2016

Defining new knowledge produced by collaborative art-science research

Schlaepfer-Miller, Juanita

RESEARCH DEGREES WITH PLYMOUTH UNIVERSITY

DEFINING NEW KNOWLEDGE PRODUCED BY COLLABORATIVE ART-SCIENCE RESEARCH

By

JUANITA SCHLÄPFER-MILLER

A thesis submitted to Plymouth University in partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

December 2015

AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Sub-Committee.

Work submitted for this research degree at the Plymouth University has not formed part of any other degree either at Plymouth University or at another establishment.

Relevant scientific seminars and conferences were regularly attended at which work was often presented; external institutions were visited for consultation purposes and several papers prepared for publication.

Publications (or presentation of other forms of creative and performing work):

Grounded Visions*: Climate Hope Garden traces*, November 2015- March 2016, ETHZ
Cyanotypes: Traces of gardens past August-September 2014 Gallery Kati Perriad, Bertastrasse. Zürich
Climate Hope Garden 2085 Part II – ETHZ April 2012
The world in 30 years – Lichthof CHN, ETHZ, November 2011
Climate Hope Garden 2085 ETHZ, June-September 2011
Gauss Rifle and *Membrane Protein* new interactive exhibits, forum PSI 2008
Not in my name Lichtspiel Bern and Elemantarraum Zürich, 2002 and 2003
Life turns slowly, Museum Bellerive, 2001
Underwear, Museum Bellerive 1998
20 new interactive exhibits at PSI forum, 1998
Point of Criticality in *Turbulent Landscapes* , Exploratorium 1996 and US-wide travelling show 1997-2000
Critical Flow and *Water circulation system*, Deep Creek Arts Center, Telluride, Colorado 1997

Presentation and Conferences Attended:

2016 February 19th "Applying a Transdisciplinary framework to art-science research" Conference on art and science research, ETH and ZHdK, Zürich
April 9th : COP 21 panel discussion University of Zürich
2015 September 2015 Workshop on Environmental Justice, Franklin University, Switzerland
September 2015 International Conference for Transdisciplinary research, Basel Switzerland
2014 June 2014 "Transdisciplinary art and science collaborations", Environmental Collapse Symposium at the University of Zürich
June, ITD14 Swiss Academies of Arts and Sciences, td-net
September ScienceCom14, Science et Cité, Beromünster
2013 ISEA Albequerque, New Mexico – September 2013
September 2013 Art, Science and Communication, Science Com13, La Chaux-de-Fonds, Switzerland
2012 "Sauti ya Wakulima – participatory media and climate change" Research Comission (FoKo) of the Institute for Integrative Biology, ETHZ 16th February 2012
2011 "Re-framing Ecological Novelty" ETHZ 16th November 2011

"Transdisciplinary art and science collaborations" at the conference Managing and understanding Ecological Novelty, Monte Verita, Switzerland, September 2011
2011 SARN Conference, Luzern, Switzerland
Art as ritual model of communication: framing and re-framing ecological novelty. Can creative methods offer a novel framework for understanding and representing rapid ecological and climatic change?
"Sauti ya Wakulima – participatory media and climate change" Africa Adapt Climate change and development conference, Addis Ababa, Ethopia, March 9th 2011

2010 "Art in science centers" panel convener ECSITE, Dortmund June 2010
"Transdisciplinary art and science collaborations" ISEA August 2010, Dortmund

2009 "Art as ritual model of communication" Reframing Consciousness conference, Munich November 2009

Publications:

ICT Update Let the voices of rural farmers be heard through cell phones
http://ictupdate.cta.int/Regulars/Online-articles-only/Let-the-voices-of-rural-farmers-be-heard-through-cell-phones

Angelika Hilbeck, Joanna M McMillan, Matthias Meier, Anna Humbel, Juanita Schläpfer-Miller and Miluse Trtikova "A controversy re-visited: Is the coccinellid Adalia bipunctata adversely affected by Bt toxins? Environmental Sciences Europe 2012, 24:10
http://www.enveurope.com/content/24/1/10

Transdiscourse: Mediated environments. Ed. "The Harrisons and Brandon Balangee" 2010

Word count of main body of thesis: 61,744

External contacts: First supervisor: Dr. Angelika Hilbeck, ETH Zurich

Second supervisor: Dr. Jill Scott, Zurich University of the Arts and the University of Plymouth

External Scientific Advisor: Dr. Harriet Hawkins, Royal Holloway, University of London

Signed Juanita Schlaepfer-Miller

Date 15th December 2015

Acknowledgements:

I would like to thank my supervisors, Dr Angelika Hilbeck and Dr Jill Scott for being there for the long haul, and special thanks to Dr Harriet Hawkins and Joe Swann for support above and beyond. Thank you to Dr Eugenio Tisselli, Dr Flora Ismail, Dr Agnes Nymora, Dr. Peter Edwards, Dr. Andreas Fischlin, Mr Hamza and all the farmers in Tanzania who contributed their valuable time to these projects. This would not have been possible without the support of my friends and my family: Kate, Beat and Tashi, I cannot thank you enough. This dissertation is dedicated to Liz Cicolini, who would have been so proud.

Defining new knowledge produced by collaborative art-science research

by Juanita Schläpfer-Miller

Abstract

This thesis takes a theoretical framework constructed for transdisciplinary research within different natural science disciplines and investigates what kind of new knowledge is produced when this framework is applied to projects at the interface of art and natural science.

The main case study is "*Sauti ya Wakulima* – The Voice of the Farmers", which involves collaboration with another intervention artist, and with natural scientists and farmers. This is a collaborative knowledge project with small-scale urban as well as rural farmers in Tanzania who have created an online community archive of their farming practices by using mobile phones to upload images and sounds onto a website. The research uses an open-ended participatory methodology that gives the participants as much creative agency as possible within the given power structures and practical and technical parameters.

A second work examined is the *Climate Hope Garden*, an installation by the author in collaboration with ecologists and climate scientists at the Swiss Federal Institute of Technology, Zürich (ETHZ). The installation consisted of a garden grown in climate-controlled chambers based on the climatic conditions proposed by IPCC climate scenarios. The project aimed to enact these scenarios on a spatial and temporal scale to which visitors could relate.

