Identification of Grand Challenges

An Approach to identifying Grand Challenges and links to e-infrastructures for research in agriculture & food

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EXECUTIVE SUMMARY

e-Infrastructures for research have to help research to be more effective and efficient in contributing to the achievement of the societal or grand challenges as captured by the Sustainable Development Goals, or the Europe 2020 strategy. Even if this sounds obvious, this is not self evident how to link challenges as comprised by the societal goals and impacts of research, to the role of research and the supporting role of e-infrastructures and associated ICT and data solutions. In this deliverable we describe an approach for linking these elements in comprehensive storylines. The assumption is that these links cannot be meaningfully done on the general level, but need to be understood on a case by case basis first before overall lessons can be drawn based on a requirements analysis across cases that are similar. These synthesized overall requirements subsequently provide guidance for the development of e-infrastructures of relevance to agriculture and food, that will be the final outcomes of Work Package 2 “Challenges & Ambitions”. In this deliverable we describe the general approach to the WP, the format for describing the cases, and the preliminary set up of two cases, where more cases will be developed also with invitations to the community through online campaigns.

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1 GENERAL APPROACH

Operational Objectives of WP 2 on societal challenges as part of e-ROSA

- Link research for impact towards the societal challenges to data and IT challenges that could potentially be solved by e-Infrastructures
- Raise awareness in the community of researchers working on research for societal impacts of potential e-services they could benefit from

Approach

- Develop storylines/case studies from end-user impacts to data and ICT challenges, as they are being tackled currently in the research community and as they could be tackled in the future with advanced data and ICT platforms
    - Base these storylines on the Impact Chain approach (see background below at Section end)
    - Incorporate an awareness of end-users and beneficiaries of the research
    - Reflect on the role of research in tackling societal challenges, also in relation to supporting decision making by private and public sector or by civil society
- Use the Second Stakeholder Workshop as part of e-ROSA to uncover the data and ICT challenges that are common to many storylines/use cases
    - Aim should be partly validation exercise for the storylines: are they correct? Are things missing?
    - Energise the community to deliver their own storylines/case studies for their challenges
    - Organise a workshop with working and discussions sessions and short presentations (10-15 min max)
- Use an online campaign to attract attention to the storylines/use cases and present some of them in more detail.
    - Present the general approach
    - Present and discuss specific storylines more in detail

General considerations

- The societal challenges as covered in for example the SDGs, Food2030 or policy agendas (such as gender inclusive development, resilient agriculture) are generally on a very high level of abstraction, therefore potentially a massive amount of research could fit under it. In many specific research projects a link is made between these abstract societal challenges, and the concrete day-to-day research objectives. Thus, it is required to reason through the link between the abstract societal challenges and the concrete research priorities and activities, to get to a link with IT and data as comprised in e-infrastructures.
- There is a challenge in delineating the problem space. For example, a societal goal as SDG 2 on Ending Hunger links to malnutrition, undernutrition, obesity, and sustainable agriculture, thus combining health aspects to nutritional intake to agricultural production of those nutritional foods and finally, environmental conditions like soil health and climate change. For the purpose of this project, it seems relevant to include the nutritional aspects of agricultural production, but not include the full link to health. Especially a value chain perspective from production to

consumption of foods (i.e. a healthy diet in local context) seems relevant as here some of the data and ICT challenges will be adressed in combining different types of data.

- For community engagement and the online campaign it is required to ensure enough lead time of events, present attractive and easy to distribute materials and activate existing networks as much as possible to reach maximum participation and visibility.

Set up of the November workshop (Second e-ROSA Stakeholder Workshop)

- First half day: societal and scientific challenges:
  - Invited presentations on the societal challenges, impact chains and the role of research as part of this
  - Should link to the storylines elaborated in preparation to the workshop
- Second half day: Technical solutions & application challenges
  - Discussion between participants on what are most important data and ICT challenges to achieve a good scientific role
  - What is happening now in terms of data and ICT and what could happen in the future?
  - Inspiring talks to bring out successful examples of what worked in other domains to bring innovation
- Third half day: Synthese to common challenges
  - Discuss and plenary synthesis
  - Consider role of open/FAIR data
  - Find common aspects of data and ICT that need to be tackled across storylines

Impact Chain Approach

For a broad theme like agriculture and nutrition, it is a complex task to properly address the key features mentioned in the ToR. Here the Impact Chain Approach provides a useful logic model and framework for the general project design in a well-structured and transparent interaction with all partners involved.

