Exploring Citizen Science. Embedded, embodied and actionable knowledge production.

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Preface

The Executive Board of Wageningen University & Research (WUR) invests in a four-year (2015-2018) research program called 'Social Innovation for Value Creation' (SI4VC). This research program is a cutting-edge theme for different substantive knowledge themes and programs at WUR and contributes to the ambition of WUR to integrate social changes more strongly with working on economic impact and technological development. The research program 'Social Innovation for Value Creation' investigates the relationship between value creation and innovations in the way ideas are developed and put into practice. This involves looking at the social component in innovation practices that WUR is working on, as well as social innovations as a recent social phenomenon in the participatory society.

In 2017, SI4VC started a two-year explorative research project that focuses on citizen science. After a year we want to show our first results of our exploration of citizen science. The exploration deals not only a) with different modes and forms of citizen science at different fields of research, but also b) with the embedding of these different modes and forms in research of WUR and with c) possibilities to program new research, i.e. citizen science in Horizon 2020 program or other EU-programs. The reason that we do don't wait till the end of this project with the publication of the end results and have decided to show the provisional results is that we also want to use this report in interaction with other researchers and think that as a result of this publication other researchers and citizens can help us to sharpen our insights and helps to program the further research in this study for 2018.

With this report on Citizen Science, we want to contribute to raising awareness among Wageningen scientists and the general public about the possibilities that different modes and forms of citizen science can offer to citizens, but above all as society as a whole.

The report clarifies the different interpretations of the concept so far and we also add our own interpretation of citizen science. In this, the concept of citizen science is situated in its historical and contemporary context.

In a broader sense, we want to close the gap between science and the public. Formerly, research results were only translated at the end of the research for a wide audience. We called that popularizing of science. Citizen science makes it possible to citizens to be involved from the start of research projects, edit and distribute research results, and who knows, determine the research agenda.

The most important target groups for this report are citizens and knowledge institutions. The knowledge needs of the citizens themselves will mainly consist of how they can build knowledge themselves and how they can use this knowledge in interaction with universities or knowledge institutions and b) other types of actors such as governments, companies, NGO's civil society organizations that in their own way acquire their knowledge.

Enjoy reading!

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1. Citizen Science in the perspective of today's society: the information and participation society

1.1 Introduction

Citizen science is often interpreted as a contribution of citizens to science. Citizen science (also known as crowd science, crowd-sourced science, civic science, volunteer monitoring or networked science) is often related to scientific research, wholly or partly by amateurs or non-professional scientists. Citizen science is sometimes described as citizen participation in scientific research, participatory monitoring and participatory action research (Hand, 2010). This involvement can be more or less intensive, with the aim of contributing to science. Another important consequence of this is that science is 'socialized'.

We see the role of citizen science more broadly. Citizen science also contributes to the organization of society, in which empowerment plays an important role in the participation society. Currently, there is a trend that people no longer appreciate so much the knowledge produced by universities and knowledge institutes and knowledge that is used and propagated by governments. People are increasingly constructing their own rationalities based on their own knowledge. In this research the central question is what this form of citizen science, in which citizens themselves have control over information, means for social innovation.

People choose their own rationalities (knowledge) and act accordingly (action). Currently there is a trend going on that places less value on science. In short, people construct their own rationalities based on their own knowledge. What does this signage mean, that citizens base themselves on their own knowledge, on social innovation? What does citizen science mean for social innovation? Is citizen science understood as pure knowledge of citizens because scientific knowledge institutions can't encourage social innovation? Can citizen science be regarded as social learning or is it rather a cognitive process in which facts, insights, neutrality and objectivity are concerned? And if it is both, then what is the predominant? In other words, in terms of action or action in the latter case it is about 'convincing the other' on the basis of insights and in the first case it is about organizing meetings from each other's knowledge and thus learning from each other. Who is believed and what is believed? How do you deal with the post truth era from science? Is more knowledge or transparency or the right answer? Sufficient questions of a fundamental nature that encourage research.

In our study we have a broader definition of citizen science and include a definition of Alan Irwin (1995). Irwin sought to reclaim two dimensions of the relationship between citizens and science: 1) that science should be responsive to citizens' concerns and needs; and 2) that citizens could produce reliable scientific knowledge (Cavelier and Kennedy, 2016).

We see citizen science as knowledge of and by citizens, also known as citizens' science. It is important to make a distinction, by using an apostrophe or not. Citizen science (singular and without apostrophe) often refers to the involvement and participation of citizens in the scientific process and is currently developing quickly in all kinds of scientific areas such as psychology, ecology, astronomy, medicine, computer science and statistics, and it is taking a variety of forms. In citizens' science (plural and with apostrophe) the ownership of the process of information gathering, analysis and use lies with citizens themselves. In fact, they take over the role of expert, or work in close and equal cooperation with formal experts (like scientists, experts of NGO's and policymakers). Moreover, we talk about citizens' science as plural, because we see it as something plural, as something of a group. We hope that research on citizens' science could provide a broader perspective on the changing role and power of citizens in governance processes and in the organization of society as a whole, science included.

Our understanding of citizen science is that of a socially constructed body of knowledge in various thematic fields that enables citizens to take an active role in a resilient society, full of social innovations. This implies that we do not narrow it down to a crowd sourced extension of formally embedded academic science. Citizen science may use and include academic science meticulously or haphazardly, depending on and according to their own problem definitions or action perspective. The boundaries of public care

provision and private initiative are shifting (Lowndes and Pratchett, 2011; Scott, 2011) and the public domain has become a shared playing field for societal players, markets and governments (Bourgon, 2011).

Citizens' science is at the cutting edge of the information society and the participation society. So citizen science finds itself at the crossroad of two major developments – the emerging Information Age and shifts in modes of governance.

The emerging Information Age

In today's information society there is more information than ever before, and information plays a central, strategic role in almost everything we do, from business transactions to leisure pursuits and government activities (Castells, 2011; Webster, 2014). The development of new digital information and communication technologies in recent decades has greatly facilitated access to information, and individuals therefore have more opportunities to act autonomously, leading to emancipation and empowerment (Bennett and Segerberg, 2011; Foth et al., 2011). This provides opportunities for dialogue, forming opinions, participations, citizen science and policy interactions etc. (Shirky, 2008; Van Dijk, 2010). Wageningen University and Research invested in this informational perspective on governance innovations, see http://bit.ly/2zhmZjd.

Shifts in modes of governance

Citizen science will increasingly become manifest in governance arena's and governance performance may significantly benefit from including citizen science. The Dutch government wants a participatory society. That requires knowledge and autonomy. The question is which knowledge citizens find necessary to meet new expectations, difficulties and opportunities. And whether they can work with scientific knowledge. Citizens' science means that the ownership of the process of information gathering, analysis and use lies with citizens themselves. Citizens' science does not exist as a directly researchable object, but is discursive, situational and volatile. It is both a social practice and a power issue and a question of faith. We see the relationship with social innovation more directly: it is a clear enabler of social innovation and is an integral part of it. It is a pitfall to think that citizens' science is a kind of complement for university science. It maintains relationships with it, taps off, competes, collaborates with it but at the same time feeds social interactions and binds people, gives perspective and feeds a sense of autonomy and. There is a clear call for more democratization of science (more openness, sharing more with society). The inability of governments and institutionalized organizations has mainly been expressed in order to conceptualize and define knowledge and science differently. As a result, citizens are prevented from participating in the participation society as they themselves have in mind.

The requirements and instructions to be a good member of society will evolve when a transition towards the participation society becomes more manifest. Inevitably this will be an uncontrolled open and evolutionary process without clearly defined aims and objectives. We see citizens science as the knowhow of modern citizenship. Any change in citizenship will affect and require changes in societies knowhow to make things work. From this perspective citizens science is an open ongoing process of acquiring the skills and knowledge to survive and achieve success in a modernizing world.

One distinct aspect of modernization for example has been the privatization of public services. With the introduction of competition in the field of public services, citizens were believed to be content in making their choice in various offers from private organisations. In these privatisation politics the fundamental question what knowledge it takes to be decisive and to make an adequate judgement has never been posed, let alone answered. If for instance people are urged to adjust their houses to comply with climate change standards, this is easy for a new or new to build house, but complicated for a house that is already over 20 years of age. Such a policy can be considered to be reckless from a citizens science point of view, because it lacks to address the issue of expertise on techniques appropriate in older houses and it drives citizens into the hands of construction firms that stick to their own proven techniques. At best citizens create sufficient science by cooperating and social learning at the level of villages or neighbourhoods. Emancipation of the citizen also can involve a more critical stance towards health advices and health precautions advocated by big institutions. Clearly this is a pain in the ass attitude, also for universities. Nothing is taken for granted anymore. This seems an inherent aspect of active

citizenship, but it can become really problematic if the information this attitude is based upon solely is based on an information bubble. An important aspect of citizen science should be the ability to see nuances and go beyond the mere black and white categorisations that are often so abundant on the social media.

If we put citizen science in the perspective of active citizenship, it becomes clear that it serves the purpose of making informed choices, develop adequate actions or counteractions and be decisive in a modernizing world. Therefore it comprises the ability to judge, to reflect, to create nuances and to understand to be able to contribute to what is considered progress in society.

In this research much attention is paid to citizens' science, science by and by citizens. In this form of citizen science it is the ownership of citizens themselves: they collect, analyze and use information and knowledge in governance processes. This form of citizen science is not primarily intended to help scientists with more or other information and therefore does not necessarily contribute to science. It is possible, but it is not the main goal. By conducting research into citizens' science, we hope to use a broader perspective on the changing role and power of citizens in governance processes and in the organization of society as a whole. In addition, the knowledge of citizens can be complementary to, but also conflict with, knowledge that is used by institutes and is produced by scientific knowledge institutes.

1.2 Objectives and research questions

Studying citizen science is part of the research program Social Innovation for Value Creation (SI4VC). The main aim of this study is to explore the importance of citizens science for social innovation and value creation. The aim of this explorative research is to gain insight into the scope and importance of citizen science in the organization of our society and more specifically for social innovation and value creation. To this end, we look broadly at how citizen science is formed, what role and meaning citizen science has and how citizen science functions and operates.

So this study discusses the relationship between citizen science on the one hand and social innovation and value creation on the other, and seeks to remove knowledge gaps about citizen science. The goal of this explorative research is to gain insight into the scope and importance of citizen science in the organization of our society and more specifically for social innovation and value creation. To this end, we look broadly at how citizens science is formed, what role / meaning citizen science has and how citizen science functions and operates. In practice, this means that different subthemes of citizen science are addressed and that citizen science is looked at in different contexts.

We are also looking at what this means for the WUR and a contribution is being made to an action perspective for a Wageningen Social Innovation Approach.

Another aim of this study is to explore the possibilities to program new research with funds of the European Union. Citizen science also has the attention of the European Union. The European Union started research projects that identify Citizen Science and show best practices. A White Paper on Citizen Science was published in 2014 (Sanz et al., 2010). It has been proposed to set up a think tank around Citizen Science and to align policy choices and funding programs to the needs of citizen science and to integrate the concept more into education, research and society. Incidentally, this paper expressly calls to do more with social values and to break free from an one-sided drive through money: *"Our society requires a paradigm shift, a new contract between all social actors in order to address global challenges with a stronger focus on scientific and social values, and not only economic ones."* In addition to the neo-liberal society universities can also feel addressed.

So the aims of this exploration deals with a) different meanings and typologies of citizen science at different fields of research, with the embedding of these different meanings and typologies in research of WUR and possibilities to develop a Wageningen Social Innovation Approach and c) possibilities to program new research, i.e. citizen science in Horizon 2020 program or other EU-programs.

Central questions

The main question is: How do people organize their knowledge and why? How is citizen science formed and what does this mean for citizens, scientific research and for the society? And what does this mean for the embedding and program of research at the WUR?

We prefer to speak of knowledge forming and not of knowledge constructing, because the last suggests that knowledge is finished at a moment and that it is consciously built. Often there is no plan behind citizen science and sometimes it is even a by-product of an autonomous action. Formulations like constructed or organised are in this situation an overly active and purposeful indication.

1.3 Research Approach

This report is the result of an explorative study.

The research started with a scope session to get all possible functionalities, 'content types or user stories' into a clear, defined set that is feasible for the next phase of the project. In addition, with a scan session, we tried to clarify the content of all these components for everyone and to create clarity. Subsequently, several theoretical in-fillings of the concept of citizen science were explored by conducting a literature study (Cavelier and Kennedy, 2016, European Commission / Socientize Project, 2013, Hand, 2010, Irwin, 1995; Merilhou-Goudard et al., 2016, etc: see chapter two. For the literature study in chapter two we made use of document- and website analyzes.

In addition to studying the theory on citizen science, we also wanted to look at the various contexts in which citizens' science is applied. In order to answer the questions about citizens' science, we studied four different contexts of practice in chapter three, which are also in WUR's field of work. The reason that different contexts are taken into account is the expectation that citizens' science will not be the same in every context. We looked at the following four themes that are relevant to the WUR: 1) organizing knowledge development and disseminating this (e.g. Soesterkwartier in the municipality of Amersfoort in the Netherlands), 2) participatory democracy (including resistance), 3) making visible the own formation of knowledge that is not (yet) visible (private nature) and 4) the relationship between the knowledge of self-made experts and knowledge institutes (food and life style). The themes vary greatly in terms of "putting responsibility back into society".

Finally, in chapter four we indicate the state of the art when it deals about the attention that citizen science enjoys at Wageningen University and Research. First we have made an intra-website analysis for the topic ‘citizen science’ in programs and projects. The projects we had found are presented in appendix 1. In 2018 we also want to approach different departement of Wageningen University and Reserach, because we have received indications that more is being done at citizen science than is now known to us. The results will be presented in a second report about citizen science in 2018.

After this, the researchers held a brainstorm to explore how citizen science can be better embedded in Wageningen research. They came up with the suggestions to be part of a Wageningen Social Innovation Approach to be developed, to organize seminars, to connect with other research institutes in Europe and with research programs of the EU and finally to establish a Citizen Science congress center in WUR.

1.4 Reading guide

The structure of this report is as follows. In chapter two we describe and reflect on different types of knowledge, different theoretical meanings, definitions, types and forms of citizen science, descriptive characteristics of citizen science and benefits of citizen science.

In chapter three we describe examples of citizens’ science in four different contexts. We show our conclusions after describing the four cases. Finally this chapter illustrates how the knowledge about citizen science and citizens' science can be further explored and to which new knowledge questions this leads. Moreover, it goes too far to answer these knowledge questions from this exploratory research.

In chapter four we presented that citizen science projects are not strongly embedded in research programmes of Wageningen University and Research. It is our primary aim to increase the interest in citizen science within the WUR. There are different ways to increase the interest in research into citizen science at WUR. We first show how citizen science can contribute to a Wageningen Social Innovation Approach. Then we show how seminars about citizen science can be combined with other thematic fields of research at WUR. Hereafter, it is indicated how citizen science at WUR can also be maintained at the European or global level. Finally, citizen science at WUR can be imbedded in a more structural manner when a citizen knowledge center is established.