Transdisciplinary research has become a key reference point in funding proposals. Despite many references in the literature, and calls for research involving both the natural sciences and humanities to solve complex world problems such as adaptation to climate change, there seems to be little consensus about exactly what kind of knowledge might be produced from such projects, and how transdisciplinary research proposals might be evaluated, especially those at the interface of art and the natural sciences. Several theoretical frameworks have been suggested for designing transdisciplinary research between and within scientific disciplines, or between the natural and social sciences and humanities. The present study applies the framework proposed by Christian Pohl and Gertrude Hirsch Hadorn (2007) to a real-world transdisciplinary art-science project in a development context in order to examine the balance between the collective, locally embodied experience and the nomothetic knowledge that arises from it.

This thesis found that transdisciplinarity is a different question from that of types of knowledge on the nomothetic-idiographic scale. Transdisciplinarity is a pragmatic question of definitions and inherited boundaries of disciplines. The framework categories do not differentiate between nomothetic and idiographic, just to which part of the problem-solving puzzle they fit. This is perfectly valid for goal-oriented, problem-solving research and can be applied to art-science research, but there are other ways of describing this work, such as using a philosophical description of the knowing process which comes closer to encompassing the richness of the knowledge produced. It is in this sense that the new type of knowledge generated by the transdisciplinary projects required an expansion of the given theoretical framework.

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Premise: A theoretical model can be verified when a transdisciplinary research framework is applied to art-science research collaborations.

0.1 Introduction to thesis

This thesis evolved as a response to working in the geographic and conceptual proximity of the Swiss Artists in Labs program (AIL), the Td Lab of the Swiss Federal Institute of Technology, Zürich (ETHZ), and the Z-node of the Planetary Collegium, a cooperation between the University of Plymouth and Zürich University of the Arts (ZHdK). Within the context of the Z-node PhD program, investigation of communication issues around climate change, agriculture and bio-fuels in art-science collaborations and collaborative art led to an investigation of the nature of the new knowledge produced by the various modes of art-science and transdisciplinary research. This seemed all the more relevant given the many funding calls for cross-disciplinary practice to solve complex world problems, in particular those involving relations between science and society – one of which is the overriding issue of accountability. A specific example is the many-faceted question of climate change, where in addition to cross-disciplinary practice it is recommended that local knowledge be included in research, due to the localized nature of the effects of climate change and the experience gained with stakeholder involvement in the development context (Oughton and Bracken 2009, UNESCO 2002, CDE 2011, Jones and Thornton 2003, Reid 2003, Reid and Huq 2005, Abay 2012). In the present thesis, transdisciplinary research has thus become not only the method used to investigate climate change communication but also a topic of study in itself.

Because of the calls for participation in transdisciplinary research, it seemed appropriate to situate the work in the art genre of participatory, collaborative and social-process-oriented relational aesthetics, and to make use of established elements of that genre. However, this research project, along with its collaborations, must also be seen in the context of the still-emerging field of the art-science interface – although, to be clear, not all art-science collaborations are transdisciplinary. The different modes of collaboration, and the logics for engaging in art-science will be discussed below.

Two case studies are presented in the thesis. The first is *Sauti ya Wakulima:* The Voice of the Farmers (2011 – present), a collaborative knowledge project with small-scale[1] rural and urban farmers in Tanzania, who have created an online community archive of their farming practices by using mobile phones to upload images and sounds onto a website. The project represents a collaboration with another intervention artist, as well as with natural scientists and farmers.

The second project is the *Climate Hope Garden* (2011 and 2012), an installation by the present author in a different mode of collaboration with ecologists and climate scientists at the Swiss Federal Institute of Technology (ETHZ). It was a garden grown in climate-controlled chambers, based on the climatic conditions proposed by IPCC climate scenarios and specifically downscaled for Switzerland.

These examples of my artistic practice are documented in this thesis in photos, and *Sauti ya Wakulima* in a video on the accompanying DVD. Both projects can be viewed online at www.sautiyawakulima.net and http://www.klimagarten.ch/, respectively.

In an attempt to understand the nature of the new knowledge produced by these projects, I have applied – to both research design and data evaluation – elements of a transdisciplinary framework proposed by the Swiss Academies of Science under the authorship of the philosophers of science, Christian Pohl and Gertrude Hirsch Hadorn (2007). The data was evaluated using mixed methods and then repositioned within a transdisciplinary framework according to predefined categories of knowledge. Both projects are ongoing and there may be scope to continue the research, particularly in the case of the *Climate Hope Garden*, as it will be repeated in 2016 on a larger scale in the Old Botanical Garden in Zürich.[2]

Against the background of a documented need to include farmers in research about themselves, and a need for local farmers to learn from each other, the *Sauti ya Wakulima* research project aimed

- to bring creative participatory methods from the arts to a development context in order to facilitate social learning and farmer-led data gathering
- to apply the principles for designing a transdisciplinary research framework to an art-science research project

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[1] According to the FAO, small-scale farmers manage areas varying from less than one hectare up to 10 hectares. They grow 80% of the food in Asia and sub-Saharan Africa. They are characterized by 'family-focused motives such as favouring the stability of the farm household system, using mainly family labour for production and using part of the produce for family consumption'.
www.fao.org/fileadmin/…/nr/…/Factsheet_**SMALL**HOLDERS.pdf (accessed 31.10.15)

[2] Details available from - http://www.plantsciences.uzh.ch/index.html

- to put transdisciplinary theory into practice and verify the framework as a model of transdisciplinary practice.

In the context of misunderstanding of climate scenarios and a lack of concerted effort to reduce CO_2 emissions, the *Climate Hope Garden* project aimed:

- to bring IPCC Climate models to a temporal and spatial scale that people (the general Swiss public) could relate to.
- To contribute to the public dialogue about mitigating CO_2 emissions.
- to question notions of evidence in science and art by constructing a site-specific work using the technologies and legitimation of science.
- to analyse the collaborative aspects of this artwork. How and to what extent were the scientists involved, how could this particular art-science collaboration be described, and where was it positioned in relation to similar collaborations?

