How to reach societal impact with land subsidence research

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Introduction

Many low-lying river deltas, home to over 500 million people, host vast areas of intensely used land surface that are subsiding due to natural causes and human-induced activities. The physical consequences of subsidence are manifold: relative shallowing of groundwater tables, salinization of ground and surface water, emission of greenhouse gasses (GHG), damage to buildings and infrastructure, and increased flood risk, flood water depth and flood duration. For delta societies this leads to serious economic loss through reduced agricultural yields, arable land loss, rising costs of maintenance and repair of lost assets, and forced sectoral divestments. For the Netherlands, economic damage of progressive subsidence could add up to 22 billion Euros by 2050 with continuing current policy (Van den Born et al. 2016).

An urgent need exists to strengthen the capacity to develop (innovative) management strategies mitigating subsidence on both local and regional spatial scales and on the short- to long-term. This requires fundamental knowledge on causes, mechanisms and rates of land subsidence, scenario forecasts and action perspectives that can be applied by policy makers and other stakeholders to take well-informed and fair decisions (Erkens et al., 2015; Erkens & Stouthamer, 2020, Stouthamer et al., 2020).

The research programme Living on Soft Soils – subsidence and society (LOSS) is an integrated research programme that addresses the issue of land subsidence in a holistic way, whereby insights about physical-chemical-biological system functioning, development, evaluation, and implementation of measures as well as an assessment of their governance and legal implications co-evolve (Stouthamer et al., 2020). The overall aim of this programme is to develop an integrative approach to achieve feasible, legitimate, and sustainable solutions for managing the negative societal effects of land subsidence. LOSS connects fundamental research on subsidence processes to socio-economic impact of subsidence and to governance and legal framework design.

With the LOSS programme and other research programmes, The Netherlands invests heavily in scientific and applied scientific research on land subsidence. The challenge is to implement the resulting (fundamental) knowledge in practice and to reach societal impact. But how can scientific programmes go about this challenge and what is needed to be successful in this regard? In this extended abstract we describe how, in the case of the Living on Soft Soils (LOSS) programme, this challenge is addressed and what we have learned in the past three years.

Theory of Change and the Impact pathway

LOSS is a programme within the Dutch national science agenda (NWA) which is coordinated by the Dutch Research Council (NWO). NWA is organized around societal focus areas and strives to ensure that (scientific) knowledge developed in the funded programmes is used to tackle social challenges. To reach 'knowledge utilisation' and 'societal impact' (Barnett & Gregorowski, 2013; NWO, 2022) there is a new standard for programme set-ups. In this set-up, programmes must define their intended societal impact, and their plan to achieve this, in the proposal. This standard is now increasingly followed by other international programmes, and it is expected that it will become more common practice in Dutch and international research funding (Barnett & Gregorowski, 2013; NWO, 2022; van Drooge et al. (2022)).

NWA developed guidelines to incorporate societal impact and knowledge utilisation in the proposal and throughout the research; the Theory of Change. The Theory of Change provides guidelines for proposals on describing how and when research and stakeholders are expected to bring about a desired change in a specific context (Barnett & Gregorowski, 2013; NWO, 2022). The theory consists of a problem analysis and an impact pathway design (Fig. 1).

The first step is to analyse and describe the problem and underlying causes. This step contributes to creating a joint vision and thus a joint interest in the research. Because there are (or can be) different views, backgrounds, and experiences, this is best done with all stakeholders involved. Being aware of (sometimes implicit) assumptions of different stakeholders is important in this process. These assumptions should be made explicit so that all stakeholders know assumptions made by their colleagues or other stakeholders. By identifying the problem, the causes and assumptions of knowledge needs will become clear. These knowledge needs are then translated into desired research output for the overall programme and the individual researchers.