2. Exploring Citizen Science

2.1 Introduction

Citizen science is not a modern invention, but rather something that has been occurring "for most of recorded history." Since science-minded individuals could not really pursue their passion as a full-time career until the late 19th century, nearly all "scientists" before this time were actually citizen scientists--people who made a living in other ways but, "because [they had] an innate interest in particular topics or questions," spent their free time performing research (Kight, 2012). Even as early as the 17th century, citizen scientists were developing the sort of sophisticated collaborations and networks that professional researchers use today and all without the aid of social media. While it's easy to focus on "armchair scientists" who pursued science just for fun, there were also a number of individuals whose interest in data was much more practical. Miller-Rushing et al. (2012) note with some sadness that amateurs have, in many cases, become marginalized over the past 150 years, during which time scientific research has emerged as a full-time profession; while many people still conduct scientific research, it is much harder for them to report their findings in respected journals and, therefore, to advance their fields.

Science communication from universities is usually one directional traffic, however well meant. Debates, workshops or dialogues are organized by universities. And if science is difficult to understand, scientists are asked to popularize it. Sometimes the suggestion is made that the scientists are also sincerely informed by citizens, but often there is an unilateral transfer of knowledge from the universities. Sometimes citizens are given the opportunity to ask questions or give suggestions. But ultimately, the researchers are primarily at the center of interest during such meetings. that it can also be done differently is proved by the experiences with citizen science. So citizens have an active role in forming of knowledge and are actively engaged in science. This can consist of data supply, suggest ideas for research, contribute to data analysis or perform the analysis entirely. In other words: popularization of science is replaced by the socialization of science.

Academic discussions of citizen science are all the rage right now. Most describe the successes of individual projects. We take the long view and examined where this genre of research fits in to the history of science.

In this chapter we first pay attention to citizen science and different types of knowledge (2.2). After that we describe two different (potential) meanings of citizen science (2.3). Then we go deeper into the concept of citizens' science and the different perspectives which can be used to study it (2.4). Finally, we draw conclusions (2.5).

2.2 Citizen science and different types of knowledge

In this section we want to understand the different forms that knowledge can exist in, so we are able to distinguish different types of knowledge in citizen science. Over the centuries many attempts have been made to classify knowledge, and different fields have focused on different dimensions. This has resulted in numerous classifications and distinctions.

Some researchers make a distinction and talk of embedded knowledge and embodied knowledge. This way, one differentiates between knowledge embodied in people and that embedded in processes, organizational culture, routines, etc. (Horvath 2000).

2.2.1 Embedded Knowledge

Embedded knowledge refers to the knowledge that is locked in processes, products, culture, routines, artifacts, or structures (Horvath 2000, Gamble & Blackwell 2001). Knowledge is embedded either

formally, such as through a management initiative to formalize a certain beneficial routine, or informally as the organization uses and applies the other two knowledge types. Embedded knowledge is found in: rules, processes, manuals, organizational culture, codes of conduct, ethics, products, etc. It is important to note, that while embedded knowledge can exist in explicit sources (i.e. a rule can be written in a manual), the knowledge itself is not explicit, i.e. it is not immediately apparent why doing something this way is beneficial to the organization.

Embedded knowledge is formed by *modes* as data collection and analysis, bricolage, co-creation and social learning. Bricolage stands for tinkering with all kinds of knowledge: experiential knowledge, myths, scientific knowledge. This way a belief system is put together.

2.2.2 Embodied knowledge

Embodied knowledge is in general, information our bodies know and use without conscious thought. Executed as routines, habits, and tasks. Also known as Instinctive Knowledge. The themes of embodiment and embodied knowledge is a long exploration of the many different ways that knowledge is not well-explained by analytic models based on the philosophy of the Cartesian Split - the idea that mind and matter (including body) are separate realms. If this dualism does not exist, then, as they say, it changes everything. More specifically, it changes the explanations and research strategies in many disciplines. Here's a sampler from a variety of perspectives (https://www.quora.com/What-is-embodied-knowledge-and-what-is-known-about-it):

- When you "embody" something, it means you know it well, and can do it with your "whole self", not just by thinking or talking about it.
- Much of human knowledge is tacit and experiential -- it is based on "being there" in particular places, as a particular person, rather than being something that can be explained and defined by the abstract structures and propositions of logic. This procedural, "how to do" knowledge is not maintained in language forms and may be hard to explain.
- Knowing has a person doing the knowing, a unique, individual perspective, and is relative to a broader context, a situation. Knowledge is *situated*.
- Knowledge is an activity of the human brain, a part of the body. It is in relationship with other people, and with the world, through other parts of the body, not just organs of perception. This includes communication via emotions and body language. The abilities to do this are a basis for more "abstract" knowledge.
- Knowledge is often represented by "embodied" metaphors that include space, movement, and an imagined course of action.
- The brain includes sensation and movement as part of its encoding of memories and concepts. When people hear or say the world *apple*, their reaching, grasping, and biting capabilities are energized and primed for action.
- It's easier and simpler to program robots to directly move and encounter their environment and adapt to what happens, than to try to anticipate and model their world analytically and make plans for them to follow.

When we talk about embodied knowledge it deals about *skills* like informs choice, grounds action, support deciveness.

Embedded knowledge is usually defined. The former refers to codified knowledge, such as that found in documents, while embodied knowledge refers to non codified and often personal/experience-based knowledge.

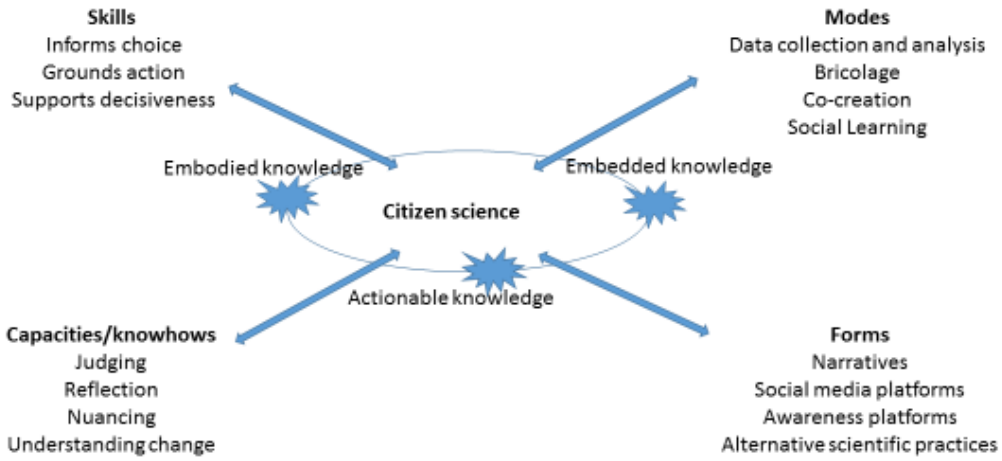
2.2.3 Actionable knowledge

New knowledge produced by academia often does not satisfy the needs of practitioners. This unsatisfactory state of affairs is frequently taken to be the consequence of the cultural, motivational and operational differences between the two communities of academia and practioners (Sexton and Hu, 2009). *Actionable knowledge* is presented as a useful concept which can fuse the expectations, contributions and outputs of academia and practitioners. Within this context, action research is argued to be an appropriate methodology to develop successful actionable knowledge. Results from an action research project are given which provide researchers and practitioners greater understanding of the key factors that shape the degree to which action research produces actionable knowledge: change focus, collaboration capabilities and systematic process (Sexton and Hu, 2009). Propositions that are actionable are those that actors can use to implement effectively their intentions. Actionable knowledge requires propositions that make explicit the causal processes required to produce action (Argyris, 2005). Causality is the key in implementation. One of the most powerful inhibitors of effective action is according to Argyris inner contradictions. Argyris show us that inner contradictions exist when the propositions to act are implemented correctly: "One cause of inner contradiction is the methodologies used by most normal social scientists to discover problems and to invent solutions. These features cause the degree of seamlessness and the validity of the implementation to be reduced. The focus on describing reality in ways that satisfies the requirements of internal and external validity makes it less likely that attention is paid to the implementable validity of the propositions. This, in turn, leads to propositions that are abstract and disconnected from implementable action" (Argyris, 2005).

When we talk about actionable knowledge we refer to *capacities*, to *know how*: judiging, reflection, nuancing, understanding change. We also refer to the different forms that are used for these capacities or to know how, i.e. like narratives, social media platforms, awareness platforms, alternative science practices.

Citizen science can contain one of these three types of knowledge. Citizen science can also consist of all three types of knowledge. We show this in figure 1 below.

Figure 1: Citizen science and different types of knowledge



2.3 Two meanings of citizen science

Citizen science is a broad concept. Up to now, two meanings can be distinguished (Cooper and Lewenstein, 2016; Eitzel et al., 2017) when it comes to define the concept. They are each represented by two founding fathers. Rick Bonney is the founding father of citizen science as contributory science (2.3.1). Alan Irwin is the founding father of democratised citizen science (2.3.2). We will briefly explain these two forms of citizen science.

2.3.1 Contributory citizen science

Within the first meaning, the concept of citizen science and therefore citizens is mainly approached as a service to scientists. Citizens are mainly approached for data collection and partly for data analysis. One of the first applications is a bird count, the so-called Audubon Society's Christmas Bird Count, which has been running in North America since the early 1900s. An important founding father is Rick Bonney, who has carried out and evaluated many citizen science projects from the Cornell Lab for Ornthology. The motive behind this was in the first instance data collection. Citizens provided the ornithologists with information that they could not otherwise acquire.

According to Miller-Rushing et al. (2012) there are two major roles of citizen science in modern research: First, to facilitate large-scale and/or geographically diverse projects, and, second, to undertake projects that professionals would (or could) not ordinarily do on their own.

One example of the first variety is the North American Breeding Bird Survey (BBS), which provides ornithologists with a huge dataset on nesting activities in both Canada and the U.S. Without the help of volunteers across the continent, professionals would be hard-pressed to come up with the finances and manpower to collect the amount of data generated by the BBS (Kight, 2012). An example of the second variety of citizen science is Maryland's Save Our Streams project, a locally-founded effort to "monitor, protect, and restore" the state's streams. Such projects, which may also be referred to as "community science" or "participatory action research," may be too locally focused to be interesting to professional researchers; that said, the success of the Save Our Streams project has led it to be used nationally as a model for similar community science programs (Kight, 2012).

Miller-Rushing et al. (2012) see a promising future for citizen science. When coupled with modern advances in communications and transportation, our renewed interest in this pursuit could help engage the public in research projects, improve scientific literacy and interest in science, and educate participants on the species, processes, and habitats that they are studying. Academics should also benefit, since an increased awareness of the scientific process will likely increase support and improve public opinion towards scientists, as well as providing data that could lead to valuable new insights.

Scientists can be critical about data collection by a wide audience. Scientists can comment on a lack of academic expertise among citizens. Are the data collected in a well-documented, systematic way? Something that professional researchers would like to see for other citizen science data.

2.3.2 Democratised citizen science

Alan Irwin wrote a now famous book about Citizen Science (1995). Irwin’s work addressed the varied social pressures shaping science by seeking to reclaim two dimensions of the relationship of citizens with science (Cooper and Lewenstein, 2016: 54):

“1. Science should address the needs and concerns of citizens, and seek to meet those needs.
2. The process of producing reliable knowledge could be developed and enacted by citizens themselves.

People bring into science such things as local contextual knowledge and real-world geographic, political, and moral constraints generated outside of formal scientific institutions."

His motivation was doubt about the quality of the science. Scientists are probably very smart, but are they also wise? He therefore advocates the use of lay, local and traditional knowledge. Irwin (1995) explores in his book mainly the difficult relationship between science, society and the environment. He involves social studies on scientific knowledge and the risk society and argues that sustainable development can' t be achieved without paying attention to questions about citizenship and citizen knowledge. He states that both for environmental policy and for understanding the living environment, it is necessary to be informed by knowledge of citizens.
Irwin emphasises the importance of understanding where knowledge comes from—of analysing the *production* of knowledge—and thus viewing it as a construct or process (Mowat, 2011). It thus becomes essential to ask, who is the expert, or how many experts are there? Citizen Science challenges the view that science is neutral and value-free, and opens it up, prising open Latour's (or is it Pandora's?) black-box of ostensible facts, so it becomes a 'contested and negotiated area of understanding' (Irwin, 1995: 62). Irwin focuses on the human purposes that drive science and innovation in the first place, saying that all knowledge is produced within a theoretical, cultural and political context (Irwin, 1995: 2). By challenging the idea that there is one way of knowing about environmental problems, or that environmental issues are necessarily scientific questions for most citizens (Irwin 1995: 144). Irwin subscribes to the idea that there is no singular universal knowledge but a plurality of knowledges. Moving away from a 'deficit' understanding of the public (Irwin, 1995: 92) – where the public is ignorant and needs a unilateral course of information to understand the issues involved – to one of dialogue and a mutually reciprocal need/exchange of knowledge, is a vital step in bringing citizens and science closer together.

If scientists 'know' from a certain perspective, then for more 'complete' knowledge – one based on 'cultural context' as much as 'cognition', other parties must be called upon to give their perspectives (Irwin and Michael 2001: 22). This process is one of contextualising scientific expertise within a wider, more complex and messy world of connections where each individual understands things in different ways. According to this account, science, which *de facto* has an allegiance to a particular field, needs citizens to make better decisions. In a process of re-scaling spaces of knowledge production, instead of seeing scientific experts as having the 'global' vision, it is in fact citizens that are able to give a broader, more diverse understanding, and who Irwin later describes as the 'embodiment of knowledge about the practical world' (Irwin 2010: 118).

Irwin's later work goes further in challenging the necessity, or indeed the possibility, for consensus, seeing it as another form of scientific absolutism that silences the plurality of citizen engagement: 'there is no guarantee that public debate will lead to consensus…with increased awareness, the old certainties and possibilities of consensus may no longer hold sway' (Irwin, 1995: 151). With this, Irwin sets up an interesting framework from which to analyse our empirical case studies. As Irwin writes, 'consensus is a way of closing-down complexity', a complexity that must be explored if real solutions to complex problems are to be found (Irwin, 1995: 123). In order to achieve this, citizens must have a role in defining and controlling whose knowledge counts (STEPS 2010).

2.4 Descriptive characteristics of citizen science

In an EU in-depth report (Science Communication Unit, 2012) has been described three taxonomies classifying Citizen Science (Den Broeder et al, 2016).

Roy et al. (2012) categorize citizen science by number and spread of participants ('local' or 'mass' and 'thoroughness' (investment of time and resources). According to King et al. (2016) it can be contributory or for the people; it can be communicity led or by the people; or co-created or with the people.