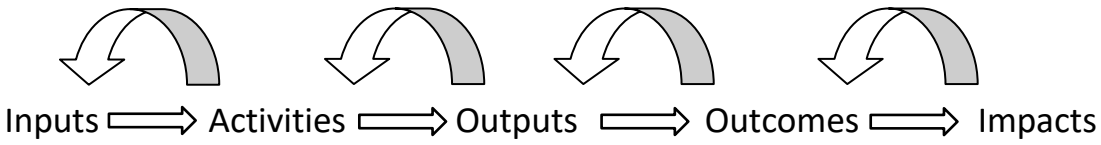

Figure 1 the theoretical concepts behind an impact chain approach

Inputs are the materials and resources that are used in an activity. This level of detail is not relevant for the project design at this early stage, but will come back later, when a more detailed project planning will be made.
Activities are what you actually do to create the change you want to achieve.
Outputs are the most immediate results of your activities. They create the potential for outcomes and impact to occur.
Outcomes describe the true changes that occur as a result of the activities.
Impact is the vision of a preferred future that underlines why the action is important. It refers to the longer-term change that you hope your action will help create.

To deliver research with impact it is important to think backward along the chain, starting with the desired impacts by asking “what do we want to accomplish” and then to ask which outcomes and outputs are required and which activities should be undertaken to achieve this. It is important to note that – in order to generate impact in the real world – the outcomes and impacts should be defined

'beyond' the limits of the project. The project should deliver outputs as specified in the project plan. In a successful project these outputs contribute to the realisation of outcomes and impacts in the outer world. However, in contrast to outputs/deliverables, the project cannot be held formally responsible for generating outcomes and impacts, since this often depends on conditions and events that are beyond the control of the project.

As an example of the application of the impact chain approach as a visual to help project formulation, Figure 2 presents an impact chain approach applied to the case of promoting precision agriculture in the Netherlands, and the potential role of the NL government and research institutes.

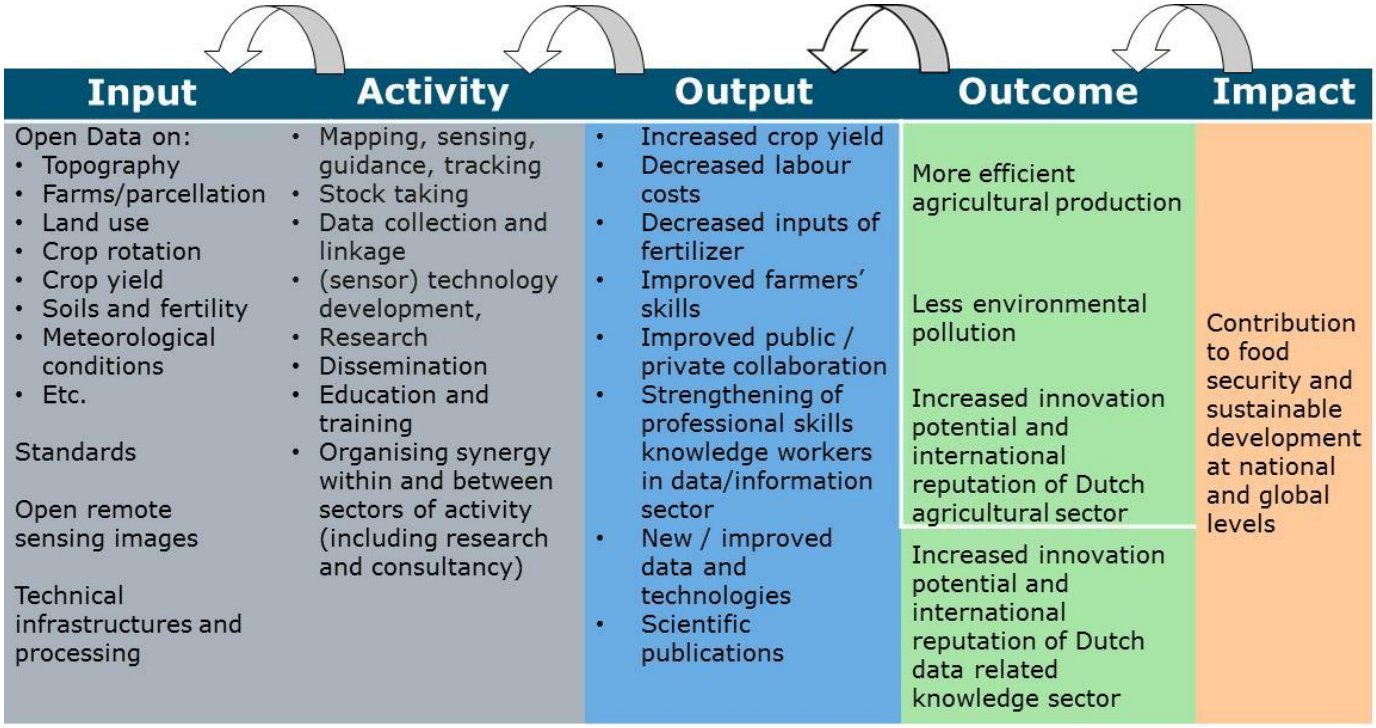

Figure 2 Impact chain approach applied to NL government and research institute support to furthering precision agriculture.