One of the main questions I wanted to answer when starting this research was whether a structured framework could be applied to a collaborative project, and whether the resulting data could be organized within this framework. The question could then be addressed: Exactly what kind of knowledge is produced by this type of transdisciplinary art-science research?

0.2 Structure of thesis

The thesis is structured around the thematic topics introduced above: narratives of agricultural production, climate change, and lay knowledge about climate change. These themes are outlined more fully in the Introduction, with the particular context of climate change in Switzerland and Tanzania introduced later in the respective project chapters. However, the transdisciplinary art-science mode of research is itself a subject of equal importance in the thesis, and attention is paid to this from the beginning. Accordingly, definitions and notions of inter-, multi-, and transdisciplinary research are discussed in section 0.4; section 0.5 focuses on the kind of knowledge produced by transdisciplinary research, with the applied transdisciplinary framework introduced in 0.6. Modes and logics of art-science research and collaboration are discussed in section 0.7.

Chapter 1 investigates participatory and collaborative art, and reviews a participatory theatre project and a bio-gas art project in Tanzania, as well as a participatory video project in Malawi. As the *Sauti* project is located in Tanzania, it is necessary to outline the postcolonial

context and the dominant role of NGOs in current research within the development field. This issue is addressed in Chapter 2, along with the question of participatory research and the role of ICT media for development. Chapter 3 describes the research design, grant applications and fieldwork procedures for *Sauti ya Wakulima*. Chapter 4 then presents the results of the fieldwork and repositions them within the transdisciplinary framework. Chapter 5 presents and discusses the *Climate Hope Garden* project. The Conclusion discusses the results from the transdisciplinary research process from *Sauti ya Wakulima* and the *Climate Hope Garden* in the context of potential for further investigation.

0.3 Thematic topics: climate change and agriculture

Climate change is putting pressure on agriculture and food production at the level of both small-scale farming and industrial food production (Beddington et al. 2011). According to the consensus paper produced from the Ecological Novelty Conference (Küffer, Edwards, Hilbeck et al. 2011), Earth's ecology is changing rapidly and in many different ways. There is strong evidence that this change is human-mediated (Walther 2002, IPCC 2007 and 2014). The resulting novel ecologies present challenges to science and society: not only are they new, but scientists do not yet know the extent of the changes and how ecosystems and societies of humans, plants, and animals will adapt, or how these changes should be managed (Robbins 2004, Seastedt and Hobbs 2008, Davis and Slobodkin 2004, Young et al. 2008, Edwards and Abvardi 1998). At the same time – and inextricably linked to the ecological changes – societies are undergoing a period of major upheaval.

There is wide scientific consensus about the anthropogenic sources of climate change, yet dissenters receive an undue level of media attention, which contributes, for example, to a lack of internalization of the behavioural changes necessary to mitigate CO_2 output (O'Neill and Nicholson-Cole 2009, Ockwell, Whitmarsh, and O'Neill 2009). Further barriers to communication about climate change include cultural filters and mistrust of the messenger[3] (Slocum 2004, O'Connor, Bord, and Fisher 1999, Lowe et al. 2006).

Although the deficit model of the public understanding of science (which implies the public is an empty vessel needing to be filled with knowledge) has long shown itself inadequate in both science communication theory and practice (Gregory and Miller 1998), it is a model that still informs much writing about climate change and the public understanding of, or

[3] See also the extensive work of the Yale Project on Climate Change Commmunication http://environment.yale.edu/climate/ (accessed 25.6.15)

engagement with, it. It is problematic to directly equate increased knowledge of any science with affective behavioural changes in the form of a real understanding (in this instance) of climate change or environmental stewardship (Tiffany Holmes 2007). Many theoretical and behavioural layers require examining here: concepts of time and place, for example, and people's relationship to them. The dearth of public engagement is nowadays (finally) being seen as a result not solely of a lack of information or comprehension, but also of the fact that scientists (particularly the IPCC) tend to communicate emissions as a problem on a universal and global scale. According to Agarwal and Narain (1991), this has resulted in scientific study being decoupled from the social and political contexts of its material production and cognitive understanding. As already indicated in the literature on research for development, it is now being recognized by both social and natural scientists that climate change needs to be understood on a local scale (Jones and Thornton 2003, Brace and Geoghegan 2010).

Catherine Brace and Hilary Geoghegan argue that climate knowledge needs to be more closely aligned with weather and the seasons, which, they say, form part of the same lexicon but are not synonymous with climate change. They suggest that using the term 'climate and the ways it may change' in preference to 'climate change' allows 'a relational approach' and an opportunity to explore how communities understand climatic issues in the context of local landscapes and environmental challenges. A relational approach would mean 'a mingling of place, personal history, daily life, culture and values' (Lorenzoni et al. 2007, in Brace and Geoghegan 2010).

As human geographers, Brace and Geoghegan bring the spatio-cultural concept of landscape into the climate change discussion. Yet within human geography, the concept of landscape has been shifted by the inclusion of language from performance, dwelling and embodiment, moving from landscape as an object with a distanced observer to a concern with landscape as a subject-object relationship (Brace and Geoghegan 2010, p. 5). Thus, by looking at everyday life scenarios, 'climate and the ways it might change' can be explored as 'knowledge-in-practice' and 'on-the-ground', and 'landscape becomes a possible means with which to organize the immediate and future, spatially and temporally intimate relations between people, flora, fauna, topography, environment and, crucially, weather' (ibid p. 6).

The concept of climate change is difficult to grasp, as distinct from the concepts of weather and the seasons, which immediately affect everyday life. Climate models reduce reality to a statistical construct about the future. According to the 4th IPCC Report, climate is a statistical description of weather over a period of time ranging from months to millions of years (IPCC 2007). In other words, it is (or can be) an abstraction of a very long-term future, and it is on this abstraction – in itself difficult to imagine – that the public is expected to base its present

decisions. This theme directly relates to the *Climate Hope Garden* research questions and will be further examined in Chapter 5.