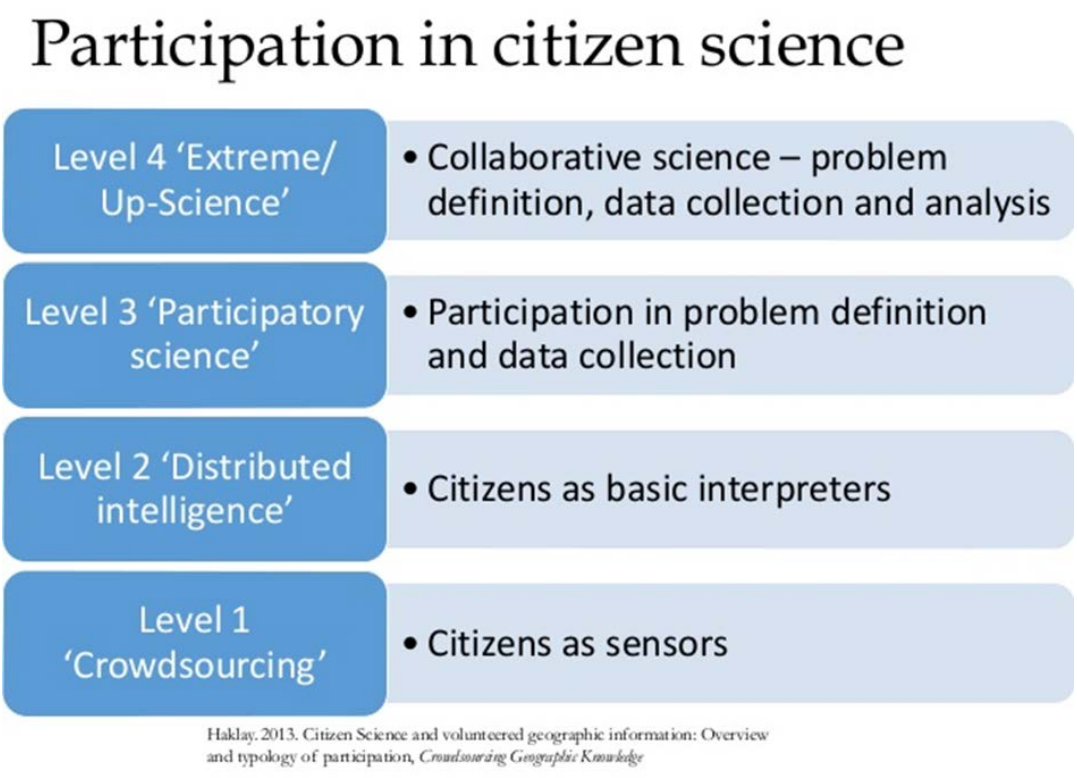
Wiggins and Crownston (2011) classify citizen science according to aims: action (citizens and scientist collaborate to address local concerns, investigation (aimed at answering scientific questions), education (aimed at educational goals), Conservation collective goods (i.e. public health or management of natural resources).

Haklay (2014) distinguish a typology with three different types of citizen science, inspired by Bonney et al. (2009):

- *Contributory projects*, designed by scientists and members of the public primarily contribute data;
- *Collaborative projects*, designed by scientists and members of the public contribute data but may help in project design, analysis, or dissemination;
- *Co-created projects*, designed by scientists and members of the public working together and at least some of the public participants are actively involved in most/all steps of the scientific process

Haklay et al. (2013) has even developed a ladder with different levels, showed in figure 2.

Figure 2: Participation levels in citizen science acoording to Haklay et al. (2013)



The highest level of collaboration is a form of co-creation: extreme citizen science. Extreme citizen science is thus clearly different from crowdsourcing as Bonney has understood citizen science in the past (level 1). Hakley distinguishes two other levels. Distributed intelligence (level 2), a good example of this is Galaxy Zoo, in which volunteers help to map and classify celestial bodies. Levels 1 and 2 are both still forms of public participation in scientific research (PPSR). In other words, science is still in the lead as a professional group. At the third level, citizens have something more to say in the management of the research. (Examples are: We need us and Community-based participatory research). After all, extreme

citizen science implies that citizens also have control over them. Together with the scientists, they determine questions and methodology.

Muki Haklay has developed at the beginning of 2011 the ladder with different levels of citizen science. The 'levels of citizen science' make an implicit value judgement in which 'extreme' at the top is better than crowdsourcing. Haklay (2016): "However, the more I've learned about citizen science, and had time to reflect on what participation mean and who should participate and how, I feel that this strong value judgement is wrong and a simple ladder can't capture the nature of participation in Citizen Science." https://povesham.wordpress.com/2016/05/20/participatory-citizen-science/.

According to Haklay (2016) there are two characteristics that demonstrate the complexity of participation particularly well: the levels of education of participants in citizen science activities, and the way participation inequality (https://www.nngroup.com/articles/participation-inequality/) shape the time and effort investment of participants in citizen science activities. The result is that Haklay has also come to a different definition of extreme citizen science. Extreme Citizen Science (ExCiteS) is a situated, bottom-up practice that takes into account local needs, practices and culture and works with broad networks of people to design and build new devices and knowledge creation processes that can transform the world (http://www.ucl.ac.uk/excites).

2.5 Benefits of citizen science

Is citizen science a contribution to science or is citizen science an expression of socialisation of science? The benifits of citizen science can be split out for four different target groups: scientists, policymakers, lay people and communities (Socientize Consortium, 2013). Den Broeder et al. (2016) grouped the benefits for these four target groups in three categories: increased research capacity, better knowledge and citizen benefits. Increased research capacity refers to the need for larger quantities of data and the need for larger number of analyses. So there is shared workload (Den Broeder et al., 2016:3).

A need for better knowledge is building on the idea that adding lay, local and traditional knowledge could improve the production of scientific knowledge and is therefore a more effectively answer to complex societal problems (Irwin, 1995). So it offers complementary, additional data. The engagement of citizens may lead to improved research strategies or to novel research methods and results Den Broeder et al., 2016:3). It also produces more socially robust knowledge.

The third category of benefits of Citizen Science is advantages for lay participants. A literature study regarding the benefits to citizens of participation in scientific research. (Haywood, 2013) yielded a list of ten main benefits (table 1).

Table 1: Claims about Citizen Science participant benefits (sources: Haywood 2013; King et al., 2016)

CITIZEN SCIENCE PARTICIPANT BENEFIT
Enhanced science knowledge and literacy (e.g. knowledge of science content, science applications, risks and benefits of science, and familiarity with scientific technology)
Enhanced understanding of the scientific process and method

CITIZEN SCIENCE PARTICIPANT BENEFIT
Improved access to science information (e.g. one-on-one interaction with scientists, access to real-time information about local scientific variables)
Increases in scientific thinking (e.g. ability to formulate a problem bases on observation, develop hypotheses, design a study, and interpret findings)
Improved ability to interpret scientific information (e.g. critical thinking skills, understanding basic analytic measurements)
Science demystified (e.g. reducing the 'intimidation factor' of science, correcting perceptions of science as too complex or complicated, enhancing comfort and appreciation for science)
Strengthened connections between people, nature, and place (e.g. place attachment and concern, establishment of community monitoring networks or advocacy groups
Empowering participants and increasing self-efficacy (e.g. belief in one's ability to tackle scientific problems and questions, reach valid conclusions, and devise appropriate solutions)
Increases in community-building, social capital, social learning and trust (e.g. science as a tool to enhance networks, strengthen mutual learning, and increase social capital among diverse groups)
Changes in attitudes, norms and values (e.g. about the environment, about science, about institutions)
Citizen scientists take action to influence policy and/or improve living environment
Citizen scientists gain access to broader (policy making) networks

The advantages of citizen science are according to Haklay (2014):

- *Crowdsourcing*: the number of people that edited the information
- *Social*: gatekeepers and moderators
- *Geographic:* broader geographic knowledge
- *Domain knowledge*: the knowledge domain of the information
- *Instrumental observation***:** technology based calibration
- *Process oriented***:** following a procedure

After presenting all these benefits of citizen science we also want to present in a figure (3) different benefits of citizen science.

Figure 3: Different benefits of citizen science

Different forms and shapes of citizen science; volume and diversity	**Analysis of actual impact and value**	**Analysis of potential impact and value**
Citizens cooperating with academicians	Improved evidence for better policies indicators of policy improvement policy contextualisation policy participation environmental awareness policy legitimacy	Environmental behaviour Nudging opportunities Citizens and community empowerment Critical agenda setting for academic research Locating policy deficits Full co-creation of policies
Citizens acting autonomously from governments and academic knowledge institutes	Actual impact may be underdeveloped, but can involve symbiosis of activities by citizens and NGOs/governments	Data triangulation to improve policy fact checking counter overt technocratic scientific models and techniques define responsible research and innovation
Citizens science for sustainable consumerism	More transparency on sustainability of production and food chains Broad environmental advocacy	Social innovations Actions by collective awareness platforms
Citizens science sprouting from resistance	Low actual impact and unrecognized value	Use criticism to improve policies Improve overlooked effects in Environmental Impact Assessments

So citizen science can offer different benefits; it depends on the meaning and typology of citizen science which is used.

2.6 Conclusion

When we oversee the different meanings and typologies of citizen science in this chapter, we notice that the direct interaction between citizens and scientists is central in different ways. Our approach of citizens' science which we have presented in chapter one, comes closest to the approach of Alan Irwin, which also drew attention to science that is only from citizens themselves and can influence scientists and policymakers in an indirect manner.

Our understanding of citizen science is that of a socially constructed body of knowledge in various thematic fields that enables citizens to take an active role in a resilient society, full of social innovations. This implies that we do not narrow it down to a crowd sourced extension of formally embedded academic science. Citizen science may use and include academic science meticulously or haphazardly, depending on and according to their own problem definitions or action perspective. The boundaries of public care provision and private initiative are shifting (Lowndes and Pratchett, 2011; Scott, 2011) and the public domain has become a shared playing field for societal players, markets and governments (Bourgon, 2011). Citizens find themselves at the crossroad of two major developments – the emerging Information Age and shifts in modes of governance. Citizen science will increasingly become manifest in governance arena's and governance performance may significantly benefit from including citizen science. In practice we believe this is a matter of co-creation: intentionally and contextually shaped in various modes and forms. In the next chapter we will illustrate examples of citizens' science in different cases.

3. Citizens’ science as a key enabler of active citizenship

3.1 Introduction

In this section we will not focus on cooperation or co-creation, but more on all forms of independent knowledge formation of citizens. Citizens' actions were previously mainly aimed at governments and their institutions. Now citizens have started to organize themselves differently and decide more themselves. This also provides other knowledge and a different need for knowledge.

Citizens experience changes, partly under the influence of politics and policy and partly self-directed. Citizens end up in the participatory society. They are considered to be active and self-reliant citizens who can no longer act as consumers of the health care society. That requires knowledge and autonomy, and those two have a lot to do with each other. Autonomy is needed to defend yourself against governments, knowledge institutions and also the business community that knows more and more from you and tells you that you have all sorts of problems. The question is which knowledge citizens find necessary to meet these new expectations, difficulties and opportunities. And whether they can work with scientific knowledge, traditionally aimed at a paternalistic relationship between government institutions with an information task that prescribes generally applicable rules for health and sustainable use of raw materials and the environment. However generally speaking, this institutionally embedded knowledge is not entirely free of interests and of conflicts, as well as of advanced specialization.

Currently there is a trend that people do not appreciate so much the knowledge that is produced and propagated by universities and knowledge institutions. People increasingly form their own rationalities based on their own knowledge. This form of citizen science, in which citizens themselves have control over information, will ultimately be of importance for social innovation.

When talking about citizen science, it usually concerns the involvement of citizens in the scientific process. This involvement can be more or less intensive, with the aim of contributing to science. Another important consequence of this is that science is 'socialized'. This chapter is actually about citizens' science: science for and by citizens. This form of citizen science is about the ownership of citizens themselves: they collect, analyze and use information and knowledge in governance processes. This form of citizen science is not primarily intended to help scientists with more or other information and therefore does not necessarily contribute to science. It is possible, but it is not the main goal. Citizens' science does not exist as a directly researchable object, but is discursive, situational and volatile. It is both a social practice and a power issue and a question of faith. We see the relationship with social innovation more directly: it is a clear enabler of social innovation and is an integral part of it. It is a pitfall to think that citizens' science is a kind of complement for university science. It maintains relationships with it, taps off, competes, collaborates with etc. but at the same time feeds social interactions and binds people, gives perspective and feeds a sense of autonomy and authenticity.

By conducting research into citizens' science, we hope to use a broader perspective on the changing role and power of citizens in governance processes and in the organization of society as a whole. In addition, the knowledge of citizens can be complementary to, but also conflict with, knowledge that is used by institutes and is produced by scientific knowledge institutes.

In this chapter the knowledge of citizens and citizen groups is kept outside the knowledge of experts from science because this makes it clear what happens when the knowledge of citizens deviates from the knowledge produced by science. In this project attention will be paid to a) the changing role of experts / science through the knowledge acquired by citizens, b) the quality of the judgment of the knowledge brought in by citizens and the relations with the origin of knowledge (science) and c) insight into the structure of knowledge of citizens.

The issue of citizens' participation in knowledge building without government support requires more attention. We will do this with a focus on resistance in study practices. The majority of the citizen participation frameworks were made from a government perspective, which raises the question of how unaddressed citizens could organize their own way of participation.

With this chapter we want to provide insight into where citizens get their knowledge from and how that knowledge is formed and how this relates to science and opinion formation. We need to do a coherent vision of the contemporary role and possibilities of citizen science when it can be at odds with science.

Below we present four cases. In all four cases, citizens are mobilized in a different way or mobilize themselves. The reason that different contexts are taken into account is the expectation that citizens' science will not be the same in every context. We study the following four different contexts. We have looked at the formation of knowledge in groups in the context of making old homes more sustainable in the Soesterkwartier district of the municipality Amersfoort in the Netherlands (4.2). We followed discussions about food and health in Dutch (social) media and the input of experts and of self-made experts with experiential knowledge. We analyzed how they reacted to each other and analyzed this (4.3). We have examined the knowledge and art of citizen participation in government processes, involving resistance practices. Citizens become involved or involved themselves in projects on aero traffic, flood protection, wind energy and gas and salt extraction. From these projects, citizens have different experiences with the relationship between citizens' knowledge and the: a) openness and transparency of government knowledge for citizens, b) government receptiveness for citizens' knowledge and) meeting government knowledge with knowledge of citizens. We reflect those experiences (4.4). Finally, in the last case about "citizens and their hidden natural pearls and hidden knowledge" we explain how to try to make visible from private natural areas what is currently invisible: knowledge that citizens have gained from their own nature terrain. How can this knowledge be mobilized and shared and to what extent does this change our images of nature in terms of social innovation and value creation? (4.5). Secondary analysis was performed when studying the four separate contexts. We have used publications that have never been placed in the perspectives of citizens' science. The chapter finishes with conclusions about citizens' science (4.6).