2 FORMAT FOR DESCRIPTION OF CASE STUDIES

2.1 GENERAL SET UP OF THE STORYLINES/CASE STUDIES

- 2 page description: visually attractive
- Invite community to deliver more case studies
- Webinars with explanation of the case studies
- Candidates:
    - CommonSense: supporting smallholder agriculture in Ethiopia (Wageningen UR)
    - Research in support of SDG 2 on Ending Hunger with links to the Sustainable Development Solutions Network (Wageningen UR)
    - AgMIP case studies on Climate change adaptation (Wageningen UR)
    - Livestock data (INRA)
    - Phenotyping data (INRA)
    - AFSIS/WOSIS: soil Informatoin (ISRIC)
    - Food Safety (AgroKnow)
    - Nutrition: Obesitas
    - Crop Yield Forecasting for early warning systems of food shortages (Wageningen UR)

2.2 FORMAT FOR CASE STUDIES 'REQUIREMENTS FOR DATA INFRASTRUCTURES FROM SOCIETAL CHALLENGES'

Headings to follow for a 2 page description (from these descriptions we have to create some visually attractive materials):

Impact pathways

- Describe the link from main impacts to outcomes to outputs and activities using the impact chain approach
- Provide a short narrative of the impact path for this particular challenge

End user groups

- Which groups are benefiting from a solution developed by science/research based on the more intensive use of data, infrastructure and analytics?
- How do these beneficiaries benefit?

Role of Research

- What role does research play in contributing towards a positive impact?
- Describe the use of data and models where and if relevant
- What are scientific challenges that limit progress?

Challenges in data, infrastructure, processing power and analytics

- What are current limitations to the use of data, infrastructure, processing power and analytics?
- What needs to be solved to take advantage of current ICT capabilities?

Solutions for more efficient Research

- What needs to happen to bring research to the next level?
- What is the role of data, infrastructure, processing power and analytics?

Monitoring the impact and implementation

- If these solutions have been developed, how do we notice? How can we monitor the progress?

3 EXAMPLE SHOWCASE 1: CROP YIELD FORECASTING

3.1 INTRODUCTION

Crop yield forecasting using combinations of crop growth modelling, remote sensing analytics and yield statistics, can be an important instrument for seasonal predictions of regional and local crop yields. Outputs can be used in multiple ways, among others to forecast regional and global commodity market development, estimate production surplus and shortages and project derived effects on food security like food supply and demand patterns, demand for food aid or financial aid. Moreover, analytics over historical statistics can provide useful insights in relevant patterns and dependencies, that can be exploited by micro-finance and micro-insurance institutions to optimize their schemes.

3.2 IMPACT PATHWAYS

Impacts: Improved food-security; disaster risk reduction; market support
Long term outcomes: better informed policy and decision making on food security issues
Short term outcomes: more efficient and transparent workflows from data acquisition to data publication; better resourced data scientists in the domain of food security; better semantic linkage between the agronomic and related domains.
Outputs: improved methods and models; modelling workflows; data curation and stewardship; targeted semantics.

Short narrative of the impact path:
Setup of an e-infrastructure for agriculture and food, including a data-infrastructure, data processing and analytics and modelling facilities and data curation and publication will allow researchers to perform more efficient and effective crop yield forecasting. This will be achieved by the availability of tools and capacity to set up and share modelling workflows and to curate resources. Improved semantic interoperability over the involved domains, combined with more open and better documented resources will allow more efficient data integration. Co-development by researchers, data scientists and end users will result in knowledge that is generated faster, is more transparent and fit-for-use. This will result in better accuracy, more trust and eventually better informed policy and decision makers. This will inform decisions and improve the situation on food related issues like disaster risk reduction and market support and climate smart agriculture.

3.3 END USER GROUPS

Researchers: better access to resources (data, analytics, publication of data); support for data curation and data stewardship;
Policy and decision makers: timely and more accurate, fit-for-use knowledge to pro-actively act on short-term and long-term food security issues
Business: better insight in market development and market potential

3.4 ROLE OF RESEARCH

Research plays an important role in the evolution of crop yield forecasting. Research has always been and will remain a main driver of innovation in the development and validation of methods and tools required in the fields of data acquisition, data analytics, modelling and decision support. While in the near future, operational services in this area might be provided by commercial parties, agronomic science (both public and privately funded) will remain a main source for innovation and broad agronomic expertise will be an important asset to setup viable services. Nevertheless, the domain will need to adapt to new developments in the fields of e-science and big data analytics and will need to be able to liaise with experts in these fields to keep this role.