The literature evidences that lay understanding of climate change is framed by the imaginative and notional triangulation of time, place (landscape) and self, and the relations between them. Hence, according to Brace and Geoghegan, it is important to characterize climate change as having not just ecological and economic but also symbolic and cultural impacts, which must be seen in this relational context (Brace and Geoghegan 2010). And it is this context that provides the rationale for undertaking both the *Climate Hope Garden* – as a way to bring global climate scenarios down to a local geographic and temporal scale accessible to non-scientists – and *Sauti ya Wakulima*, which aims to give Tanzanian farmers a platform to explore, voice and document their practices in relation to climate change.

Cross-disciplinary practice was a means to this end. Along this path the processes of the practice itself became equally interesting and provoked questions about the nature of evidence, both within and outside of established disciplines, and the balance between collective, locally embodied experience and the nomothetic knowledge that might arise from it. The processes raised questions about the difference, in other words, between general and particular knowledge, between the abstract conclusions drawn by the scientist or scholar and the concrete instance of experience, in itself unfathomable, from which this knowledge is adduced. In this context I share the concerns of many – for example, the geographer Andrew Barry in his paper *The Logics of Interdisciplinarity*, with regard to the way in which interdisciplinarity has come to be seen as *the* solution to many contemporary problems, in particular the relations between science and society, the development of accountability, and the fostering of innovation in the knowledge economy (Barry et al. 2008, p. 21).

0.4 Defining inter-, multi- and trans-disciplinary research

> Transdisciplinary projects are, in an idealized form, equally committed to the disciplinary knowledge bases of the natural sciences and technologies, the value-laden themes of humanities and also the procedural methods of the social sciences. (Krohn 2008, p. 369)

In order to define cross-disciplinary practice, it is necessary to establish a conceptual basis for this terminology: firstly, what is meant by ‘discipline’, and secondly, what is meant in this context by the prefixes ‘inter’, ‘multi’, and ‘trans’. Disciplines are still the primary cognitive and social units of research and teaching in universities, as Brewer so famously stated: “The

world has problems, but universities have departments" (Brewer 1999). The value of a discipline is that its adherents share assumptions about how to define a problem, what methods to use, and what results count as evidence (Stichweh 1992, Kuhn 1962). So on the one hand there is value in the structure of a discipline and knowing how knowledge is produced within that structure. On the other hand, disciplines themselves are increasingly characterized by internal differences – for example, that between physical and human geography (Harrison et al. 2004, in Barry et al. 2008). In discussions of the value of transdisciplinary knowledge, disciplines are frequently portrayed not only as conventional and closed, but also as lacking – or even repressing – creativity. Against this it is argued that the value of a discipline is precisely its ability to account for the conditions of its existence and for the ways in which it arrives at its knowledge practices (Strathern 2004, p. 5 in *ibid* p. 26). According to Strathern disciplines have an in-built accountability at the level of production and epistemology – that is a knowing of how knowledge is made and where it comes from. An issue then for cross-disciplinary work is what are the models of accountability? How is it measured and validated? Particularly if the reaching beyond disciplines includes, (as in the case of transdisciplinarity) reaching beyond academia. If society is included as part of the research paradigm then Strathern asks who validates society, what is 'society' in this context and what do we need to know about it in order for 'socially' to be a 'legitimizing epithet' or a reference point for 'socially robust science' (Strathern 2004 p 89). The notion that society has an 'agentive capacity', implies that it should do something about science. This entrenches the science/society divide, instead of - as Strathern does - ask the more interesting question of why these two entities have to be seen to be in partnership (ibid. p 88).

If disciplines can be difficult to define, then cross-disciplinary praxis is an even more slippery customer. The three terms most frequently defined in this context are *multidisciplinary*, in which several disciplines cooperate but remained unchanged; *interdisciplinary*, where there is an attempt to integrate perspectives from shared disciplines; and *transdisciplinary*, which involves the transcending of disciplinary norms, whether this be in order to address the complexity of life-world problems, or to overcome the distance between specialized and lay knowledge, or between research and policy. Transdisciplinarity is the term used by the philosophers of science Helga Nowotny et al. when they speak of *mode 2* knowledge production as transcending disciplinary boundaries (Nowotny et al. 2001). Pohl and Hadorn assert that transdisciplinary research differs from 'inter-', 'cross-', 'multi-' and 'pluri-' disciplinarity not only in degree or elements of integration, but also in kind. Transdisciplinarity, they argue, goes beyond integrating knowledge from different disciplines to integrating the perspectives of social groups outside of academia (Pohl & Hadorn 2008).

Navigating the plurality of terms and meanings around inter- and transdisciplinarity is not simple. Much depends upon the level of integration of different disciplinary types of knowledge and modes of collaboration, including ways of evaluating evidence, as it does, too, on the dominance of one or more disciplines. Barry et al. characterize three modes of interdisciplinarity: first, the *integrative synthesis mode*, where work is judged by the criteria of the antecedent disciplines and its values are assessed by these additive criteria. The *subordinate service mode* is one in which the service discipline compensates for a lack in the master discipline. For example, by adopting a natural science problem-framing technique, the social sciences enable the natural sciences to engage with social factors; or again, the social sciences may be employed in the public understanding of science (Irwin and Wynne 1996). The third mode is the *agonistic antagonistic mode*, where the interdisciplinarity 'springs from a self-conscious dialogue with, criticism of, or opposition to, the intellectual, ethical or political limits of established disciplines' (Barry et al. 2008, p. 29). This latter mode resonates with discourses in socially oriented participatory art and art-science, where the nature of art and science are regularly called into question.

Of the many definitions and descriptions of transdisciplinary research, the most useful and concise comes from Carole Després, who states that when research methods are borrowed from different disciplines, and the disciplinary competencies of team members are used to their best advantage, then the definition of the research strategy and the ongoing interpretation process are truly transdisciplinary (Després 2004).

Questions arising from this statement might be: How can a research process be designed so that the disciplinary competencies of the team are used to their best advantage? How can the disciplinary methods be combined? What will the results look like? What kind of knowledge will be produced?

In the context of transdisciplinary art-science projects, this provokes the additional question: To what extent does transdisciplinarity transgress the disciplinary norms of art? If it does not, as art has no sufficiently defined norms, then is transdisciplinarity still a useful term for the kind of art-science projects this thesis is investigating? This is the type of issue to which I referred above (see Abstract p. 2), when I observed that the new type of knowledge generated by the projects required an expansion of the theoretical framework.