3.2 Collective knowledge in Soesterkwartier district

For the sustainability of old homes, residents often receive individual information from companies showing that they are certified. This certificate should help to ensure confidence in the company and to legitimize the approach or working method of the company. Residents are therefore individually approached and addressed. Not only the approach from companies but also the management of governments is aimed at individuals with mainly individual subsidy opportunities.

With the example below, we show why residents choose to unite instead of choosing individual projects.

The Association Sustainable Soesterkwartier is an initiative of and for the residents of the Soesterkwartier district in the municipality of Amersfoort in the Netherlands that are working constructively through cooperation for an affordable energy bill and sustainable measures. In 2009, residents in Soesterkwartier have been engaged in collective investments in measures to save energy and in alternative energy sources, which are particularly beneficial for themselves. The residents thus contribute to making the livability in the street, the neighborhood more sustainable and improving the quality of life, and they also have a share in the city's sustainability agenda (De Jong, 2015). In addition to financial benefits, the unexpected effect is mainly in the social field. One mainly learns to know each other; people are more willing to help each other and it is especially nice to improve a neighborhood with each other.

In this section we mainly indicate which approach and what knowledge mobilizes in the sustainability of old houses at neighborhood level and thus legitimizing works because the trust among residents is increased.

In the Roerstreet in the Soesterkwartier district, residents worked together on energy saving. Purchasing jointly measures is of course cheaper - and more enjoyable. This makes your house energy-efficient and comfortable in a simple way. They have continued this success for the entire neighborhood. Street ambassadors carry the success of the Roerstreet in their own streets. The goal of street projects is to save as many people in the neighborhood as possible by energetically tackling their homes. Every house is a tailor-made suit that reduces energy consumption and increases comfort. For example, they have an answer to the rising energy prices and together they reduce our CO2 emissions. The goal is a conscious neighbourhood that chooses for the environment and each other.

The initiative came about because at the end of 2009 a lady asked her 20 street mates to think about how the energy management in their houses form the thirties could be improved. The houses were badly insulated, the heat leaks considerably; so the costs for energy are relatively high. She wanted to insulate her house better, but she wanted to do this with others to reduce costs. In addition, she also wanted to involve the neighbors in the environmental and climate issues and the energy and raw materials policy.

After a few house meetings 13 families decided to participate in 2010 to jointly insulate walls, floors and roofs; prevent heat leakage and provide windows with double glazing. Not everyone implemented all these measures, but at least a large part had the walls insulated. This was most achievable in order to live more comfortably in the near future. Especially during the colder period is now experienced that the less draft near windows and floors and that the gas bill is actually lower; ranging from one-third to half compared to that of the time before the investment.

An additional advantage was that, by investing time and labor together in research and making contacts with suppliers and contractors in insulation materials, offers, etc., it was necessary to make fewer efforts than if they had to do so alone. In addition, this collective ensured that up to 10 percent could be saved in insulation investments.

The lady who has taken the initiative, acted as a contact person for this street. This led to the concept of 'street ambassador' that was rolled out in more streets in the neighborhood, in the district and later in other districts in the city of Amersfoort. The street ambassador takes care of calling the neighbors with coffee and cake; distributes the tasks and responsibilities among those people who have the time and inclination, especially among those who have (a bit) perspective on this type of activity.

Between 2010 and 2013, some 200 houses were isolated in over 20 streets. Walls, floors and sometimes roofs are provided with insulating materials. Often with the help of the street ambassador, residents of one or more streets are called together to invest together. The concept with street ambassadors to carry out isolation projects has now also been implemented in other neighborhoods and is one of the methods used by an Amersfoort company to insulate even more houses.

In the first 5 years, some fifty residents of the Soesterkwartier have carried out activities in various fields that have led to beautiful and visible results. About 200 people are members of the association. An additional effect of this mutual cooperation is that people got to know each other better; each other's knowledge and skills utilized and knew from each other what they had time and interest in. This has resulted in a new network with a social component. Meetings are often fun and a number of times people have dived into the pub after a meeting. That resulted in new ideas.

The neighborhood association has various working groups that focus on their own windmill, solar panels and sustainable building. The sustainability projects also reveal other problems / issues / challenges in the socio-economic area in the neighborhood. The Association would like to mobilize more citizens in other parts of the neighborhood. A group of people have tried to set up a network of Goeie Buren: helping people who struggle and trying to help others at work. That has not (yet) come to vigor, but it

did result in an extra activity: a good number of Wednesdays per year in the pub and meet each other in an informal way and get to know each other better. It is mainly the active residents, coordinators of groups and institutions, the neighborhood pastor, members of the recently established neighborhood church, but also interested people from other neighborhoods who take a look and have a beer in the pub that has been specially opened for these purposes.

Residents thus benefit from a joint approach to keep the energy bill affordable. Residents remain informed of all sustainable initiatives that are set up in the neighborhood, via a website and a newsletter, which is published a number of times a year. Residents can contribute good ideas and help to implement them, together with neighbors. During meetings, residents come into contact with other knowledgeable and enthusiastic neighborhood residents and knowledge is exchanged about sustainable themes. Various activities for the residents are organized from the association.

The activities within this theme for the district and the members are:

- organization of information meetings, together with the municipality;
- theme information evening on relevant topics, such as isolation;
- possibility to become a street ambassador. The association recruits these people and ensures that they receive training;
- information evenings / energy showers for streets;
- addressing and involving street residents in a savings campaign;
- drop information board with the heat scan in the neighborhood;
- guiding the making of houses more energy-efficient.

The activities within this theme towards the outside are:

- permanent collaboration with the municipality of Amersfoort;
- contact and negotiate with providers of measures.

From this section it becomes clear that residents often do not opt for an individual approach, but often organize themselves into groups to mobilize knowledge, to become acquainted and to share knowledge and to gain confidence in the knowledge. Citizens' science is thus socially formed in a collective and there is social learning.

A mismatch has thus arisen between citizens' science as a social construction and the individual approach from the institutionalized environment of citizens: governments, housing corporations, insulation companies, etc. Institutionalized organizations could better accommodate citizens by better integrating their approaches and the associated policy instruments that influence citizen science as a social construction. Concerning the case Soesterkwartier we refer to Wals (ref) which indicates that we are witnesses of a cultural revolution, in which social learning yields more than what a government says. There is more mixing with social learning between domains that are now often separately represented by governments or institutionalized organisations. That mix produces more friends, more wisdom, etc.

3.3 Make fair choices about food, health and lifestyle

3.3.1 Food and healthy lifestyle

Recently, there has been a lot of attention in the Netherlands for (healthy) food, sports and lifestyles. There is a real hype. Through social media, books are promoted, such as Power Food (Rens Kroes), Power Food from Friesland to New York (Rens Kroes), Green Happiness (Tessa Moorman and Merel von Carlsberg) and Killerbody 2 (Fajeh Lourens). The authors are both well-known Dutch and unknown self-made experts with experiential knowledge that they provide. This can be regarded as a form of citizen science.

The authors appear in talk shows or other TV programs and, in addition to accolades from citizens, also receive a lot of criticism in the media from knowledge institutes such as the Nutrition Center or dietitians or nutritionists. The nutrition center and nutrition experts also regularly change their insights when it comes to healthy food. This applies, for example, when it comes to eating eggs, drinking milk, etc. The question is how these changes are seen by citizens who want to consciously deal with nutrition. Do they see these changes in the establishment of the nutrition center and the nutrition experts as a logical consequence of the increase in the state of knowledge, or do they see this as a sign of lack of knowledge and experience it as a kind of randomness: tomorrow the advice will be different, so what do you have?

Fajeh Lourens got a lot of criticism from experts in the week of 15 - 20 January 2016 as a result of her new cookbook. Fajah Lourens reaps criticism with her sales success of the book Killerbody 2. In a talkshow of Eva Jinek she reports that she only needs 1340 ckal and sports daily and limits herself to 1200 ckal if she wants to lose weight. Critics find this unhealthy and a bad example.

According to the creators, The Green Happiness promotes 'a lifestyle' and gives 'menu suggestions that can be followed as a diet.' The two ladies of The Green Happiness, Tessa Moorman and Merel von Carlsberg, received criticism from all sides of their dietary advice. Nutritionist Miljuschka Witzenhausen gives her opinion on the much-discussed diet type The Green Happiness. "I think you will have shortages with this diet in the long term". According to the Nutrition Center and many experts, their diet is also dangerous.

After all the commotion Tessa Moorman and Merel von Carlsberg therefore wanted to settle all comments on their own website (ref). The creators of the controversial Green Happiness diet defy all criticize on their dietary advice.

But that leads to a reaction of one of their biggest critics, clinical epidemiologist Liesbeth Oerlemans. "It is annoying that they once again make crucial mistakes as dietitians", which lists all the problems on her blog. "You need to be able to trust a dietitian, which is why I filed a complaint last month, now they have the chance to respond to all criticism and make crucial mistakes again, it's just very bad." Oerlemans regrets the nonchalant reaction of the dietitians, who called the fuss "not always fun", and points to the danger of their advice. "I think it's good that they advise a lot of fruit and vegetables and less animal products, but the ladies keep on picking up nonsense, even though many people think they're scientific, but that's not the case at all." Moorman and Von Carlsberg attribute the trade according to its damage. By way of illustration, she gives three examples: the lack of protein in the diet, the shortage of vitamin B12 and the number of kilocalories that the ladies communicated with a recipe for a snack - but after all criticism. "If you advise vegan food, but again does not indicate that the number of proteins has to increase by 30 percent, that's disturbing." That's basic knowledge, endorsed by the Health Council and you should never forget them. "Then they advise milk substitutes, but they're all no proteins in. Well in soy, but that is not allowed. " Even with vitamin B12, according to clinical epidemiologist, The Green Happiness gives another wrong advice. "On Facebook they write that noble yeast flakes are the solution for a deficiency of vitamin B12, but that is not correct: a supplement is necessary when you do not eat animal products, but they do not give that compelling advice again. Then the snack: the healthy snicker. "This snack contains 432 kcal and not 108 kcal, as The Green Happiness claimed. Now they have removed the number of kcal. So they have just been lying. "Finally, Oerlemans complains about the statement of the ladies that critics have not read their book properly." I get very angry about that: go into the content. They ignore the annoying things. "She waits anxiously for a response to her complaint to the NVD, the professional association of dietitians."

3.3.2 Medicaments and healthy lifestyle

Concerning health there are discussions in the Netherlands about the use of, for example, bacteriophages or the use of cannabis. Machteld Huber introduced the concept of positive health in the Netherlands in 2012. Positive health means: "Health as the ability to adapt and direct control, in the light

of social, physical and emotional challenges of life (Source: From the environmental vision Hillegom, inquiry RD). In this definition, health is no longer seen as the absence or presence of disease, but as the ability of people to deal with the physical, emotional and social life challenges and to manage their own as much as possible.

That control is currently lacking can be clarified on the basis of discussions currently being held, for example, about applications of cannabis (for example cannabis oil or baceteriophages.

3.3.2.1 Cannabis oil

First of all, a case concerning the use of cannabis by a father with his daughter Sofie. Sofie has suffered from a particularly severe form of epilepsy since she was 3 years old. The child is continuously coping with poorly communicating brain signals, so that her brain development is stuck and no progress is made. With Sofie this means that she is on a three-year-old level while she is now six and a half years old. This is not surprising, the high percentage of epileptic activity in the brain means that there is almost no time for learning.

From January 2012, the doctors and professors who accompany Sofie and her family decide to give medication to the then three-year-old toddler because of her epilepsy. The toddler swallows various anti-epileptics, whether or not in combination with Frisium, a benzodiazepine, and follows several heavy diets. But Sofie's attacks do not diminish and she also regularly arrives in hospital for short or longer hospital admissions. Taking medication for forty-five months and diets did not cause any significant improvement. When a professor from the accompanying team at the Gasthuisberg hospital in Leuven in May 2015 suggested starting a ketogenic diet, he added that this was the last thing he could imagine. The ketogenic diet that had to show the improvements attributed to it after ten to twelve days eventually lasted twenty-seven days and did not bring the slightest relief. According to the father, it is criminal what his daughter has had to endure during this diet.

Luckily, Sofie's parents had a very last rescue tool that does not know Western conventional medicine and where the Leuven physicians team also did not want to be actively involved. Because Jean-Pierre had already talked to them about his last rescue, cannabis oil. He even suggested to them to give it to their daughter under supervision and to monitor the results. They did not want to take this piste in the academic hospital corridors and the Vonckens did not have any other option than to give Sofie cannabis oil in domestic circles.

Before we tell the sequel of the story, we must first answer another question. How did Jean-Pierre get all his knowledge about cannabis oil? From the very first drop, the effect was spectacular and according to the parents, the cannabis oil is very effective. They now see a playful child, a child that is discovering and already takes a book to look into it and this was not the case before.

For a long time, Jean-Pierre was on the internet as a modern sleuth not only to look up and study everything about his daughter's illness. At the same time, he was looking for possible alternative treatment methods that had a favorable outcome in epilepsy, and this on a global scale. In this way he came on the trail of parents in the same dire situation as he was in the United States. They served as a last resort their epileptic child cannabis oil, which has no roaring effect, and the result was amazing. Also via the internet Jean-Pierre met other Belgian parents in the same context, namely parents of an epileptic child without a favorable response to conventional medicines. This family also uses illegal cannabis oil to treat their sick child and again with amazing results.

To have and administer cannabis oil, which is an illegal drug for one and for the other a lifesaving drug, their parents have a legal penalty: seven years in prison, but this does not seem to affect the father at all. On the contrary, his behavior may be unlawful and possibly provoke a prison sentence. The man does not shun the media to tell his family story. "We do this open and expose, of course we want to help our daughter Sofie in the first place but we also want to reach the parents of other children with epilepsy and

inform them about the possibility that cannabis oil brings and thus help other children and families. I ask them not to do this on their own but under the guidance of a doctor.

Doctors, professors and other aid workers know nothing about cannabis oil. This ignorance immediately explains why there is no real scientific debate about medicinal cannabis: ignorance prevails.

3.3.2.2 Bacteriophages

In Georgia it is very common to use phage therapy instead of antibiotics. But the Netherlands is not yet that far. A bacteriophage, in short a phage, is a small virus that can destroy bacteria. In fact, a phage is not concerned about the resistance of a virus and causes it to explode. Phages can be found everywhere and can be grown relatively easily. In principle, there is a phage in each discovered bacterium that can negate its negative effect. Up to now, the Netherlands seems to be mainly faced with resistance from the pharmaceutical industry. Moreover, Dutch governments do not yet give subsidies to grow phages and doctors seem 'afraid' of the unknown. During the Medicine program, hardly any attention is paid to the subject of bacteriophages.