Some typical research activities that would require support from e-infrastructures are:

- Estimation of length of the growing season and other crop characteristics, getting the most out of available data by (real-time) acquisition and fusion of experimental, crowdsourced and remotely sensed data
- Deriving crop growth sigmoids, based on remote sensing data analytics and statistical interpolation procedures, supported by historical archives.
- Setting up an e-infrastructure supporting automated workflow for crop yield forecasting, using a variety of data acquisition, data analytics, modelling and visualisation modules
- Parallelization of crop growth models (e.g. the WOFOST/WISS model), data processing and analytics to be able to produce faster, higher resolution results

The role of research would be:

- To bring forward scientific knowledge on crop modelling and crop yield forecasting and to improve methods and tools accordingly
- To discover and develop, and transparently publish and re-use resources (data, data processing, analytics, models, workflows)

3.5 CHALLENGES IN DATA, INFRASTRUCTURE, PROCESSING POWER AND ANALYTICS

Improving the availability of research infrastructures
Infrastructure for high performance computing, analytics etc. is generally not available, not accessible or researchers are not knowledgeable to use it. In many cases, infrastructure that is available is set up on a non-sustainable, local (e.g. within research institute) or temporal (e.g. within projects) basis.

Improving the availability and access to data and the capacity to work with alternative data
Access to a lot of data required for crop yield forecasting is limited, either because it is being protected for strategic and commercial reasons (e.g. weather data), because it's scarce (crop calendars), or because it is partly hidden in textual documents or sitting on researchers' laptops. The capacity to overcome this and to work with and combine data sources, including alternative data like crowd sourced data, data from text mining etc. is still lacking.

Development and testing of big data analytics solutions for geospatial data
While there are enormous developments in the area of big data storage, processing and analytics, the capacities to work with big spatiotemporal data are still lagging behind. New concepts generally do not seem to scale to the spatiotemporal domain (e.g. lack of storage strategies and performance, lack of spatiotemporal analytics). Currently the domain still seems to rely on classical GIS or at the best hybrid concepts with their specific disadvantages regarding aspects like volume and velocity.

Development of dedicated semantics
The domain of crop yield forecasting is cross-cutting domains (agronomy, meteorology, soil science etc). Yet it does not have developed semantics that can support the required knowledge integration.

3.6 OTHER SOLUTIONS FOR MORE EFFICIENT RESEARCH

Improving the capacity to work with heterogeneous data
Development of the capacity to overcome current data gaps and to work with and combine data sources, including alternative data like crowd sourced data, data from text mining etc.

Improving the capacity to use data science and develop solutions

To promote and realize co-development of analytics and visualisation for policy and decision makers by agronomists, data scientists and public and private end users.

Improving the attitude of the scientific community towards sharing of resources
To realize a culture shift towards open sharing of data, knowledge and tools and the role of data management, curation and stewardship.

3.7 MONITORING THE IMPACT AND IMPLEMENTATION

Several indicators that can be developed to monitor implementation and impact

Implementation / output:

- The amount of processing, data analytics and modelling components that are available through acknowledged e-infrastructures
- The number of data sources available through acknowledged e-infrastructures that are either potential input for or are generated by crop yield forecasting initiatives
- The amount of crop yield forecasting initiatives that have implemented their knowledge development or operational processes into e-infrastructure supported workflows
- The amount of co-development initiatives between the “classical” research community of agronomists and ICT and the data science community
- The amount of services in the area of food security that are tapping from data, information and knowledge generated by crop yield forecasting initiatives

4 EXAMPLE SHOW CASE 2: RESEARCH SUPPORTING AGRICULTURAL TRANSFORMATION TOWARDS SDG2 ENDING HUNGER

4.1 IMPACT PATHWAYS

As a follow up to the political agreement reached with the Sustainable Development Goals, there is now a commitment of countries/nation states to reach the goals as described in the Sustainable Development Goals, and monitor their progress towards these goals. Looking specifically at SDG goal 2 of Ending Hunger, it is formulated as 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture' which describes the vision of the desired impact by 2030. This visionary impact translates to different outcomes in different nations, for example, in the Western world, the nutrition aspect is much more important in fighting obesitas and fighting unhealthy eating habits that lead to diseases, while in the developing world, there is much more focus on producing enough food with a good quality and enough variation, and reducing risks in the agricultural production chain.
Each nation state needs to define its own actions for reaching the SDG targets, leading to the creation of national networks, called SDG Academies. Statistical agencies have a role to play in measuring the achievement of the goals, via relevant indicators (168 of these indicators have been defined). There are also thematic networks to facilitate this process, for example, the Sustainable Development Solutions Network created by Jeffrey Sachs, and where Wageningen UR is involved in shaping the research efforts towards SDG 2. Thus as outputs and activities, relevant communities need to be formed at the national level, statistical agencies need to establish monitoring networks, and the whole idea of designing packages for agricultural transformation is gaining momentum. The thinking around agricultural transformation (https://www.idrc.ca/en/article/agricultural-transformations) is that a new organisation and way of doing things is needed in the agricultural sector to maintain or increase production, while at the same time providing less burden to the environment and improving the nutritional status of foods (see here for an example of such an approach for Uruguay).