There are many more definitions of art than there are of transdisciplinarity, but I have to place my flag somewhere. Taking the view that contemporary art must be aware of the contemporary world, in which science and technology are essential, it can be convincingly argued – with the editor of *Leonardo*, Roger Malina – that 'artists must appropriate all useful scientific knowledge and applicable tools for artistic expression' (Malina 2006, p. 17).

In these terms, the kind of art-science research this thesis is investigating cannot prima facie be described as transdisciplinary, at least from the perspective of art, because, as a discipline, it does not manifestly transgress its own norms. This mode of art-science research would, from this point of view, be more accurately described as interdisciplinary. On the other hand it can be argued that art consists radically in the breaking of norms, and hence transcends the very concept of norm. As Pablo Picasso is famously reputed to have said: "Learn the rules like a pro, so you can break them like an artist." Paul Klee's dictum, 'Art does not reproduce the visible, it makes visible' (*Creative Credo* 1920), is perhaps even more relevant, for what is not yet visible cannot be subject to the laws of the visible, it simply transcends them: that is the essence of creativity. Inasmuch as it is creative, an art-science collaboration would unquestionably, in these terms, be transdisciplinary.

At a different level, when agro-ecologists and botanists collaborate with artists in defining mutual research questions and ways of presenting and evaluating data, they are de facto transgressing their own disciplinary norms. For this reason, too, the term transdisciplinary might be fairly applied, especially in a case like the present thesis, both of whose projects are not only situated in the development context of life-world problem-solving, but, as Hadorn prescribes, include the perspective of lay participants.

It is thus with some reservations, but also with confidence in the arguments proposed, that the term transdisciplinary is used here. An additional reason for using this term is that it is part of the frame of reference of Swiss academic structures and specifically of the transdisciplinary literature of Christian Pohl and Gertrude Hirsch Hadorn – see their *Principles for Designing Transdisciplinary Research*.

It will, therefore, be argued below that the three-year case study of a participatory arts practice set in the field of Tanzanian agriculture can with some justification be called transdisciplinary. The same could be said of the *Climate Hope Garden.* That is also transdisciplinary in its interface among climatology, botany, and public understanding of science: a media project that is also a botanical-agricultural and climatological-futurological project. The argument is complemented by an exploration of the design, execution and evaluation of the project, in which the thesis critically reflects on transdisciplinary research and on the new knowledge it produces.

This theme will already be taken up in the next section, which introduces the transdisciplinary framework and its position in current discourse, and explores the kinds of knowledge produced by transdisciplinary research. This will be followed by a scrutiny of some of the concepts and logics involved when artists and scientists collaborate.

0.5 What kind of knowledge is produced by transdisciplinary research?

Recent discussions in transdisciplinary research theory for sustainable development (Pohl et al. 2010) have conceptualized two methods of knowledge production. The first is generated by boundary organizations such as regulatory bodies (for GMOs, for example), which exist at the edge of scientific and political institutions and involve actors from both sides, that is science and policy makers or NGO representatives, and possibly also include mediators (Guston 2001). The second, more interactive type of knowledge production takes place in the applied context and is what Nowotony and Gibbons refer to as *mode 2 knowledge production* or *socially robust knowledge* (Nowotny et al., 2001, Gibbons et al., 1994). It is perhaps important to note that these authors are not talking about different types of knowledge (on the science-art, nomothetic-idiographic, general-particular scale), but of socially and organisationally different ways of gaining knowledge. According to Pohl (Pohl et al. 2010) these conceptualizations of the different modes of knowledge production differ in how they perceive the relationship between science and non-science. While boundary organizations stabilize the relationship between science and society, mode 2 knowledge production creates a new epistemology, a new form or way of thinking about scientific knowledge. This has been important to many discussions about how both transdisciplinarity and art-science might contribute to new, socially robust scientific knowledge.

Socially robust scientific knowledge for example, is created when lay knowledge is included in knowledge production, for example from farmers who are experts in their field(s). In his discourse-defining paper on radioactive fallout on English hillsides after Chernobyl, *May the sheep safely graze? A reflexive view of the expert-lay knowledge divide* (Wynne 1996), Brian Wynne cites the safety failures that occurred when farmers were not consulted about grazing patterns of sheep. He argues for 'alternative, more culturally rooted and legitimate forms of collective public knowledge' (Wynne 1996, p. 46). Wynne was one of the first critical voices in the debates surrounding the public understanding of science, and he contends that there continues to be a distinction between science and non-science, stalwartly maintained by a scientific, technological or expert community. He argues that 'long-standing, deeply cultural presumptions of a categorical divide between factual, objective and real knowledge on the one hand, and cognitively empty emotion or values on the other' are reproduced. Furthermore, he critiques, 'whilst science looks after the former, lay publics are only capable of taking sentimental, emotional and intellectually vacuous positions' (Wynne 2001, p. 445). Much literature now acknowledges that science is not neutral and value free (Wynne 2001, p. 445), yet the question of how transdisciplinary research contributes to scientific knowledge cannot be answered without calling into question the broadly accepted view of the nature of

scientific knowledge (Krohn 2008, Wuelser et al. 2012). In fact the idea of equally valuing multiple forms of knowledge is not new: it was suggested by the neo-Kantian philosopher Wilhelm Windelband, in his 1894 rectorial lecture (Krohn 2008). In his seminal paper *Inter- and Transdisciplinary University: A Systems Approach to Education and Innovation*, Jantsch stated, 'the classical single-track and sequential problem-solving approach itself becomes meaningless today' (Jantsch 1972). This may be true in theory, but in many cases empirical scientific knowledge still trumps all other forms of knowledge such as embodied, local or indigenous knowledge (ICSU 2002). This is also true in my experience of applying for transdisciplinary research grants, which were frequently turned down because they were not 'scientific' enough.

However there are still many questions, including 'What can be learned from transdisciplinary research projects?' that are not yet fully answered. According to Krohn (2008, p. 369), transdisciplinary projects are mixtures of idiosyncratic and nomothetic knowledge structures. Krohn asks if some nomothetic lessons can be learned from case studies despite their situational conditions, or can lessons be learned *because* they are embedded in real-world contexts (Krohn 2008, p. 375)? This question is central to a project like *Sauti ya Wakulima*.