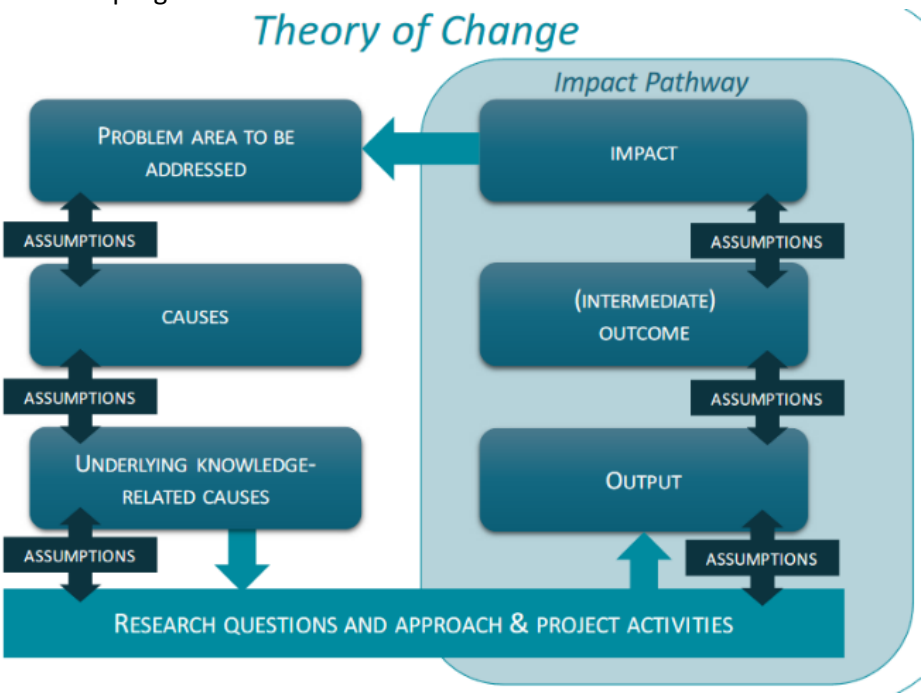

Figure 1 Theory of Change (NWO, 2022). The method aims to reach societal impact and offers tools to (research) programmes for a structured approach dealing with the challenge of facilitating and stimulating the use of scientific results in practice. It starts with a problem definition resulting into research outputs. The impact pathway defines the steps to optimise the changes of societal impact.

Impact pathway

By drafting an Impact Pathway scheme, the steps and efforts of stakeholders needed to reach the desired societal change, are determined. The Impact pathway reasons back from the desired impact and defines which research outcomes are needed for the desired impact and which research outputs are needed for the research outcome (see Fig. 1).

In the Impact Pathway scheme, impact is defined as changes that are in part or entirely the consequence of knowledge and expertise generated by research. These changes can be behavioural, cultural, economic, industrial, ecological, or social. Who needs to do what differently if the desired impact were to be achieved, is indicated in de outcome. The outcomes are generated by stakeholders and (partly) in collaboration with the programme. Outcomes require the research outputs as input (Fig. 2). Research outputs are directly generated by a research programme and may consist of scientific papers, new articles, or numerical models.

Figure 2 Impact pathway; from research outputs via research outcomes to impact (source: NWO). To reach impact, stakeholders need to change behaviour. By determining outcomes, it becomes clear who needs to do what differently. Outputs then are generated to support those different stakeholders (the who) to be able to change behaviour (the what) - stakeholders use the results of the programme.

Stakeholders' role to reach societal impact: lessons learned from the LOSS programme

The desired societal impact of the LOSS programme is 'contributing to knowledge-based, well-informed decision making on land subsidence' and outcomes and outputs are set to contribute to this desired impact (see Fig.2). LOSS aims to optimise the flow from output to outcome. One strategy to do so was working with stakeholders to peel back integral societal issues into research questions and via outputs and outcomes back to societal answers. To stimulate and facilitate working together, LOSS aims to create an open environment and the right preconditions. In the next paragraphs we describe how LOSS has been doing this and what we have learned writing the proposal and during the course of the research.

Five stakeholder groups

Stakeholders were actively involved in the development of the proposal to tailor the structure of the programme to optimise (intended) research output and the coordination between output and outcome. The problem definition and shared sense of urgency did not need much attention. Attention for the (consequences of) land subsidence was already established and there was a joint vision that research into physical-chemical-biological system functioning, development, evaluation, and implementation of measures as well as an assessment of their governance and legal implications were needed.

However, it became clear in this early stage that although the overall vision and interests were aligning, stakeholders had different interests, needs, expertise and roles regarding knowledge development and dissemination. As a result, the LOSS programme distinguished five 'stakeholder groups': universities, knowledge institutes, consultancies, governments, and society.

Stakeholders focus on output or outcome

Some stakeholders have a focus on research output, where others are more focussed in research outcome or even on impact. Fig. 3 shows that all stakeholders are essential in the impact pathway, but that they have their own role in reaching societal impact. The differences in interests, needs, expertise and roles regarding knowledge development and dissemination are essential, since the different roles in the pathway ask for these differences. A lesson learned from setting up the LOSS programme is that an early engagement of stakeholders groups specifically for research output, outcome, and impact, improves the research uptake during and after the programme execution.

Universities and (applied) research institutes are output-focussed and develop knowledge and techniques and apply this knowledge (through models) mostly on national or international scale. In this, universities are mostly concerned with fundamental understanding, while (applied) research institutes mainly translate this into possible consequences. For example: calculation rules are typically developed by (applied) research institutes, while the process understanding of these rules mostly comes from universities.

Both universities and institutes are essential to translating societal issues into societal questions and research questions since comprehension or recognition of the problem is needed to define research questions. Universities and (applied) research institutes develop new knowledge, but generally have only limited capacity for the full dissemination of knowledge.