4.2 END USER GROUPS

- National ministries: they need a better understanding from the data on what the specific problems are they need to tackle in their geographies
- National SDG academies: they need data and information to help their national members to agree and design potential interventions around agricultural transformation pathways
- National statistical agencies: they need to monitor the progress towards SDG goals, and many indicators are new, so they need new data sources to adequately quantify these indicators. Also processing capabilities are required.
- Agricultural supply chains: many players (farmer cooperatives, processors, consumer organizations) in the supply chain could be actively involved in designing interventions relevant for their set up and company goals. They need an easy set up to access the results of research and to enable research to access the data sets in their supply chains.
- NGO and citizen organisations: these organizations use the political momentum created by the SDG's to stimulate further concerted action by a range of actors. They could use access to data and research in their arguments to stimulate the right interventions.

4.3 ROLE OF RESEARCH

Research has a role to play in the complex environment around the SDG's as it can act as a facilitator, as sounding board, and as developing new methodologies. With respect to facilitation, as research

organizations and individuals often do not have a specific view or opinion how to reach sustainable development, they can organize the fora to bring the different end user groups together and design jointly the interventions. This often starts with first developing a joint understanding of the problems.
With respect to sounding board, here research can help to bounce ideas and check the impact of potential innovations as proposed by the actors (end user groups). Through methods of impact and integrated assessment, different options can be weighed on their potential impacts and their unintended consequences, facilitating the decision process by communities.
Finally, for new methodologies, it is recognised that the traditional disciplinary approaches used by research do not work very well for the complex challenges as put forward by the SDGs and to realise visions. Therefore, new methodologies are needed that incorporate the inclusive, transformative and visionary aspects, and as a first step the Agricultural Pathways have been proposed by the SDSN, which is a method to design back-casting scenarios by visualizing what one wants to achieve, and then reasoning backwards to all the actions needed now to achieve this, while including all relevant actors in the exercise.
Given these very recent developments, the role of data and models is not yet clear. However, it is a given that methods need to be as much as possible data and evidence based, that transparency helps in multi-stakeholder set up, and that data sharing and joint analytics are requirements.

4.4 CHALLENGES IN DATA, INFRASTRUCTURE, PROCESSING POWER AND ANALYTICS

Given that the implementation of the actions towards SDG 2 is a relatively new process, and the research approaches are also in development, the challenges in data, infrastructure, processing power and analytics are not fully mapped out. The comprehensive nature of the analyses required reinforces potentially all challenges found in the more specific showcases (for example, yield forecasting). Thinking along the DIKW pyramid (figure 3), the challenges for research are sitting mostly at the knowledge level, which is close to the decision making level, and which involves trade-offs on conflicting goals, decision support, partcipatory models, and building on many specific information sources. Three levels of innovation are required in data, infrastructures, processing power and analytics:

1. Interoperability & data integration to answer comprehensive content questions, linking production to nutrition and nutrition to health, in terms of spatial interactions
2. We need a federation mechanisms over the infrastructures supporting the specific niches/scientific disciplines.
3. Working across scientific disciplines at the knowledge/wisdom level requires different tools and resources for researchers: more focus on decision support, knowledge rules, trade-off analysis tools, participatory models.
4. Have easy-to-use data analytical and presentation tools, that can be run in participatory settings to enable facilitation by scientists.

