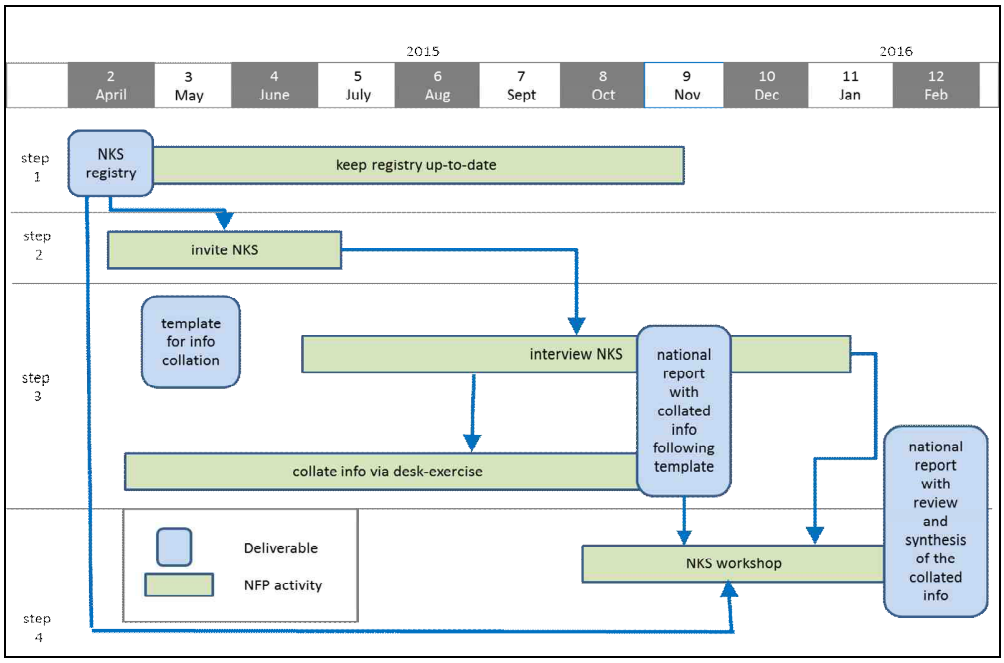
The main purpose of the EC-funded INSPIRATION project is to formulate an end-user driven strategic research agenda (SRA) for land-use, land-use changes and the related, impacted compartments of the Soil-Sediment-Water (SSW) system in order to meet current and future societal challenges and needs. Next to that, the project aims to scope out models of implementing the SRA and to prepare a network of public and private funding institutions willing to commonly fund the execution of the SRA.

National Key Stakeholders (NKS):

In a series of NKS interviews across EU nations the "National Focal Points (NFP) gather for nations individually information related to the INSPIRATION scope (land and SSW-system use and management) on:

- Research and Innovation (R&I) needs
- Experiences regarding connecting science to policy/practice
- National and transnational funding schemes

In the interviews we focus at NKS – like you – positioned at a strategic level, i.e. leading persons in their field of profession; with a good overview on opportunities; a clear vision on, and insight in knowledge demands (short, middle and long-term). Furthermore, these NKS are well positioned and participate in relevant professional network(s) and may also have potential to become an ambassador for INSPIRATION. We selected NKS to represent different disciplines and institutional backgrounds including: land-use planners; managers; soil, sediment and water experts; researchers, funders and regulators/policy makers.



Workflow in the first year of INSPIRATION

This interview:

Collecting input from you – an expert in your field – is crucial for the project in order to help us describing the state-of-the-art in our country as input into the European research agenda. In the interview we will go through a series of topics and questions: The interviews of NKS (ca. 20 per nation), together with a desk study on research needs and funding possibilities will be synthesized to a 'national report'. This synthesis will be reviewed in a national workshop, to prioritize the topics for the suggested Strategic Research Agenda (SRA) from our country's point of view. The national reports will finally be used as input for elaborating the European SRA and cross-nation matchmaking (matching research needs to possible funding).

Example questions:

Research and Innovation (R&I) needs

- Which societal challenges do you regard as important?
- Starting with your own experience: which specific topics (research needs) should be included in the SRA?

Experiences regarding connecting science to policy/practice

- How would you define 'scientific knowledge'?
- To what extent has been made use of the state-of-the art in scientific research for the formulation of existing policies in our country?

National and transnational funding schemes

- Does your organisation provide external research funding?
- Which experiences and expectations in funding schemes (public / private) do you have in your own field that could offer opportunities for future research on land-use and -management and related impacts to Soil-/Sediment-/Water-systems

Your benefits from participating:

- A chance to influence the European SRA on land and SSW management in the light of societal challenges and needs;
- Being able to make use of the results of the project: overview of research need and of existing and promising funding schemes on different levels (sub-national, national, European, international) and opportunities for a better connection between science and policy/practice;
- Use the matchmaking opportunity to get in contact with other networks in- and outside our country, and countries learn which shared challenges can be taken up jointly.

Contact and further information:

For general information on the INSPIRATION project visit our website: www.inspiration-h2020.eu

Contact the National Focal Point: **See the INSPIRATION website for contacts**	Contact the general project coordination: Stephan Bartke stephan.bartke@uba.de

INSPIRATION acknowledges the received funding from the European Community's HORIZON2020 Framework Programme under grant agreement no 642372