Consultancies and governments are more outcome focussed. They use and disseminate the knowledge to understand and untangle (provincial or municipality scaled) problems, providing them with a knowledge base for policy development. For example, civil servants that advise policy makers or politicians, need fundamental knowledge when they are faced with problems such as land subsidence to understand the problem at hand. This fundamental knowledge about mechanisms or impact of land subsidence most likely comes in the form of calculation rules, scientific explanations in (scientific) papers and numerical models. The civil servant receiving this information therefore needs to have a scientific background in the relevant field to be able to use this information. This is rarely the case. Consultancies have more possibilities to specialize and consequently do have the knowledge needed. The lesson learned in LOSS: If a research programme aims to generate long-lasting societal impact, it is essential to include partners such as consultancy bureaus, that translating fundamental knowledge into studies used in policy design and implementation.

LOSS stakeholder involvement

LOSS has been organising stakeholders-researchers meetings at least twice a year, one-on-one meetings and site visits where stakeholders and researchers are stimulated to show, share, and discuss needs and expectations. The goal is to enable stakeholders to follow and monitor research output and talk about their wishes and needs regarding the research output, allowing for intermediate adjustments in the research. It also aims to optimise co-creation and collaboration between all stakeholders and in extension optimise the chances of knowledge utilisation. This approach also contributed with incorporating stakeholders needs into the programmes proposal. For example, the ministries need for a detailed land subsidence model to formulate realistic objectives (rail)ways.

Additionally, researchers help governments to disentangle the complex societal problems into comprehensible (research) questions.

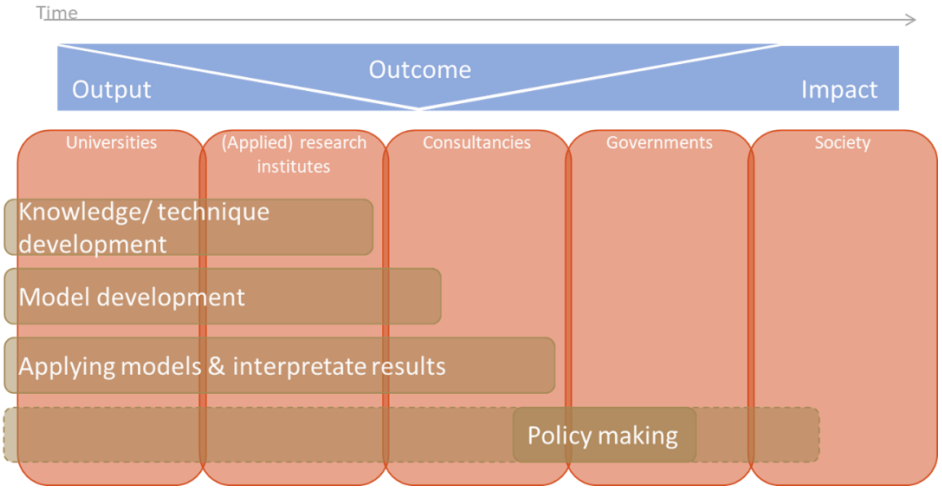

Figure 3 Stakeholder groups (pink) and roles (brown bars) in realizing the impact pathway (blue bar). Every stakeholder group is essential in the pathway from output to impact and have a specific role. For example: To give good advice to the government about possible and effective measures, consultancies need state of the art models and knowledge. Consultancies need universities and (applied) research institutes to do (fundamental) research and develop knowledge that can help them improve their models. Universities and (applied) research institutes need consultancies to bring knowledge into practice. In the end, society benefits when governments use up to date knowledge to make their policies effective and efficient.

Concluding remarks

How can scientific programmes go about the challenge of (applied) research utilisation in practice and, by extension, reach societal impact? Specifically for the LOSS research programme we conclude three key factors for success:

- A joint problem statement and articulation resulting in a research proposal including an impact pathway; The Theory of Change and Impact Pathway scheme give a valuable framework to structure research programmes in such a way that the chances of contributing to societal impact are optimised.

- Assigning roles to stakeholders, based on interests, needs, expertise regarding knowledge development and dissemination; For each element in the Impact Pathway scheme, output, outcome, and impact, different stakeholders group are relevant, they should be identified and included.

- Follow the Impact Pathway scheme as a guideline throughout the project, and update and adjust when needed. During the LOSS programme it became clearer that the role of consultancies in the knowledge chain is essential, since they are the link between (applied) research institutes and policy makers and are crucial for the pivot point 'outcomes'. We think that societal impact cannot be achieved if this group is not included. Simultaneously LOSS experienced that involving consultancies in research programmes is a challenge and needs more attention.

This approach is likely to be also successful outside the Dutch context and culture. Most international research programmes are rooted in societal issues and aim to reach societal impact. Also, the different stakeholder groups and their role in knowledge development, dissemination and implementation are not typically Dutch. Because the emphasis of the method lies societal impact through co-creation and durable engagement of stakeholders, the Theory of Change, Impact Pathway scheme and three key factors for success would also be relevant elsewhere.

Acknowledgement

The research presented here is part of the NWA project Living on Soft Soils: Subsidence and Society (grantnr.: NWA.1160.18.259).

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