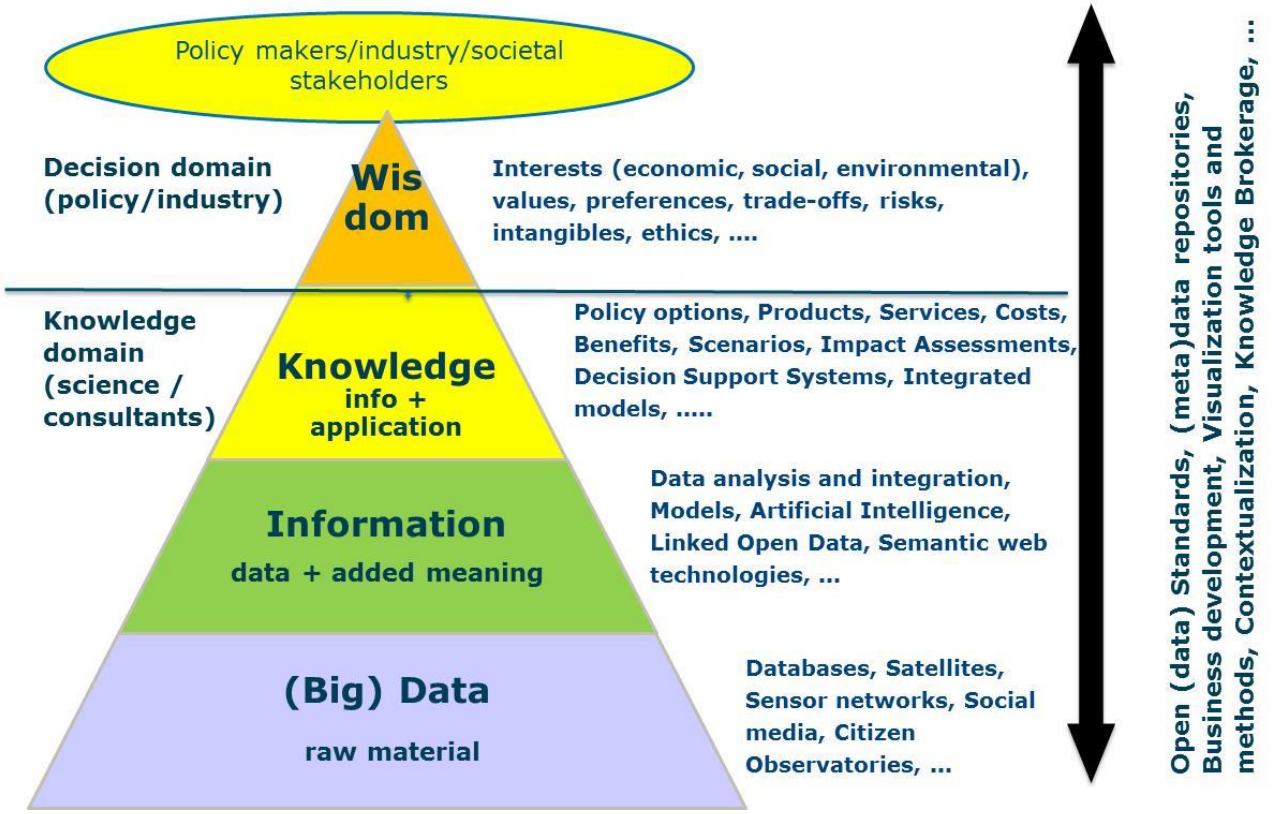

Figure 3 DIKW pyramid of data to information, to knowledge and wisdom

4.5 SOLUTIONS FOR MORE EFFICIENT RESEARCH

For research to become more relevant in the context of SDG 2 End Hunger, it needs to develop new scientific methodologies, while at the same time applying them with lots of different data sources and informatoin points. This combination of development of methodology and the resources to support those methodologies is extremely challenging. This will not work in all applications, and all cases, so accepting that there is room for experimentation required, and that these experiments might not all succeed is crucial in first stages of development. The scientific methodologies need to be tested in many more locations; now some tests have been made and some first examples are available, but many more are required. At the same time, new solutions have to be thought of for reaching impact with the help of research. While a useful contribution can be made from research, the research has to be connected to societal dialogues and multi-actor approaches. Useful solutions required are:

1. The development of vocabularies of useful terms, coupled to generally available data sources, to enable first analysis in a efficient way.
2. Enabling access to quality controlled data sources processed in a consistent, coherent and quality assured way, to allow maximum use of data available.
3. Tools for visualization geared towards participatory discussion to ensure inclusion & joint learning of all stakeholders participating sessions

4.6 MONITORING THE IMPACT AND IMPLEMENTATION

It is important to monitor the links between the different elements, i.e. the connection between the new scientific methodologies developed, their use and/or dependence on data and visualization tools and the upated applications with real stakeholder involvement. With/without analysis could be made to evaluate the specif importance of having scientific methods based on data and ICT tools, connected to e-infrastructures across applications with multi-actor processes, in other words, comparing an application of the scientific method with the use of common data and ICT infrastructures, to an application without, in the context of agricultural tranfsormation and SDG 2 End Hunger Implementation.

5 EXAMPLE SHOW CASE 3: RESEARCH SUPPORTING USE OF REMOTE SENSING DATA IN THE DEVELOPMENT CONTEXT

The ongoing project CommonSense is subject of the show case. It focusses on Ethiopia as an example in Africa where e-Infrastructure is still in its infancy. Research to transfer knowledge and experiences form Europe in a developing infrastructure targeting open science in agriculture is challenging. In this show case an outline is given and barriers are identified to indicate its specific nature within this context. It shows reseacht is not only facing 'research' challenges, but also societal, cultural and political aspects. The project is still in progress.