The TROIKA Foundation now wants to ensure that the Netherlands also uses the proven successful phage therapy. The Dutch TROIKA Foundation was established to provide an answer to the growing threat of antibiotic-resistant bacteria. Citizens including a single doctor as ambassador support research into and development of solutions that use bacteriophages; specific viruses with which a bacterium can be killed in a very targeted way. One of their initiatives is the development of the SID (See, Identify, and Destroy) robot for medical infection prevention, with which we combine state-of-the-art detection and identification equipment with the effective decontamination by means of bacteriophages. They want to make bacteriophages known to a broader public and contribute to solving bacterial problems in the medical world, but also in the food sector, and animal husbandry. The Dutch foundation TROIKA Foundation has started a petition to use bacteriophages in the fight against antibiotic resistance. With enough signatures, the TROIKA Foundation wants to hand over the petition to the government with the request to offer bacteriophage treatment under well-documented conditions to patients who are no longer working on antibiotics. The Petition has therefore started to try to break through institutional frameworks.

3.3.2.3 Science, food and lifestyle

Science has been given an almost divine halo. The posited omniscience of some scientists is first and foremost not questioned by citizens. Secondly, on closer examination, it is striking how paradoxically enough scientists very rarely find a consensus about a certain topic. Professor x sees it in another way then professor y. Both are undoubtedly very learned people, but their decision is not always the same.

This is no different in today's pharmacology and medicine, also based on ideology and market profits. In certain cases, the medicines tested and approved by scientists according to current scientific procedures do not always work. Who knows, maybe they even cause damage in some cases.

Other substances that have not been tested and not recognized by Western science, such as cannabis oil, prove in practice that they work or at least do no damage because cannabis is known to be remarkably non-toxic. Incidentally, the stubbornness occurs with which certain doctors continue to painful treatments while they do not want to use other means. Even if this drug is an illegal drug, doctors should at least study and consider it for the sake of their patient's health. Because this should remain the top priority everywhere and always; the health of the patient. Could it be that the medical world will soon undergo a paradigm shift through citizen science, but is not aware of this yet?

The strange attitude assumed by science is, in addition to academic conservatism, often the result of ideological and financial implications rather than mere scientificity. Even President Obama allowed himself in a documentary by Dr. Neurosurgeon. Sanjay Gupta is not aware that in the case of medicinal cannabis one must follow science and not let his political ideology prevail.

The above developments are an interesting study object, in which the relationship between, on the one hand, knowledge gained by citizens and, on the other hand, knowledge of experts can be investigated and the role that the government sees for itself.

Who is believed in food and health? How does knowledge of citizens relate to knowledge of scientists, governments etc? How do citizens and followers of these citizens construct their insights? What knowledge do governments and knowledge institutes offer? How do people organize themselves if they want to develop and propagate their own knowledge? How is thought about knowledge and forming of knowledge? Interesting questions for follow-up research.

The following is to be read on a blog from Albert Heijn: "What scientists lack is that modern consumers are surrounded by news all day long. Consumers are bombed all day with fragmented news and information about food and the effect of food on our health, the environment and animal welfare. You can hardly contain all that news. In order to deal with it anyway, as a consumer you no longer listen to opinions that you can't find yourself in. That is what you are shut yourself off. This means that it is virtually impossible for an expert to convince the 'infidel' of their mistakes" (http://www.albertheijnblog).

What we see in the above stories is that many discussions about food and health are traced back to factual knowledge of scientists as opposed to the opinions of citizens' experiential knowledge. Simply putting one another aside is done with concepts such as alternative facts, one-sided information, facts control, fake news, filtered information, faith, information bubble, common search for facts, intransparent science, post truth, trolling, distrust in science.

Incidentally, it is doubtful that people are convinced with facts, fact checking or joint fact finding. Scientific American points to the contrary. Recent experiments at Darthmouth University have taught voters to defend incorrect facts extra stubbornly when they think their worldview is under threat (Meeus, 2017). Fact checking leads to division rather than insight. This has everything to do with politics. The paradox reveals that citizens' political views, in particular, inhibit their respect for fact checks. As soon as you involve their world view or political principles, people will rather defend nonsense. Ergo: political opinions and visions inhibit our factual insight. In addition, there are other trends that ensure that information flows do not meet:

- the personification of news leads to us being informed unilaterally (Pariser, 2012);
- those who live in an information bubble / obtain unilateral information believe in that information;
- a continuous stream of filtered information is sufficient to confirm and reinforce a certain image on society;
- an information bubble can be made;
- supporters of another information bubble question science from another information bubble and discredit those scientists (methods are wrong).

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- an information bubble can be made;

- supporters of another information bubble question science from another information bubble and discredit those scientists (methods are wrong, numbers are not correct, etc).

Currently there is a cultural evolution going on. The communication landscape of people is changing. It is now about short statements via the media. It is mainly about opinions. People unlock their knowledge through opinions of someone else. There is nothing wrong with that, despite the fact that scientists see it as stupidity. Should we not enlarge opinion formation much more by giving it much more meaning from knowledge development / knowledge development ?! Opinions are based on something. Opinions play a much greater role in this era. Knowledge can also be unlocked through opinions.
consumers who have often made their own choices in what they do and do not want to hear or believe. You can conjure up so many irrefutable proofs and graphs, it often ends up on consumers who have already formed their own opinion.

3.4 Respond to unwanted changes

In this section we show with various examples that citizens experience policy changes and proceed to knowledge formation through the influence of politics and policy. The examples also show that the knowledge of citizens then puts pressure on politics and policy. Examples briefly discussed in this section are the choice for growth of air traffic, choice for wind energy, choice for flood protection policy and choice for salt and gas extraction.

How open and transparent to citizens is the knowledge of governments, companies, social organizations and knowledge institutes? What is being done with the knowledge of citizens? Is there any meeting of knowledge at all? This section is mainly about gaining insight into the art and knowledge of citizen participation in projects with governments, companies, social organizations and knowledge institutes. This mainly concerns the relationship between citizens 'knowledge and the a) openness and transparency of government knowledge, knowledge institutes, companies and social organizations for citizens, b) receptiveness of governments, knowledge institutes, companies and civil society organizations for citizens' knowledge and c) meeting knowledge of governments, knowledge institutes, companies and social organizations with knowledge of citizens. Ultimately, this section shows whether citizens know how democracy works and what they believe is democracy and how they can find a place in this. Is the participation society to be realized by citizens or are there mechanisms that create blockades?

3.4.1 Air traffic

Noise pollution caused by air traffic is calculated in the Netherlands. Almost nothing is done with measurements. Based on the calculations, it is determined how many flights airport Schiphol can execute, which runway is used for this purpose and which routes the aircraft have to fly. This paper reality is often not in line with reality. Pilots fly differently, more often than agreed at night or with older planes.

However, there are measuring stations, Schiphol and municipalities, that measure and record the noise of aircraft flying overhead. Little is done with that information. Many citizens have also started to measure sound effects themselves. They blame the government and Schiphol for being aware of model calculations because they are more favorable for air traffic than noise measurements.

In addition, citizens have trouble with the noise regulations of governments that do not take peak loads into account. This means that we look at the average inconvenience per year. A plane that flies late in the evening or early in the morning does not add much to the average, but as a resident you are sitting upright in your bed. This is really not to explain to citizens. Only airports benefit from this method of calculation.

Large groups of Dutch people have to deal with noise pollution from aircraft. This applies to areas in the vicinity of Schiphol Airport, including around the regional airports and the future Lelystad Airport. Because airplanes at Lelystad have a low level of low flying over a large area because the other altitudes are already occupied by air traffic for other airports, the nuisance is disproportionately large. Moreover, for the airport Lelystad not only the direct area around the airport is affected by nuisance but also residents of the Dutch provinces Friesland, Drenthe, Overijssel and Gelderland.

The discussion about measuring and calculation has been going on for years. A Member of Parliament has insisted on combining all available measurement data and placing new monitoring stations where necessary. These measurement data must be used to make good reports in which both the calculations and the measurements are compared.

Measurements can now be compared with the radar data and its measuring techniques are so good that it is possible to determine exactly what the source of the sound is. By combining measurement and calculation, a much better picture of the actual nuisance can be created. This makes it easier to make agreements, to maintain them better and citizens feel taken seriously again.

Nuisance is now measured, but the data is not used. That does not do justice to the residents who sometimes feel really cheated. We can draw conclusions about the future of aviation only on the basis of the real facts about noise nuisance.

3.4.2 Wind energy

The revolution from fossil energy to wind and solar energy is in full swing in the Netherlands. Wind turbines are rapidly being installed in the Netherlands. Residents of wind turbines still feel insufficiently taken seriously by governments, the business community and civil society organizations. Local residents have united in numerous local and regional associations against wind energy and have united at the national level in the Dutch Association of Resident Wind Turbines (NLVOW). The NLVOW has drawn up a code of conduct on how they should deal with local residents in decision-making on wind energy. The NLVOW code of conduct is a response to the proposal for a code of conduct of the Dutch Wind Energy Association (NWA), the branch organization of the wind industry. That proposal is unacceptable to the NLVOW because it does not change the current state of affairs when building wind farms. The NLVOW wants local residents to have rights, both with regard to their role in developing plans, and with regard to compensation for depreciation of houses and impairment of living and living enjoyment. The NWEA proposals do not provide for this and, according to residents, are limited to vague commitments and beautiful words. The fact that the NLVOW code of conduct is a response to the NWEA code of conduct does not mean that it is an anti-story. On the contrary, it is an independent proposal that takes into account the interests of all parties, not only from local residents, but also from nature and environmental organizations and from developers of wind farms. Unlike NWEA, the NLVOW code of conduct also focuses on the government. If the aim of a code of conduct is to contribute to strengthening support for wind energy, the State, provinces and municipalities play a crucial role. And so it is very important that governments participate in a code of conduct.

One of those residents is Albert Koers, co-founder and chairman of the Dutch Association of Resident Wind Turbines (NLVOW) who wants to stand up for the rights and interests of local residents. He is emeritus professor at the Faculty of Law in Utrecht and has continuously worked on the quality of public decision-making in his career.

In 2016, he published a book about wind energy that is critical of wind energy from the commercial wind sector and the government. With the book, Koers shows how the national government undermines our democracy and the rule of law. And how supporters and opponents of sustainable energy are diametrically opposed to each other, fighting each other with real and false arguments. The book shows how the central government systematically marginalized lower, democratically elected governments

when formulating and implementing the wind energy policy, and how systematically the government has restricted the legal protection of citizens. When it comes to wind energy, the short-term objectives for the government are obviously so important that damage to democracy and the rule of law is taken up: "collateral damage". The vulnerable citizen versus an increasingly repressive government regime. Gigaturbines are forced without a say. The operators and the government obtain the proceeds and place the bill with citizens. The fact that the NLVOW has appealed to the Aarhus Convention to the European Court of

The fact that the NLVOW has appealed to the Aarhus Convention to the European Court of Justice and that the UN Tribunal has received complaints about the Dutch government should encourage people to think.

3.4.3 Waterfloods

Climate change can lead to very different and difficult predictable rainfall patterns. As a result, the discharge pattern of the Rhine can also change. The government is anticipating to this with the Delta Program Rivers. One of the intended measures concerns the construction of an inland dike channel at Varik and Heesselt. The aim is to give the river more space and to keep high water levels within bounds. The province of Gelderland has included the secondary channel in the spatial structure vision Waalweelde West. Some of the inhabitants of the area are not convinced of the necessity of these far-reaching measures, and have united in the residents' group 'Waalzinnig'.

Waalzinnig is made up of a group of residents of the villages of Varik and Heesselt, who are affected by the proposed secondary channel. Their villages are in that situation located on an island, some houses have to be demolished and that everything has a lot of impact. If the measure is really necessary, then residents work on it. They have asked the province and the Delta Commissioner to convince them of this need. The residents themselves also studied the reports of the Rivers Delta Program, the underlying reports and the Rheinblick report, but mainly find expressions of major uncertainties.

Although the residents have been informed about the fact that there will be a secondary channel in the Waal that can reduce water levels of 40 to 50 cm and thus contribute to the task of discharging a maximum of 18,000 m3 / s at Lobith, but they do not get a satisfactory answer to questions about the substantiation of those 18,000 m3 / s at Lobith in the year 2100 and the impact that taking or not taking measures in Germany can have. They experience the current developments more as an increase in a sense of insecurity.

Because Waalzinnig thinks that the legitimacy of the secondary channel from the research reports and the government policy was insufficiently demonstrated, they turned to the Science Shop of Wageningen UR. The residents have filed a question at the Science Shop that can help them to accept what is happening, or can help to offer counterplay. We asked to examine how the legitimacy of the secondary channel should be seen in the light of so many uncertainties.

The researchers have indicated that the scientific underpinning of the normative discharge that provides the legitimacy for the decisions about the secondary channel raises many questions, is not transparent and is still under development. Calculating the climate scenarios with the GRADE instrumentarium has been done very recently, only after the planning of the secondary channel has already gone through several steps. These outcomes are also characterized by the Expertise Network on Flood Risk Management as too temporary and too uncertain to be able to build a policy.

The criticism focuses first of all on the incomplete way in which the German situation is discounted in the model results with which decisions on the spatial structural vision and MIRT have been legitimized. Due to possible flooding in Germany (in the current situation above 14,000 m3 / s) capping of peak discharges occurs. In addition, questions can be asked about how effects of climate and climate change have so far been justified in GRADE. A question, for example, is whether no climate influences have been included in the reference situation due to the increase in rainfall periods. This study shows that there is a lack of transparency with regard to the generation of the information that underlies the determination of

the normative discharge. Although a large number of publications (articles, reports) were consulted in this study, it was not possible for the researchers to obtain sufficient insight into the application of the instruments such as why certain methods were chosen and how the models were developed. calibrated. This applies to the weather generator, to GRADE and SOBEK, and to the way in which the simulated discharge values were used in the statistical analyzes. Secondly, it was not possible to gain insight into the versions of the individual components that were used in the deconstruction of the 18,000 m3 / s used. Thirdly, it was not possible to clarify which assumptions, assumptions and choices (among others with regard to distribution functions) were used. The conclusion in the "Final Report" about GRADE2.0 that this model train is now ready to calculate the effects of climate change can therefore be challenged, especially in view of the fact that the validation still shows large deviations (for example 2000 m3 / s for the 1988 drains) and when considering the major model uncertainties at stake, as well as the lack of transparency.

In the administrative approach surrounding the secondary channel, the fact that climate calculations with GRADE2.0 were not yet made at the time of the decision-making moments and the scientific substantiation was therefore inadequate. The plan development for the secondary channel is now based on new safety standards. The social consequences of the normative discharge have never been widely discussed (in accordance with the vision on the planning of the Elverding Commission). Little or no opportunities have been created for the residents of the villages concerned to object to the chosen normative disposal, while this is used as a legitimation to construct the secondary channel. In addition, there is also no form of objection or appeal against the proposal (spatioal structural vision) of the province to construct the secondary channel.

The questions and criticisms regarding the substantiation of the normative discharge of 18,000 m3 / s concern, among other things:

- lack of legal anchoring of the normative discharge of 18,000 m3 / s;
- lack of transparency with regard to methodological choices, underlying assumptions and reliability of the constituent models of the model train indicated by GRADE (Generator of Rainfall and Discharge Extremes);
- criticism of the incomplete way in which possible flooding in Germany that will peak discharges has been taken into account;
- questions about the extension of wet precipitation periods as a result of the method in which a series of observed weather data are transformed into a series of 50,000 years using a sampling method consisting of resampling according to the Nearest Neigbour principle.