Using the example of island ecology, Christoph Küffer questions how it is possible to generalize about knowledge from real-world systems, which are often highly idiosyncratic. He makes the analogy to medical doctors who have the challenge of building up a body of knowledge from individual cases. Conservationists tend to use two strategies to get around this; one is 'one answer fits all problems', which is limited because conservation laws are rarely applicable without accounting for a particular context. The second approach, 'every problem requires a different answer – suffers from a lack of predictive power and ability to learn from research and management in other places' (Küffer 2012, p. 127). It can be seen that the more generally applicable a piece of empirical knowledge is, the higher its scientific value – at least in this definition of natural sciences (Krohn 2008 p. 369).

What is needed is new forms of learning and theory formation which could enable the insights gained in one case study to be transferred to another. This same argument could be applied to transdisciplinary art-science, which, like Küffer's 'cross-island learning', is also more than an exchange of facts and could also be described as 'a way of collaborative thinking and theory formation that depends on long-term continuous interactions' (Küffer 2012, p. 132).

There may also be generalized features of arts knowledge that combine 'idiographic concerns about problem solutions with nomothetic expectations of generalized knowledge' (Krohn

2008, p. 272). This is the crucial issue of this thesis: finding knowledge that lies between the reductionism of science and the holism of culture. This, however, as Krohn admits, is much more easily proposed than done (Krohn 2008, p. 374). The specific challenge of the thesis thus comes to light, for this is exactly what it aims to do: to define the knowledge (if any) generated by the participants in the space created by artists, scientists and a farming – or, in the case of the *Climate Hope Garden* project, an urban European – community.

Some further concepts in transdisciplinary research theory that need to be explained are reflexive learning and integration. Central to transdisciplinary research are the concepts of recursiveness and reflection. According to Wynne, reflexivity is 'the process of identifying and critically examining (and thus rendering open to change) the basic, pre-analytic assumptions that frame knowledge commitments'. Applying this to scientific knowledge, he goes on to say:

> My interest is to ask how bodies of knowledge such as science act (or do not act) as systems for reflexive learning in the sense of understanding their own pre-commitments so that these can be negotiated rather than blindly imposed on society at large (Wynne 1993, p. 324).

The open question is whether transdisciplinary research can better facilitate reflexive learning than the sense of reflexivity that is generally being encouraged in disciplinary practice, and in doing so can produce other types of knowledge. The notion of science engaging in reflexive learning is important in many contexts and particularly in terms of engaging publics in social learning about critically relevant and ill-defined problems such as adaptation to climate change (Tàbara 2013).

In the context of transdisciplinary research, the second concept, 'integration', means interrelating epistemological, conceptual, and practical elements that were not related before (Jahn et al. 2006, in Pohl et al. 2010). According to Jahn et al., the process of transdisciplinary research centrally involves integration problems. Jahn talks about the different dimensions of transdisciplinary knowledge that are produced by integrating different forms of knowledge from various disciplines. The 'cognitive epistemic or knowledge dimension' develops when knowledge components from different disciplines are first distinguished from each other and then linked. The next dimension is the 'social and organisational dimension', which involves sorting and connecting different interests, sub-projects and organisational units. The 'communicative dimension' is when linguistic means of expression and practices are developed as prerequisites for producing common publications. The 'material or technical dimension' entails redesigning different material for the technical

elements of proposed solutions into socially and normatively embedded and functional material systems.

Integration can be a stronger or weaker form of interrelation. A weak form would be a boundary object – i.e. an object to which all those involved refer, based on their specific interest, but which does not require explicit communication between the perspectives. A strong outcome would be a consensus reached about the causes of a problem and its sustainable solution (Pohl et al. 2010). A boundary object could be, for example, a conceptual model that everyone in the research group can identify with. Or the mobile phones in *Sauti ya Wakulima* could be boundary objects, and in the *Climate Hope Garden* the garden itself is a model and a boundary object that not everyone has the same conception of, leaving room for discussion and flexibility, a place where concepts from different disciplines can meet.

Again taking the example of climate change, when climate models are being developed, integration issues are critical. The process of developing climate models shows the tension between nomothetic (or core disciplinary) knowledge, and idiographic knowledge – i.e. knowledge of the unique features of our current climate (Krohn 2010).

It is important to keep in mind, when talking about different 'types' or 'kinds' of knowledge, that knowledge is a dynamic spectrum, a process moving constantly between the general and the particular, the idiographic and the nomothetic. To know the particular instance in its full individuality (idiographic knowledge) involves the breaking of knowledge into the per se unique moment of encounter. The raising of this encounter to the level of abstract (nomothetic) knowledge is ultimately impossible: there will always be a gap between the individual instance (e.g. of evidence) and the truths that can be abstracted and generalized from it.

Scientists tend to concentrate on the individual instance/object only as evincing general structures or laws. Newton was not concerned about the ‘thisness’ (*idios*) of the apple, but about the laws governing its fall. These laws govern all material objects, yet no scientist knows what matter actually is. They know only what their methods and apparatus allow them to know about how it is constituted and behaves. That is a function of the general truth that we only know our world in and through the sign systems (languages in the broadest sense) that we use to access it. The point is that these systems form a continuum; they all work in the same way. The thesis question is, then: Where on that continuum does the transdisciplinary knowledge of these art-science collaborations lie? The immediate problem is that of defining a ‘where’. It is easier to define the two polar extremes; otherwise one is, most probably, confined to saying ‘somewhere in between’. But to define the continuum as such goes quite a long way to justifying that ‘in-between’.