CommonSense is a project carried out in the Dutch G4AW Program targeted at the use of Geodata for Agriculture and Water (G4AW) to improve food security in developing countries by using satellite data. CommonSense is carried out in Ethiopia and uses amongst others data from Remote Sensing to offer services to monitor crop growth, produce local weather information nationwide, localized weather forecasts, monitor yield and market prices. It is supporting the smallholder farmers mainly through Micro Finance Institutes (risk assessment), Coops and Unions, agricultural production networks (sesame business network), Development Agents (Min of Agriculture).

The basic notion is the provide the smallholders adequate farm advice to better secure their yields and improve their livelihood and meanwhile supporting food security in Ethiopia.

5.1 IMPACT PATHWAYS

Major impacts of informing the smallholders, mainly trough farmers associations, is to be expected from strengthening the full chain. We may distinct various actors on the value chain for any crop from field to consumer market. For example for sesame, which is a cash crop in Ethiopia and generating foreign currency from export for Ethiopia, the value chain can be seen as follows is as follows:

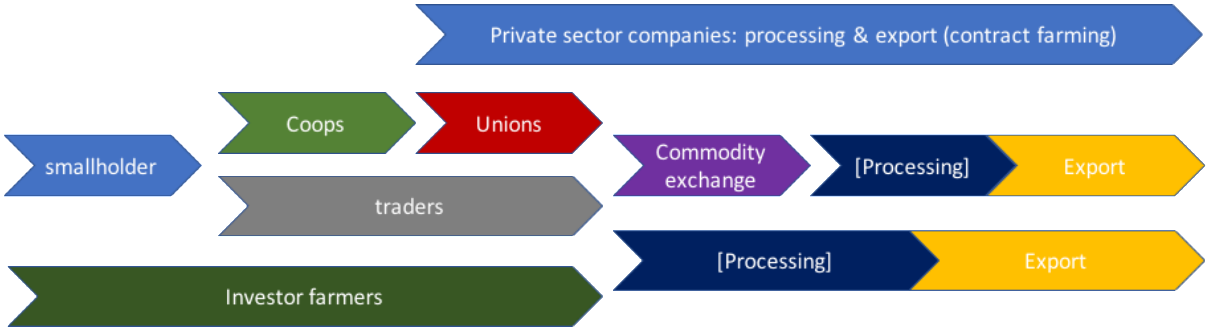

Figure 4 a graphic representation of value chains in Ethiopia as part of the CommonSense Project

The services provided by the project CommonSense will support the first part of the chain, by use of intermediate actors like for instance the unions. They provide information for farm management, supply the inputs, store and/or trade the harvest and more.
The challenge is to reach the intended users being the small holders. In Ethiopia there are barriers related to education, language, access to technical infrastructures and the good quality data to provide meaningful information. To overcome these barriers is using intermediaries like Coops and Unions, Extension services offered by the government to directly target at the user group and a second approach is the use the micro finance institutes with adequate information to grant loans with a high pay back rate.
Major impact will only appear if the advices produced (farm advice, weather forecasts and support for loan assessments) are sufficient (just the right quality) and well communicated.

5.2 USER GROUPS

The major target group here are the smallholders, but basically any actor in the whole chain can use and benefit from the services delivered. In summary we can distinguish the following users:

- Smallholder farmer
- Coop and union employees
- Loan officers of Micro Finance Institutes
- Development agents (DA) as the extension officers of the ministry of agriculture
- Traders
- Agro industry
- Research and knowledge institutions

5.3 ROLE OF RESEARCH

By its nature the project is a research project. It partly explores ways to reject or to go forward on existing research on crop growth and monitoring, and partly its goal is to implement (intermediate) results as 'viable' products. The services offered are based on existing research, but parametrized, extended and localized to be valid in the context of the selected region/country. It is built on knowledge and experiences showing good results elsewhere in the world, but has to be modified and adapted to fit in the Ethiopian context. The resulting product must be fit for use in Ethiopia and the approach applied is 'user centered', starting to identify the user needs. It follows on headlines the following process.