The research showed that in planning, both collateral and uncertainties had to be worked on. The impression has arisen that these securities have been dealt with more prominently than the uncertainties. For example, it is questionable whether it is possible to predict with a certain degree of detail how the river will behave in 2100. Based on the fact that climate change must be seen as a wicked problem, that is not possible. The search for certainties leads to a technical dominance in the discussion about climate adaptation. For example, the identification of the secondary channel by the Delta Committee is sought in the technical field and much less in dealing with uncertainties or as a precaution. The suggestion arises that it is quite possible to calculate exactly how the behavior of the Rhine will develop between now and 2100. Showing uncertainties is less comfortable for water management and policy, but it does provide a more open discussion in which the politics has the primacy, and with which a step can be put back in the process of depoliticiation. Giving precedence to technical arguments (the rationality of the normative discharge accepted as a result of complex models) rather than discussing how to deal with uncertainties contributes to an undesirable effect of depoliticisation, namely a difficult to understand technical discourse that can lead to to an own perception of reality (reality construction) that deviates from the daily image of citizens. This involves consciously and unconsciously choosing a

technically complicated discourse for describing problem-solution combinations, with which political influence is reduced.

Within this discourse, the uncertainty surrounding the normative discharge over 85 years seems to be reduced to a one-dimensional causality, namely by how many degrees the temperature will rise in the next thirty and eighty years. This effect of depoliticisation is stimulated by the method of institutionalization, in which there is a science policy interface, with a relatively closed setting of delta law, delta fund, Delta Program, which cooperates with a number of large knowledge institutes and companies, making input from outside. difficult if not impossible. Within this science policy interface, reality constructions can arise that are so in-transparent and technical, that politicians can no longer understand this. In this case, the effect goes so far that the accuracy of the substantiation and the transparency of the working method show shortages, because nowhere, for example, there is a total overview of all the assumptions, knowledge gaps and uncertainties that play a role.

3.4.4 gas- and salt extraction

3.4.4.1 Salt extraction

Soil subsidence due to salt extraction in the area around Wijnaldum is much faster than previously expected. This is the conclusion of Rinze Post from the Winamer Belang action group on the basis of figures from the government. The government has taken measurements at various locations in the area. According to the action group, it is irresponsible to allow drilling under the Wadden Sea near Harlingen. These would also have major consequences for the old buildings in the city. At the moment, the 'Soil Movement Technical Committee' is preparing a report on the situation in Wijnaldum.

Individuals with damage have to wait a long time for any compensation in the Netherlands. The Netherlands can learn a lot from Germany when it comes to dealing with mining damage.

The province of Fryslân has opened a website where people with damage from gas or salt extraction can report their damage. A digital map has also been made with all Frisian drilling sites, including information about the companies responsible for these locations.

In mid-November 2015, a fighting Winamer Interest presented its plans. The foundation represents residents of Wijnaldum and surroundings. The board, led by chairman Rinze Post, is worried about the consequences of salt production by the Frisia salt factory near Wijnaldum. Salt mining leads to considerable soil subsidence. According to the foundation, this has negative effects on the quality of homes, business premises and agricultural land, not to mention a decline in value on the housing market. Resistance is not easy; How big are the chances of the small citizen against companies with a lot of money and a government that prefers to look the other way?

The foundation filed an advance payment of 254,000 euros with the Board Committee Franekeradeel-Harlingen. This committee prepares a redesign plan for the province of Fryslân. Rinze Post, chairman of Winamer Belang, indicates that the commission has a budget of EUR 47.7 million, but private individuals do not care much about this. The money mainly goes back to municipalities, the province and the Wetterskip, for locks and pumping stations, with which the groundwater is kept up to standard for agriculture. These governments and semi-governments recycle their own contribution to the fund.

Everyone declines the responsibility and citizens are sent from the box to the wall. 'We are not going to talk about it,' say minister Kamp of Economic Affairs, the province, State Supervision of Mines, the Technical Committee on Soil Movement (TCBB). The citizens now have enough of it. Their goal is to repair the damage in all places where the soil has dropped by more than ten centimeters and compensation for the decline in value of our homes. During an information evening Post showed with figures how in the period 1978 to 1997 there had been an average annual soil subsidence of about 0.5 to 3.7 millimeters. These measurements in North Friesland were done in the context of gas production,

which was already under discussion at that time. The measurement data comes from KNMI research. All of a sudden, between 1997 and 2005, the decrease was 14 to 26.6 millimeters per year. The cracks and subsidence in the houses are witnessed. According to Post, the Netherlands is far behind the neighboring countries, where it has long been customary, that the burden of proof is being reversed. Not the citizen has to prove that damage has been caused by the mining company, but it is up to the company to prove that it is not. According to the citizens, this is so honest. Governments and companies have large scholarships; against a force majeure of lawyers and budget a citizen can never cease.

3.4.2 Gas extraction

The 'Groninger Bodem Beweging (Soil Movement)' (GBB) is a community organization founded on November 6, 2009 with the aim to defend the interests and needs of people who suffer (financially and / or emotionally) the causes (direct or indirect) or gas extraction in Groningen , Netherlands. Since the founding of the GBB the amount of earthquakes has greatly increased. Because of the earthquakes in 2012 and 2013, the complexity of the problems became bigger and bigger, and cultural heritage and historical issues were seriously damaged (During et al., 2017).

Due to these developments, the aim of the GBB focus on safety of the people, although the injury claims are still as important. Besides this the focus of the 'target group' changed. This has been expanded from people with actual damage to all 'Groningers' and we achieve with the press and media the whole Netherlands and even far beyond the Dutch borders!

The GBB is often in the news to the attention of the media and advocates:

- No financial or emotional burden on residents because of gas extraction;

- Good and complete claims handling;

- A beautiful and safe environment and preservation of our cultural and historical heritage;

- Investing in renewable energy sources and future prospects for the region.

The aim of the Groninger Soil Movement (Groninger Bodem Beweging) is to promote the interests of the members insofar as they are damaged by gas extraction. In particular, the association will:

- Collecting relevant information and providing information to members;

- Promote research into the consequences of gas extraction;

- Talk to other parties on behalf of the members, including the media and politics;

- Supporting information from members who submit claims to NAM or other parties involved;

- Acting on behalf of all members

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Due to these developments, the aim of the GBB focus more on safety of the inhabitants, though the injury claims handling remained as important. Besides this the focus of the 'target group' changed. This

has been expanded from people with actual damage to all ‘Groningers’ and we achieve with the press and media the whole Netherlands and even far beyond the Dutch borders!

The GBB is often in the news to bring this issue to the attention of the media and advocates:

- No financial or emotionally burden on residents because of gas extraction;
- Good and complete claims handling;
- A beautiful and safe environment and preservation of our cultural and historical heritage;
- Investing in renewable energy sources and future prospects for the region.

The association will not individual members on their request legally assist when making claims. The Groninger Soil Movement is not legal assistance insurance but a movement of residents who want to join together to stand stronger against NAM and the authorities. Only when this appears promising, the association will start legal proceedings in the future.

The goals are pretty ambitious, more than we can currently achieve. It is not that bad because it is first about getting as many members as possible; then you are much stronger as 'Soil Movement'. In the coming year the board and other volunteers will focus on three things:
• Increase the number of members
• Collection of the necessary knowledge to provide the members with good information and advice.
• The development of the services via the website. There is a forum on the website where people can get in touch with each other.
The Groninger Soil Movement also has a sub-website: Gasbevingen Portaal (http://opengis.eu/gasbevingen/). On this subsite of the Groninger Bottom Movement they provide the following information:
- Map with thematic information about the Groningen gas fields and the consequences of gas extraction in that area;
- Statistical information and graphs on the area concerned and gas extraction;
- Current list of earthquakes caused by mineral extraction.

The information relating to earthquakes is current with a delay of max. 15 minutes after publication by the KNMI. The data from the Oil and Gas Portal will be refreshed after publication with a delay of 1 week. With the menu option metadata you can see which data has been used in the composition of this site. The website makes use of opensource software.

3.5 Active citizenship in own private nature

In this section we try to make visible from private nature areas what is currently invisible: knowledge that citizens have gained from their own nature terrain. How can this knowledge be mobilized and shared and to what extent does this change our images of nature in terms of social innovation and value creation?

There are various private individuals in cities and in the outlying area who are engaged in small-scale nature development on their property. This often involves the construction of small elements (up to about 1 hectare) that can significantly increase the natural values of a site. Small-scale nature development generally takes place on a pasture, field or a very large yard. Examples are the construction of row trees, wood gables, bushes, flowery grasslands, reed beds, marsh strips, lakes, pools, trees (rows) and pilot whales. There are also individuals who own small natural elements and want to manage this more ecologically, in order to give more different types of plants and animals a place.

Private nature management is getting more and more opportunities from the Dutch government. What now continues for private nature management is still largely controlled by Dutch governments. For example, provinces provide a so-called Subsidy Scheme (Kwaliteitsimpuls) Nature and Landscape, known

under the abbreviation S) K) NL. This arrangement is for both the design and management of nature. In order to obtain this subsidy, individuals must meet a number of conditions. Participation in the S (K) NL means that a parcel gets the destination nature. This often leads to depreciation of the land. This depreciation is often paid out tax-free to the landowner. In order to participate in the S (K) NL, the land must be included in the nature management plan of the province. If the land is included in a nature management plan as part of the Ecological Main Structure then an investment subsidy can be applied for. In its nature management plan, the province determines which nature management type must be realized on what grounds. In addition to a compensation for the reduction in value, a landowner also receives compensation for the costs incurred for the planning and the layout. After the establishment, an annual management fee is offered.

The province of Friesland has visited 55 private nature managers to let them know about their experiences with private nature management. Those stories are shown in a book "Nature in our own hands. Private nature management in Fryslân. "It goes too far to implement all initiatives here. Two examples to illustrate.

Tineke de Vries is a citizen who manages a strip of approximately 13 ha of nature. The variation in the strip is large: there are pieces of marsh, damp scallop land, herb-rich grassland, high and low peat forest. It manages it itself and the larger pieces with the neighbor. She sees how nature develops. Especially the grassland needs a lot of time because the fertilizers have a long time to work. Tineke has made the design plan and plan itself because it provides for design that fits both the person and the area and is much cheaper than when it is done by a consultancy firm. In addition, together with Dorpsbelang she has created a walking route that made the area a bit of everyone.

Father and son De Boer manage about 30 hectares of grassland, reed land, marsh and water. They have developed a lot of practical knowledge, sometimes with damage and disgrace. At which water level is it safe to mow? They know better than anyone which birds and animals live there, how they behave and where which plants grow and why.

The stories of individual citizens provide food for thought. They illustrate the dedication and perseverance of citizens. Their motivation, knowledge and eye for detail is not only admirable, but also shows that they look beyond nature alone. They recognize the importance for well-being and health, not only for themselves but also for the environment they invite and involve. This creates social contacts and village walks. The private nature managers consist of a large diversity of people: farmers, ex-farmers, estate owners, outdoor visitors. Their areas were very diverse. Thanks to the private wisdom of some private individuals, including governments, some areas have been preserved. The variation in the size of areas that private individuals manage is large: from one hectare to hundreds of hectares. Governments can learn from this that they should focus less on the one hand only on the size of nature reserves and efficiency (one big manager), small nature reserves also good for biodiversity and can lead to more ownership from the whole society.

Approach for unprecedented nature initiatives

At the moment, governments mainly have initiatives in their sights through their government subsidies, through agricultural collectives. The initiatives that do not make use of this are often unknown to the authorities. That brings us to the question: how do you track unprecedented initiatives? How do you share unprecedented knowledge?

You can trace unprecedented initiatives by inviting them or others, for example through magazines from the latent target groups (for example, De Landeigenaar or De Boerderij) or via social media (linked in calls or, for example, posting on a facebook page) or via crowd funding.

Next, it must be explored what the information strategy will be to be in discussion with many initiatives and to examine how a large amount of initiatives can be presented. Because what do you do when 5000 initiatives are brought in? How to make the information manageable, to channel it? The initiatives can

first be approached via a short survey (+/- 4 questions) about their private nature initiatives. From the inventory rounds it then becomes clear what interesting cases are.

With the differences in private nature management we wanted to show the diversity of ambition levels and especially the differences between experiential knowledge versus formal knowledge.

3.6 Conclusions

With the above examples, we first wanted to illustrate that different contexts lead to different forms of citizens' science.

The examples in the previous paragraphs were all focused on citizens' science. Citizens' science primarily looks at science for the benefit of citizens (e.g. open science). Previously, citizen science was used to illustrate the contribution of citizens to science. We therefore reason the other way around. We are therefore primarily concerned with public confidence in science, but also with the confidence of scientists in citizens. We examined how science was approached from citizens' sciences. Science is not yet of and for everyone. In doing so, we encountered various approaches to science. Science as a professional group of researchers who practice science, involving knowledge of scientists, everything that happens at universities. And science as the accumulation of knowledge between people (including citizens), where knowledge itself is central and not the knowledge holders. In the latter case, science is all that people do to bring knowledge about subjects. This last definition is broader and this one we prefer.

We are not only concerned with the knowledge of citizens, but also with the action perspective that may or may not result for citizens. Citizens' actions were previously mainly aimed at governments and their institutions. Now citizens have started to organize themselves differently and decide more themselves. This also yields other knowledge and a different need for knowledge: above all knowledge that can be transformed into its own action perspective.

The previous sections show that on a large number of subjects trust in science (and the democracy that makes use of it) has been violated. There are often no absolute certainties in science. It would help scientists to put uncertainties open and honest on the table. If the scientists do not do that, then they will be 'unmasked' at some point and citizens will less and less believe what 'the experts' say. The answer to the question 'who can I trust?' Is in any case not a scientist who suggests knowing exactly what it is. Governments are pulling millions of extra to convince citizens of their scientific insights. Governments say that they take citizens seriously and want to listen carefully to citizens' concerns. What they actually mean is that after listening, they want to explain why governments are right. This struggle of wanting to convince with facts is often more often doomed to fail. The feeling often wins today from the facts.

From the previous sections, the inability of governments and institutionalized organizations has mainly been expressed in order to conceptualize and define knowledge and science differently. As a result, citizens are prevented from participating in the participation society as they themselves have in mind. From the previous paragraphs there is a clear call for more democratization of science (more openness, sharing more with and more with society).

After studying the cases of co create knowledge in Soesterkwartier, make fair choices about food and lifestyle, respond to unwanted changes and active citizenship in own private nature, it is striking that social media play an important role in knowledge sharing and knowledge development of citizens. Knowledge is not shared via traditional scientific publications, but via social media. Also what knowledge is, is at issue here. What knowledge is for citizens can be dismissed as opinions or belief systems. We also see the clashes between formal knowledge on the one hand of formal organizations and the embedded, embodied and actionable knowledge of citizens on the other hand.