0.6 Designing a transdisciplinary research framework

0.6.1 Pragmatic principles (Pohl and Hadorn / Swiss Academies)

In order to structure the new knowledge that might be generated by transdisciplinary research, Pohl and Hadorn (2007), in conjunction with the Swiss Academies of Science, suggest a set of principles for designing transdisciplinary research questions, including how to identify the actors involved and what type of new knowledge could be produced. Transdisciplinary research grew out of ideas such as the inclusion of stakeholders, as in the rapid rural appraisal work of Robert Chambers from the 1970s and early 80s (see Chapter 2). In the late 1970s the physician and zoologist David Bradley – who researched from 1974 onwards at the London School of Hygiene and Tropical Medicine and the Zoology Department at the University of Oxford – engaged in transdisciplinary research in order to solve complex problems, but did so (he himself affirms) without much self-reflection (Bradley 2007 in Pohl & Hadorn 2007). In the foreword to the *Principles for Designing Transdisciplinary Research*, the Swiss Academies of Science (Td-Net Advisory Board) state that transdisciplinary research is complementary to basic research and is required to address concrete challenges in the fields of health, environmental change, North-South collaboration and social dynamics. They further contend that transdisciplinary research functions by developing new and unusual methods and ways of asking questions and understanding complex relationships. Yet in order to do so, it must be undertaken with systematic procedures; hence the proposed *Principles*.

Published in 2007, the Academies' *Principles for Designing Transdisciplinary Research* was shortly followed by a second, more extensive book, a *Handbook for Transdisciplinary Research*, which Pohl and Hadorn co-edited with a number of other Swiss transdisciplinary scholars (Hadorn et al. 2008). The three types of knowledge described by Pohl and Hadorn in the framework for transdisciplinary research had first been identified and named in *Research on Sustainability and Global Change – Visions in Science Policy by Swiss Researchers* (ProClim 1997). Indeed all these texts stem from the Transdisciplinary-Net project (td-net www.transdisciplinarity.ch) created in 2003 to support and promote transdisciplinary research in the engineering, natural and social sciences, and the humanities. The perceived need for the network was rooted in an awareness that while transdisciplinary research was required to help solve *complex world problems* (a.k.a. *wicked* problems), due to the complexities of the research process, the researchers themselves needed support, exchange and mutual learning to help them achieve their goals.

The design framework constituted by the Academies' *Principles* was created for transdisciplinary research projects between different natural science disciplines, or between the natural sciences and humanities; until now it has not been applied to a project situated between the natural sciences and creative arts.

This section will outline these principles with the intention of applying them to the design of a transdisciplinary art-science research project. The case-study chapters (Chapters 3, 4 and 5) will then indicate how these principles have been applied.

I will, however, first step back a moment to clarify what I understand by scientific knowledge. According to classical thinking, science is a cognitive faculty for explaining the development of natural things, including humans. Science was undertaken through contemplation (*theoria*). Theory referred to the knowledge about self-evident principles on which scientific demonstration was based. The knowledge gained by demonstration was termed *epistême*, but this was of no use for day-to-day living, which required skills for action (*praxis*) and production (*poiêsis*), and prudence (*phronêsis*) for deliberation about things that called for choice. Aristotle saw scientific knowledge as separate from the various aspects of practical knowledge (Aristotle 2003 in Hadorn et al. 2008). According to Hadorn the three types of knowledge – 'target', 'systems' and 'transformation' knowledge – resemble Aristotle's distinctions (Hadorn et al. 2008).

Pohl and Hadorn (2007 p. 20-23) propose the following principles for designing transdisciplinary research:

1. reduce complexity by specifying the need for knowledge and identifying the actors involved
2. achieve effectiveness through contextualisation
3. achieve integration through open encounters, and
4. develop reflexivity through recursiveness (iteration).

Within these principles, Pohl and Hadorn define three forms of knowledge that might be produced by particular types of research question. The first is *systems* knowledge, where the research questions would be

> empirical questions about the genesis and possible further development of a problem and about interpretations of the problem in the life-world. The challenge for systems knowledge is reflecting on and dealing with uncertainties through real-world experiments.

The second is *target* knowledge, which is concerned with

> questions relating to determining and explaining the need for change, desired goals and better practices. Target knowledge aims to explain better practices and generate better questions, pluralism of norms and values, depending on views of systems relations and options for change. Its challenge is clarification and priority setting of various values in relation to the common good as a regulatory principle.

The third type of knowledge is *transformation* knowledge, provoking

> questions about technical, social, legal, cultural and other possible means of acting that aim to transform existing practices and introduce desired ones. . . reflect[ions] on feasibility of proposed solutions. . . technical, social, legal, cultural options for change depending on views of system relation and goals. The challenge here is learning how to make existing technologies, regulations, practices and power relations more flexible (Pohl and Hadorn 2007, p. 36).

Many researchers have employed this tripartite framework in their studies (CASS-ProClim 1997, Hubert et al. 2008, Kiteme and Wiesmann 2008, Messerli and Messerli 2008, Stauffacher et al. 2006, Hinderlang et al. 2005, Walter et al. 2008 – all in Hadorn et al 2008); according to Messerli and Messerli (2008), the framework has become standard in the field. They use a modified version and describe

- *systems* knowledge as knowledge concerning the current situation,
- *target* knowledge as knowledge concerning the target situation or where one wants to be, and
- *action* knowledge (*transformation*) as shaping the transition from the current situation to the target situation (CASS-ProClim 1997, in Messerli and Messerli 2008, p. 59).

One or more of these types of knowledge has been used to describe, for example, the process of integrating the types of knowledge needed for practical problem solving.

In a study of grazing land management in the Mediterranean, Hubert et al. started with farmer-based knowledge. Into this they were able to integrate knowledge from other disciplines without increasing complexity. In this way they were able to manage the tension between 'scientific exigency and social relevance' (Hubert et al. 2008, p. 122). For Boniface Kiteme and Urs Wiesmann – in a case study on sustainable river basin management in Kenya – target knowledge was particularly relevant but had to be defined broadly in order to fulfil sustainability criteria (Kiteme and Wiesmann 2008).

Bruno and Paul Messerli synthesized their experience of mountain research with the transdisciplinary research framework (CASS-ProClim 1997) and found that target and action (transfer) knowledge became as prominent as system (current) knowledge in the first stage of

research. However, this is not to say that the methodological challenges of knowledge confrontation and integration were solved at this stage. They found that 'transdisciplinary research requires an additional step in knowledge integration in order to make use of generalized conceptual knowledge in a specific societal and environmental context.' Furthermore, they remark apropos knowledge integration that 'transformation and translation procedures between researchers and stakeholders outside academia require intensive and time-consuming interactions' (Messerli and Messerli 2008, p. 58-60).