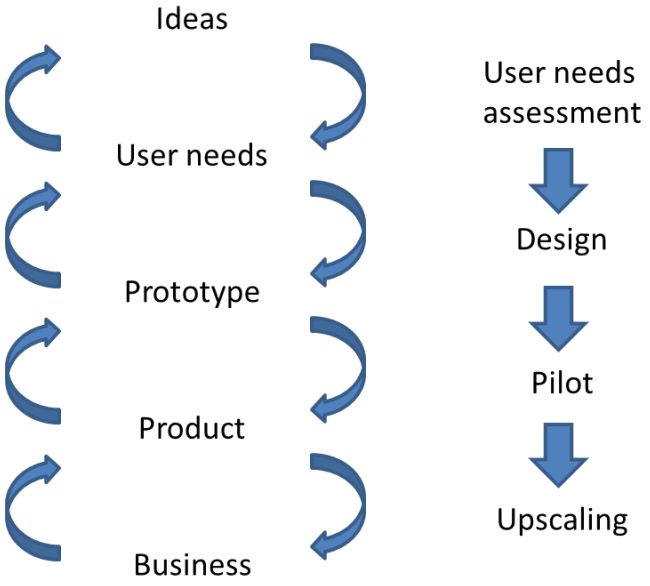

Figure 5 the reseach-to-product approach tested as part of CommonSense Project

Monitoring and evaluation during the project (and possibly thereafter) will trigger iterations in the process to improve results.

In addition one of the criteria of the donor is that the project has an outreach of more then 200.000 smalholders (direct & indirect) and services and products should be sustained after the project is ended, based on a realistic business proposal. Even that phase is very much supported by the research in the sense that the scientific result should be translated into 'easily' consumable and 'to the point' information to the targeted user groups.

5.4 CHALLENGES IN DATA, INFRASTRUCTURE, PROCESSING POWER AND ANALYTICS

The data infrastructure in Ethiopia is weak. Internet is available with reasonable band width in Addis Ababa, the capital of Ethiopia, but more remote areas lack this completely. In stead of data transmission, information exchange is mainly text based and dependent on SMS (short message service) and IVR (interactive voice response) technology.

To be flexible and ready for the future we proposed an SDI set up (Spatial Data Infrastructure). A pre-condition for this is off course that an existing infrastructure is around. Since this is not the case the set up of the architecture is based on principles of a SDI (creating nodes with web based technology), but no full benefit of such an infrastructure can be made yet.

A big challenge was get the support of Ethiopian governmental bodies to what the project would deliver. For example the National Meteorological Agency (NMA) has by law the mandate to be the only one allowed to publish weather related product (forecast, etc). Since we wanted to provide local weather forecast for farm management advices we needed the approval of the NMA and there support to distribute local weather forecasts.

The Information Network Security Agency (INSA) controls all data related affairs in Ethiopia and also related to the Ethiopian policy all data should be as much as possible provided by Ethiopian organisations. It meant we had to inform this agency to show no threats are generated from the data and information services the project wanted to provide.

Within Ethiopian the ICT capabilities vary a lot. Partly (mainly the business) has vary good capabilities, Sill a lot of capacity building is needed especially for governmental organisations to take full advantage of current ICT capabilities.

5.5 SOLUTIONS FOR MORE EFFICIENT RESEARCH

In Ethiopia a big number of donor based research projects are going on. Cooperating more between project focusing on the same domains could bring a lot of efficiency. Even in the short period of time this project evolved we noticed that much impact and synergy can be reach by cooperating with local networks and to approach research in the country, For Common sense from the start we were working togethet with the Sesane Business network (SBN) and due course we became more and more connected to the Agriculture Transformation Agency (ATA), the research institute for the ministry of agriculture.

Next finance is especially for poor countries as there are many in Africa is a huge problem. Since research is very donor dependent to sustain good results and/or to follow up on promising research project is crucial to be more efficient and to reach the intended impact.

The role of a good data infrastructure is evident, it will develop well since technology is becoming available more easy and affordable, but there is still a long way to go.

5.6 MONITORING THE IMPACT AND IMPLEMENTATION

One of the condition for the G4AW program was to monitor and evaluate progress made in the project. This is related very much to the outreach to farmers and creating a sustainable business case. To come up with simple numbers, like the number of small holders reached is the easy part. To assess the impact of our results is much more complicated, especially in this case since the past two years were years of severe drought, which means that assessing the increase in yield (income) is virtually impossible for our project. Nevertheless indicators to monitor progress are developed so we should be able to draw conclusions once the project will be upscaled.

6 EXPECTED IMPACT

The (likely) impacts of investment in research on broader societal challenges need to be understood to enable priority setting and efficacy in such investments. With investments in e-infrastructures the additional challenge is that impacts will only be achieved to make science in other fields within agriculture and nutrition more efficient. This deliverable offers a methodology and formats for scoping out the likely impacts and through synthesis of the identified challenges, the common challenges that have to be prioritised to be resolved, as they will enable most scientsts to progress, also in connection to the societal impacts of their research.

In the coming months, online campaigns will be organised to disseminate this method to a broader audience, to further uptake. The broader community will be asked to develop their own showcases through an online-campaign. In a second round, the community will be invited to feedback and validate the common challenges in data and ICTs.