This exploration of citizens' science show us also more detailed questions which have to be answered in follow-up research:

a) How can science or knowledge development be approached from Citizens' science? Often citizen science is used to illustrate the contribution of citizens to science. We reason the other way around. This

concerns citizens' trust in science, but also the trust of scientists in citizens. We examine how science can be approached from citizens' sciences. In doing so, we will encounter different approaches to science. Science as knowledge of scientists, where knowledge is primarily reserved for universities and knowledge institutes. OR science as an accumulation of knowledge between people (including citizens), where the knowledge itself is central and not the knowledge holders.

b) How is knowledge gained from citizens' science? Opinions about science or knowledge development are strongly determined by the era in which surgery takes place. Currently, a cultural evolution is taking place whereby the communication landscape of people changes. These are often short statements through the media. It is mainly about opinions. People unlock their knowledge through opinions of someone else. There is nothing wrong with that, despite the fact that scientists see it as stupidity. Should we not enlarge opinion formation much more by giving it much more meaning from knowledge development?! Is it still about what or who says it? Opinions are based on something. Opinions play a much greater role at this juncture. Knowledge can also be unlocked by opinions.

c) How is the relationship between knowledge and action perspectives among citizens? We are not only concerned with citizens' knowledge, but also with the action perspective that this may or may not create for citizens. Citizens' actions were previously mainly aimed at governments and their institutions. Now citizens have started to organize themselves differently and decide more themselves. This also yields other knowledge and a different need for knowledge: especially knowledge that can be transformed into an own action perspective.

d) From what kind of theory / frameworks can the impact of citizens' science be determined? Can citizen's' science be assessed from social learning? How can this be broadened? How does society organize itself? How it is related to each other? To develop what the thoughts are about science, about opinion formation and about actions and knowledge of citizens from a perspective of evolutionary theory and social learning. In that evolution there are 2 paths to distinguish: 1) the science policy interface and 2) wild thinking (Claud Levy Strauss). Two communication systems can therefore be distinguished that evolve. Science has become disembedded by its own instructions, unable to relate to cultural changes in society. Scientific thinking and wild thinking grow further apart. This creates a tension. How does society organize itself? How does this relate to structured thinking? Answering this questions requires follow-up research. A nice illustration of this is the process where citizens' questions have been asked for the National Science Agenda. How do you answer questions from citizens in science?

Here we can also refer Luhmann (refs) nicely when it comes to transitions of systems and fields of tension of systems. Reference can also be made to the work of Arjen Wals, who indicates that we are witnesses of a cultural revolution, in which social learning yields more than what a government says. There is more intermingling with social learning between domains that are often staged separately. That mix offers more connections to other people (friends) and wisdom.

3.7 Recommendations for further research

Science is beginning to discover citizen science more and more. These are mainly forms of citizen science that contribute to science. Much less is known about the forms of citizen science that create uncomfortable relationships with science.

Citizen science can contribute to science, but also pose a threat to science. For knowledge institutes, citizen science can be an outright attack or thus come across the integrity, transparency and reliability of the research methods used and the data obtained.

Science can also feel marginalized if scientific knowledge is of less importance in the debate and in decision-making and the belief in post-truth, fake news or in the knowledge of citizens is stronger.

Where citizens acquire their knowledge, form or organize and disseminate knowledge, less is known, as well as about cases where knowledge of science and citizens collide.

In this research project this knowledge gap has been partially removed, but much more research is needed to approach citizen science mainly from the role of service to citizens themselves. The social

relevance of further research into citizens' sciences is mainly for citizens. They gain insight into the way in which they form knowledge themselves and can use them in decision-making procedures and how they can operate with science in the event of a difference of opinion.

We also want to offer more insights into roles and opportunities from science to deliberate with citizens about their insights (citizen science) and also to learn from science.

The economic relevance of research into citizens' science lies in the critical approach of research methods and techniques used and collected data. A lot of money is invested in research. Researchers may then be asked back for being transparent about their assumptions / assumptions with regard to models, measurements, theories, etc. Citizens' science can stimulate discussions about this and can thus help prevent long-term funds from being invested in research that is not transparent and reliable.

4. State of the art: studies about citizen science at Wageningen University and Research

4.1 Introduction

Citizen science projects are not strongly embedded in research programmes of Wageningen University and Research. Incidentally has been paid attention now to citizen science from different research programme directions (see appendix 1). Despite the strong rise of citizen science since the mid-nineties, the subject has received relatively little attention within the WUR. The Nature calendar is the longest running project with a duration of more than 20 years. This project represents only one subject: nature and only one form of citizen science, namely data collection and data analysis. In other words, the other forms of citizen science are not represented in the longer term (only occasionally) and are not heavily motivated by the view of extreme citizen science or citizens' science.

This chapter illustrates how from WUR the knowledge about citizen science and citizens' science can be further explored and to which new knowledge questions this leads. Moreover, it goes too far to answer these knowledge questions from this exploratory research. It is our primary aim to increase the interest in citizen science within the WUR. There are different ways to increase the interest in research into citizen science at WUR. We first show how citizen science can contribute to a Wageningen Social Innovation Approach (4.2). Then we show how seminars about citizen science can be combined with other thematic fields of research at WUR (4.3). Hereafter, it is indicated how citizen science at WUR can also be maintained at the European or global level (4.4). Finally, citizen science at WUR can be imbedded in a more structural manner when a citizen knowledge center is established (4.5).

4.2 Contribution to Wageningen Social Innovation Approach

Based on research on citizen science in 2017 and 2018, we want to make a contribution from this project to the Wageningen Social Innovation Approach action perspective, with a description of how you can connect well to citizens' sciences. We pay particular attention to contextualization and action orientation. A final meeting will be organized from the project to determine what the outcomes of this research project mean for the action perspective of the Wageningen Social Innovation Approach.

In 2018, the translation to the WUR will be made more explicitly and the WUR will be able to deal with the results of this report. What knowledge is offered and how is the demand for knowledge interpreted? Where is the boundary between the receptive / critical and the stubborn / headstrong citizen, according to Wageningen researchers who approach the phenomenon of citizens' science (they are believed or do not get trust).

For the WUR, there may also be uncomfortable situations around citizens' science. For example, citizens can mobilize scientists in various ways to strengthen civilian knowledge as has been done around ammonia (Hanekamp et al., 2017), in which 123 private individuals and organizations donated 37,160 euros to carry out research. Or in flood protection policy where assumptions and assumptions in the knowledge of governments and of knowledge institutions have been uncovered on behalf of citizens via the WUR science shop. In both cases, the outcomes were at odds with the scientific knowledge of the WUR and knowledge institutes such as RIVM, Deltares and KNMI and it was strategic and process-based from the WUR to 'puzzle' and improvise how the WUR could best relate to citizen knowledge.

Chapter three has shown that experience has now been gained outside the WUR with the relationship between scientific knowledge and civilian knowledge, such as in the Groninger Bodemeweging and the Dutch Association of Resident Wind Turbines (NLVOW).

By reflecting on these uncomfortable situations from the past, a Wageningen approach can emerge that, in the future, constructively relates to knowledge of citizens and knowledge formation in general and thus reinforces WUR's attitude and image in the event of possible

4.3 Citizen science at WUR: seminars about citizen science

One of the possibilities to further explore the potential for citizen science for WUR is the organization of seminars on citizen science. In the seminars we want to elicit discussion about the reasons for the emergence of - and different ways of - knowledge science in science. For Wageningen UR and for other knowledge institutions and governments, the key question is how they can relate their knowledge to knowledge from cititzens' science, in which we want to offer perspectives for different contexts from a Wageningen Social Innovation approach.

The ultimate goal of the citiziens' science seminar is to 1) gain more knowledge about citizens' sciences and more appreciation among academics for citizens' sciences (for example no longer discard them as angry or stupid citizens who exhibit NIMBY behavior) and 2) knowledge gaps to put further on-site and to identify exploratively (explorative character, not to know whether we already know everything, what we already know to share with each other) and 3) that researchers from other more substantive science groups know how to use a Wageningen approach dealing with civilian knowledge in order to ultimately strengthen knowledge formation.

The target groups (internal / external) of the seminar are:

- researchers from both the substantive science groups and the more environmental scientific and social science science groups;
- Stakeholders from science: researchers working for citizens as well as researchers who feel attacked or uncomfortably related to knowledge of citizens;
- Stakeholders from citizens' initiatives (preferably familiar with scientific and governmental issues);
- Stakeholders from governments;
- Stakeholders from WUR;
- Stakeholders from other universities and knowledge institutions.

Subject choices and involvement of other WUR themes

Although many WR themes have approached content, they have noticed that they are increasingly coming into contact with science from and for citizens. That is why citizens' science is a relevant theme-transcending topic. In fact, the substantive themes should explore which questions they find most relevant for their substantive topics. We will give you a shot for inspiration below:

WR themes that are related to this topic are: 1. Sustainable Food and non-food production, 2. Global Food and Nutrition Security and 3. Healthy and Safe Food for Healthy lives. There are plenty of discussions about food and health about scientific knowledge of knowledge institutes and experiential knowledge of citizens. The headline could be: Scientific knowledge and civil experience about food and health. Who is believed?

4. System earth management: think of climate change, flood protection, soil quality. In this seminar, the assumptions in science, transparency of science, could be discussed in particular. The headline could be: Science on climate change, flood protection, earthquakes in the Northern Netherlands, wind energy and ammonia: buttery and inimitable?

5. Metropolitan solutions. Around metropolitan solutions the subject of citizens science could be nicely combined with big data and could focus on the subject of Smart Cities. Think, for example, of LomboXnet, a residents' initiative in the Utrecht district of Lombok that led to a world premiere at the end of 2015. Lombok received the first vehicle-to-grid charging stations: smart charging stations for electric shared cars that can charge, store and then supply households with electricity from solar energy. Together with network manager Stedin, General Electric and car manufacturers Nissan and Renault, this sustainable district energy system was rolled out to a number of other municipalities in the province of Utrecht and will follow even more in the Randstad this year. The headline could be: Who are chasing the real smart innovations in cities: scientists and / or citizens?

6. Circular and biobased economy. The headline could be: is the circular and biobased economy of scientists also circular and biobased according to citizens? We know a citizen who is very adept at mobilizing networks and knowledge to start critical discussions about assumptions and assumptions.

These relationships can also be made for the Investment themes Resource use efficiency, A global one health and Resilience. From resilience, the question could be formulated as to how the knowledge of governments and knowledge institutions can resiliently relate to the knowledge of citizens.

With a seminar on citizens' science, we hope to offer the participants a broader perspective on the changing role and power of citizens in governance processes and in the organization of society as a whole. In addition, the knowledge of citizens can be complementary, but also contradictory to knowledge of knowledge institutions.

4.4 Citizen science at WUR from an European and global view

From the WUR, more conscious relationships can be built up with other Dutch and foreign universities and knowledge institutions. From this research project the first contacts have been made with the INRA in France who have written a report on citizen science in France (ref). The further expansion of relationships can promote and accelerate the accumulation of knowledge on this subject.

Also opportunities for European and global projects and programs about citizen science can be explored together with European and global partners.

4.5 Knowledge center citizen science

Citizen science is currently (till 2017) being approached mainly from programs and projects. This has the disadvantage that knowledge building stops when those programs or projects have ended. Only citizen science as a form of data collection and data analysis has a long duration within the WUR. Currently, the knowledge within the WUR about citizen science is fragmented. The ESG is active in citizen science. This science group departs from the KB Social Innovation theme primarily from citizens' science as a study object. The SSG (for example, Catrien Termeer and Arjen Wals) has also gained various experiences with Citizens' Science. Other science groups often depart from substantive themes, such as 1) food and health, 2) climate and flood risk management, 3) sustainable energy and 4) private nature, and from these substantive topics, they increasingly come into contact with citizen science.

The subject of citizen science could receive more attention within the WUR if it were coordinated more from a knowledge center. This concerns the coordination 1) of different citizen science forms, 2) to other research themes within the WUR and 3) to other universities or research institutes.

Up to an inclusive approach of citizen science at WUR!

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APPENDIX 1: Citizen science projects at WUR

In this appendix we describe different projects about different forms of citizen science which have been done by researchers of Wageningen University and Research (WUR). These projects have been finishes recently or are still going on. We want to show the similarities and differences in the characters of the different projects about citizen science.

It isn't easy to get an overview of these projects, because there is lacking a good infrastructure for knowledge management about different topics. Wageningen University and Research is investing in this infrastructure and has developed recently a website where different projects about citizen science are presented together. These overview isn't complete. This deals with the fact that researchers have to know that this website of citizen science and WUR exists *and* researchers or project leaders have to be disciplined to get their research on this website.

In the presentation of projects about different forms of citizen science we create two sections: projects in the field of citizen science which represent citizen science as a form of data collection or data gathering and data analysis; project which can be characterized as extreme citizen science or even citizens' science.

1. Projects in the field of citizen science: data collection and data analysis

Participatory monitoring of water quality in the city

The aim is to investigate at 3 appealing pilot locations in Amsterdam how citizens assess water quality in relation to utilities (ranging from e.g. watering to swimming) when, by monitoring, they get to know the water system in their vicinity, how monitoring data collected by citizens relate to monitoring data obtained by professionals and what information citizens need about water quality to decide on how to use the water.

Due to the fact that water quality assessment is linked to functions that often contribute to health in the city, this project is linked to water assignments to other developments in the city. In addition, through the use of innovative sensors for the determination of pathogens in water in combination with source research, a better understanding of water quality in relation to utilization and fluctuations in space and time is achieved.

For the first time, civil scientists have measured the water quality in Amsterdam. Without them, it was not possible to get a nice and detailed picture of the water quality in Amsterdam. The Gaasperplas is rated best: the water looks clean, smells good, many plants and animals have been found and few E.coli bacteria. These and many other results were presented on Friday's 6th October 2017 at Waternet's headquarters during the final meeting of the Clean Water Experiment. The first results were shared through a quiz about The Clean Waters Experiment, the scientists give there more explanation on remarkable results. In addition, there was an interview with 3 participants who have actively measured during the summer. The reason that they participated in the experiment was that they swim almost every day in the Amstel or the IJ and wanted to know how clean the water is. The odor test is, however, experienced as least attractive. Because the odors were best penetrant and the tubes in the Waterbox were leaking. The micro-experiment, or the aquatic animal net, and the cultivation of bacteria on a petri dish were the most attractive. They are nice to do because you quickly see results. Civil scientists liked to participate because you learn to look at the water in your area in a different way. And it's surprising how clear the water is. Some important and remarkable results:

• The highest E.coli value has been measured in the Erasmus Park. Duck poke is probably the cause or incorrect measurement. That is still being investigated.

• The temperature of the water in July was so high (almost 23 degrees) that some participants thought the thermometer was broken.

• There are 14 kingfishers spotted, a few years ago, there were still little ice birds.

• Half of the water is suitable for swimming in Amsterdammers.

• 1000 measurements have been made.The water is clear for 83 centimeters in diameter, but in the IJ, the Entrepothaven and the Gaasperplas it is a few meters.

• After measuring, Amsterdammers give the water a higher figure than before.

• Three-quarters of the Amsterdammers feel more connected to the water by measuring.

• In some parts of the city, the water often tastes salty, often to nothing, sometimes to ice tea or clay and the smell is 'forest'.

Cimulact (Citizen and Multi-Actor Consultation on Horizon 2020)

CIMULACT has as a main objective to add to the relevance and accountability of European research and innovation Horizon 2020 as well as national - by engaging citizens and stakeholders in co-creation of research agendas based on real and validated societal visions, needs and demands.

The project will expand the outlook and debate on Science, Technology and innovation (STI) issues, increase scientific literacy in a broad sense, which includes the understanding of the societal role of Science, Technology and innovation (STI), and create shared understanding between scientific stakeholders, policy-makers and citizens. This multi-actor approach will embrace EU28 plus Norway and Switzerland.

The CIMULACT project is contributing to the European Union's research and innovation agenda. This contribution is based on the future views of ordinary citizens like you and me from 30 European countries.

CIMULACT's main objective is to improve the relevance of European research and innovation processes by involving citizens and stakeholders in drawing up research and innovation agendas. This is done through workshops. By initiating discussions between citizens, stakeholders, scientists and policymakers, views and scenarios about desirable future are made and discussed, and then converted into recommendations and suggestions for further research and policy.

Filling in the blind spots of urban air quality together with citizens

Air quality in cities and its impact on public health is currently a growing concern, receiving ample attention from policymakers, scientists and general public. New emerging technologies enable air quality measurements to be crowdsourced and are considered to be a promising complement to the sparse official measurements. To successfully apply these new air quality observations, two issues must be addressed: which incentives do citizens have to be actively involved, and how to quantify the added-value of alternative measurements with respect to official monitoring stations. While exploring these issues, Valkenburgerstraat and Kromme Waal in Amsterdam are central in this study.

Air quality and its relation to health is an urban challenge, receiving a lot of attention. However, making sensible measurements of air pollution is very difficult, as very small concentrations can already be harmful. Despite a dozen official air monitoring stations installed in the city of Amsterdam measuring numerous air pollutants (Luchtmeetnet, 28-09-2015), it is known that the traditional monitoring network is unable to capture local variations in air quality. And mainly because of financial motives, extending the traditional monitoring network is too expensive. This is why policymakers and scientists are looking for alternative and additional solutions, to map air quality variation inside cities. In particular, by the fast development of new emerging sensor technologies, crowdsourcing is considered as one of the most promising alternatives to collect information. A second advantage of crowdsourcing is that awareness, next to technical innovation, is considered to be a successful strategy to stimulate behavioural change and reduce the air pollution emissions with cleaner air as a result. Participation of the public is therefore

very valuable. As a nice side-effect, it offers the possibility to alert individuals and make personal recommendations to minimize their exposure to polluted air, and as a result improve the health of the general public. However, existing initiatives to involve the public in air quality monitoring, like iSPEX, 'IkHebLast' [I am bothered by..] and MijnLuchtkwaliteit [My airquality] (see also 'Related information') show there are still multiple challenges to tackle. The focus of this project is on the challenges concerning community building, data gathering and data assimilation from official and alternative data sources (e.g. crowdsourcing).

Nature's Calendar

Knowing when life cycle events will take place is important for many sectors in society including health, agriculture, fisheries, tourism, nature management, gardening and forestry. The timing of flowering of pollen producing plants determines the start and duration of the hay fever season. Flowering of fruit trees determines the risk of frost damage and pest control. The timing of fruit ripening determines the timing of personnel availability for fruit harvest. Nature's Calendar has mainly focussed on health related topics and developed several tools to help society to adapt to changes in timing. Examples include Allergieradar.nl (Allergy Radar), Tekenradar.nl (Tick Radar) and the Oak processionary caterpillar Expert Center (www.eikenprocessierups.info). Nature's Calendar is actively communicating the results of monitoring, analysis and forecasting to society via its website Natuurkalender.nl, twitter, presentations, markets, educational program and via media.

Nature's Calendar (De Natuurkalender) is a national citizen science project that aims to monitor, analyze, forecast and communicate the timing of yearly recurring life cycle events. Nature's Calendar concludes that due to the increase in temperature the length of the growing season is almost one month longer in the period 2001 to 2010 compared to the situation fifty years ago. Nature's Calendar is coordinated by the Environmental Systems Analysis Group of Wageningen University and the Foundation for Sustainable Development and involves over 30 organizations, 8,000 volunteers and hundreds of school children. Nature's Calendar aims to: 1. Monitor, analyse, forecast and communicate the timing of yearly recurring life cycle events (phenological events).2.Determine the impact of changes in the timing on society. 3. Develop and implement tools and methodologies that allow society to adapt to changes in the timing. And 4. Increase the awareness on changes in climate and changes in biodiversity.

Nature's Calendar is a citizen science project which means that the general public is asked to participate in the research by monitoring phenological events like the start of flowering, leaf unfolding, leaf colouring, leaf fall and the first appearance of migratory birds, butterflies or dragonflies. Over 8,000 volunteers are registered as observer. In addition, hundreds of school children participate in the research in the context of the GLOBE program. The observers report their phenological observations via www.natuurkalender.nl or via paper forms. The observations are visualized via the website.

Arnold van Vliet, an employer of WUR, initiated and coordinate the following citizen science networks (in chronological order). All except for the Splashteller are still running.

1. Nature's Calendar (www.natuurkalender.nl, since 2001) which is the Dutch phenological network. I revived the network in 2001. In this context I met Isabelle.

2. GLOBE the Netherlands (www.globenederland.nl, www.globe.gov, since 2001) where we monitor various environmental variables together with school children.

3. Tick Radar (www.tekenradar.nl, since 2006) where we study the increase in ticks, Lyme disease and co-infections in the Netherlands by asking people to report tick bites.

4. Allergy Radar (www.allergieradar.nl, since 2009) where we ask people to report hay fever symptoms.

5. Splashteller (2011 only) where we asked people the report the number of bugs on their licence plate after a car drive to monitor insect density variation. Possibly we will be able to revive this one as there currently is a lot of interest in the insect decline.

6. Mosquito Radar (www.muggenradar.nl, since 2014) where we asked people to send in dead mosquitoes and currently to report mosquito nuisance levels.

7. EVOCA, Responsible life-science innovations for development in the digital age (link to website). Involve 12 PhD students in 6 case-studies in various African countries. I'm directly involved in implementing a mosquito radar in Rwanda and supervision of two PhD students.

8. Global Mosquito Alert (https://ecsa.citizen-science.net/global-mosquito-alert, since 2017) which is a global citizen science network on mosquitoes currently under development together with among others the UNEP. The mosquito citizen science networks from Spain, Italy and the Netherlands are currently used as an example.

9. European Ash dieback (www.essentaksterfte.nu, since 2017) that aims to monitor the distribution of Ash dieback caused by the fungus *Hymenoscyphus fraxineus*.

10. GrowApp (www.growapp.today, since 2017) as part of the European GLOBE program where we ask people to create time-lapse video's of the changing seasons (phenology related).

This year Arnold van Vliet was also involved in a project in which we analysed the strengths and weaknesses of the Dutch citizen science network for nature (see Dutch infographic at www.citizensciencevoornatuur.nl).

He furthermore coordinates the nature news website www.naturetoday.com (click here for the English version) where we aim to bring nature back into the news domain by motivating scientists to communicate more often to society. Currently over 20 nature organisations and knowledge institutes use the content management platform (80 thousand unique visitors per month). The ambition is to scale it up to other countries.

2. Projects in the field of extreme citizen science and citizens' science

Wisdom of the crowd and value creation

In this research, the relationship between the information society and the participation society in the creation of collective and public value is central. In this research, new forms of value creation are identified that are driven by social innovation and digital innovation. The focus is on concrete examples of value creation that arise in interaction with new digital information or data streams. The research focuses on recognizing the cohesion and tension between collective values and the more general public values, and the way in which value creation relates to, for example, open data or closed information sharing.

In the current information and participation society, private, collective and public values are created by new players and in new digital ways. Government organizations supply goods and services aimed at public interest. But companies, civil society organizations and citizens can create collective or public value in new coalitions and organizational forms. New digital resources offer additional ways. Through social media, online platforms, mobile apps, etc., social initiatives can find and share information and data much easier, and thus create social value. The difficulty here is that there are different views between the actors about public value.

Questions: What does the increasing power to the people by digital networks mean for the established order? Research questions are formulated on the following themes:

- Digital commons: power to communities?
- Online sharing: power through online platforms?
- Digital hubs and pop-up companies: possibilities for social entrepreneurs to realize worldwide missions?
- Citizens' science: power to citizens' knowledge?

- Blockchain: power to the consumer for change for good?

Civic power through social bonding

This project examines various forms of dynamics concerning citizens' initiatives and what can be learned in terms of mechanisms and principles for governance and the various roles and attitudes the involved actors take on.

Within the current social and political context, personal responsibility and self-initiative play an increasingly important role. The many civic initiatives and self-organization are examples of how people take care of their own environment and can be characterized as a transition 'from below', starting with people.

This project examines various forms of dynamics of self-organizing groups of citizens taking charge of their living environment. The research focuses on four types of dynamics: 1 the dynamics of drivers underlying citizens taking charge of their living environment; 2 the dynamics of various forms of capital; 3. The dynamics of relational strategies of bonding, bridging and linking. And 4. the dynamics between social and spatial bonding. Moreover, this research focuses on the way the boundaries between public responsibility and active citizenship are shifting move, and what can be learned for governance (how we organize society).

Citizen science supports nature conservation

The researchers mapped out citizen science for nature in the Netherlands for the Ministry of Economic Affairs. The report describes the strengths and weaknesses of the system and sets out points for improvement. They make reference to the great value of the observation system. However, the good performance of the system is not automatic. The value of citizen science is underestimated, and that makes the system vulnerable.

The researchers have identified four levels in the involvement of the general public in science: from crowdsourcing (such as the national bird census in which everyone can participate) to ‘extreme citizen science’ in which a small group of volunteers work as scientists in a professional manner on the definition of a problem and the collection and analysis of data.

Thousands of volunteers are involved in the monitoring of nature and biodiversity in the Netherlands. Their observations of plants, animals and mushrooms and toadstools - as well as the subsequent analyses and interpretations - are extremely valuable. Research into nature and biodiversity relies heavily on the efforts of hobbyists and amateur scientists. Even just the reports that the Netherlands is required to submit to the European Union are 95% based on data collected by volunteers.

Nowhere else in Europe is there such intensive collation of data by regular citizens about nature as in the Netherlands and the United Kingdom. In the Netherlands, that is partly due to a long tradition of recording nature observations, a high density of volunteers and an infrastructure of professional organizations that support volunteers and help with the collection and interpretation of observationsse out of a love of nature and because they gain enjoyment and satisfaction from it.

Citizen science: the road to social involvement?

Research question:
What does citizen science mean and what forms are the basis for the use of citizens in nature research (characteristics of the target groups, interaction of citizens with research, social involvement and strategies to reach more citizens as a participant)?

The results of this preliminary study provide key points for an empirical follow-up study on how citizen science projects now realize social involvement of citizens in nature and how they can contribute to

increasing social involvement (more participation in nature research and / or more activities as a user, gua There is a renewed attention for citizen science, i.e. research projects to which citizens contribute voluntary and whose results are used actively by science and society. The aim of this project is to explore the impact of the citizen science instrument on social involvement in nature, how they could improve social involvement in nature.

Many citizens of citizen science have more than average social involvement in nature and are active as a user and guardian. For a growing number of new observers this applies less. This offers opportunities for citizen science to contribute to social involvement in nature. There is a wide range of plat fora, especially for advanced participants, but these offer little incentives for new observers to perform nature activities themselves. In recent years, more attention has been paid to developing and communicating entry models that are close to the perception of the citizens, such as the National Garden Bird Count and all kinds of radars to identify health hazards in a timely fashion. Also, cooperation is being achieved with organizations inside and outside the natural domain that are closer to the world of new observant.rdian, or decision maker)?

The potential of co-creation for nature policy: a conceptual and empirical exploration

This project reports on a search for the potential of co-creation for nature policy. A search in literature, in different disciplines, on good empirical examples and on what lives in practice. With this conceptual and empirical exploration, the debate on co-creation and its significance for nature policy is at least uncrystallised. The search mainly indicates that the content of co-creation is not fixed. Rather, there are several routes and possibilities for fruitful co-creation. Co-creation is not a question of paved paths nor of fast and unambiguous roads. Co-creation should, in addition, argue that this report should be understood in a broader social context and its potential to be viewed in the light of micro and meso / macro conditions.

This project reports on a search for the potential of co-creation in nature policy. A search in literature, in various disciplines for good empirical examples and to find out what is happening in practice. This conceptual and empirical study is by no means the last word on co-creation and its significance for nature policy. The main outcome of the study is that the implementation of co-creation will be an open process, and that there are likely to be different pathways and possibilities for fruitful co-creation. Co-creation is not a question of following the beaten track or of quick fixes and straightforward formulas. Moreover, the report argues that co-creation should be understood within a broader social context and its potential should be seen in the light of conditions at the micro, meso and macro levels.

Informational Governance

States have traditionally invested heavily in the development of environmental information systems in Polar regions in order to monitor the changes in natural environment. But also private sector contribution is rapidly growing in line with the increasing economic activities such as shipping, fisheries and fossil fuel exploration. Non-state actors, efficient in mobilizing financial or informational resources, see new opportunities in redefining their role and setting the rules of the game applicably to Arctic resource use and governance. Information is changing from being a passive input or output of state policy decision-making, towards being a transformative factor in multi-actor governance.

Governance of information has become one of the most relevant, complicated, multi-scale and controversial issues in today's world as a result of increased capacities to collect, store and share information. A major challenge is to identify governance arrangements that can foster knowledge creation, learning and innovation and social networking but at the same time be responsive to societal concerns on totally free or fully controlled flows of information.

On the other hand, it erodes personal freedom, intelligence of businesses and the powers of classic public and private institutions as nobody is in control of information. What kind of governance arrangements can assist in assuring the positive developments in the Information Age? For instance, how can increased

transparency of different types of information and inclusion of a variety of societal groups lead to a more inclusive, sustainable and fair society?

Increasingly, local communities are governing their common pool resources, while becoming responsible for implementing sustainable use of marine and land based ecosystems. Challenges of reconciling individual and collective values in situations characterized by uncertainty and ambiguity are dealt with through collaborative processes and networks, in which trust is conditional for developing desired learning capacities. Information stemming from, for instance, governments and scientists can play a key role in fostering learning processes and adaptive capacity, either directly because it shows how resources can be used, or indirectly by changing the structure of governance networks. However, even more important are the information collected by the local communities themselves, because of context relevance and trust to sources within the networks.