In the development of a stakeholder platform for resource-use negotiations in woodland in Switzerland, Karin Hinderlang et al. used the concept of target and transformation knowledge to describe the knowledge elaborated specifically by stakeholder participation. This knowledge production occurred in four phases: from preparation and reflection to development and knowledge transfer. The practitioners contributed new systems-knowledge in the form of traditional knowledge, and the scientists brought knowledge from former and current projects (Hinderlang et al. 2008).

The approach employed by Walter et al. in a development and sustainability study in Switzerland paid special attention to the integration of different types of knowledge, as all knowledge types are required to support sustainability transition. They set out their framework, relating a general transdisciplinary project framework to the *TIPS* approach, and detailing the knowledge type involved in specific steps. The *TIPS* approach was developed by Michael Stauffacher et al. (2006) and stands for *Transdisciplinary Integrated Planning and Synthesis*. This approach understands transdisciplinarity as 'based on a socio-cultural constructivist paradigm, which emphasizes that individuals and organizations actively construct knowledge in a specific social setting (Resnick 1987), according to existing knowledge and experiences' (Walter et al. 2008, p. 225).

These examples indicate that researchers use Pohl and Hadorn's three types of knowledge to distinguish phases of the research process, and to define the knowledge produced by various actors. In most cases these knowledge categories prove most useful in the integration process, where knowledges are synthesized or brought together in a way that is valid for the various participants.

Pohl and Hadorn see participatory research on the basis of collaboration between disciplines as the means of meeting the requirements of transdisciplinary research. The question remains, however, whether art-science research can be sufficiently structured to fit the framing principles, and if so, what is lost in the process? Although – with respect to their four principles – generating three types of knowledge seems highly ambitious, Pohl and Hadorn

suggest that only some of the requirements of transdisciplinary research need be met at each project phase; it is not necessary to meet all the requirements at every phase.

0.6.2 Theoretical principles (Habermas / Després)

Another way of structuring transdisciplinary research that includes the creative arts is proposed by Després et al. (2004). In a participatory design process, which they base on Habermas' *Theory of Communicative Action*, they classify knowledge into four categories: scientific, instrumental, ethical and aesthetic. In their structure not all social groups contribute to all kinds of knowledge produced. Thus the participation of artists, designers and citizens contributes to aesthetic knowledge.

This way of categorising knowledge is in itself interesting and certainly simpler than Pohl and Hadorn's 3-fold distinction, but it is questionable whether it encompasses the complexity and interrelations of scientific and ethical questions that occur in messy, real-world settings. It also seems closely aligned with disciplinary competencies, which has certain disadvantages. For if the contribution of artists is limited to their known competencies (i.e. aesthetic knowledge), the knowledge produced may remain in its limited disciplinary box and not become truly transdisciplinary (i.e. *mode 2* knowledge). In fact, artists may well contribute to other forms of knowledge than the aesthetic: both citizens and artists have been shown to contribute, for example, to scientific knowledge (Irwin and Wynne 1996, Arends and Thackara 2003, Ballangee 2009).

Therefore, although Pohl and Hadorn's principles for designing transdisciplinary research, with their defined categories of knowledge, are not without limitations, they permit a mingling of disciplinary competencies in order to produce identifiable, practically applicable knowledge that could at least in theory be applied to art-science research collaborations. Chapter 5 will describe how these principles were applied (in part) to the *Climate Hope Garden*, and Chapter 3 will deal in the same sense, but more fully, with *Sauti ya Wakulima*, where there was more data to evaluate. Chapter 4 will describe how this data was repositioned within the transdisciplinary framework.

0.6.3 Institutional principles (Osborne)

Osborne distinguishes three main discourses of transdisciplinarity in the sciences:

1. A systems theoretical approach to producing an integral education innovation system (Jantsch 1970, Kim 1998, Somerville and Rapport 2000).
2. A sociological science policy approach to new forms of knowledge production (Gibbons et al. 1994, Nowotny 2003).
3. Literature on research methodology in the collaborative solution of life-world problems of environmental sustainability and health (e.g. Klein 2001, Pohl and Hadorn 2007, Hadorn et al. 2008) (Osborne 2015).

In this latter discourse the specifically transdisciplinary aspect of the research process comes from the identification of problems external to the scientific process itself, and cannot, therefore, be adequately addressed by disciplinary knowledge. Here the form of knowledge production has its basis in broader social processes to which it is responsible, and in the specifically European concept of a social democratic educational welfare state. Institutionally, this form of transdisciplinary social science is associated with the European Research Council and the Swiss National Science Foundation. Osborne argues that its practice-oriented literature primarily consists of methodological reflections on transdisciplinary case studies, and is related to a philosophy of science that places a framing emphasis on the non-disciplinary and problem-based nature of science – e.g. the concept of a post-normal science developed by Funtowicz and Ravetz. The concerns of this post-normal science focus on conditions of system uncertainty and higher decision stakes requiring extended peer review communities (Funtowicz and Ravetz 2003).

The crossing of disciplinary boundaries is achieved in this approach by a 'dissolution of disciplinary frameworks' rather than by transformative or constructive changes within each discipline. It is precisely this concept of the dissolution of existing disciplinary frameworks that raises the spectre of re-disciplination via the new discipline of a methodologically standardized transdisciplinarity (Osborne 2015, p. 14). Many universities now offer courses focusing on methods of transdisciplinarity, and these are in some cases a compulsory unit of a Master's in Ecology program, for example.[4]

Again according to Osborne, the established transdisciplinary discourse is positive and organisational: it is a discourse of the state.

> The overwhelmingly common feature of such discourses, both epistemologically and politically, is an instrumental, technocratic humanism in which the policy-based formulations of life-world problems are construed in such a way as to be amenable to

[4] The ZHdK and many other art schools offer courses in transdisciplinary studies https://www.zhdk.ch/?mtr_en as does the ETHZ http://www.tdlab.usys.ethz.ch/education/tdcs.html

> technological and other instrumental solutions (Osborne 2011, in Osborne 2015, p. 15).

It is important to note that these three approaches (0.6.1-3) come from different concerns, and are not, therefore, immediately comparable. Thus transdisciplinarity is a different question from that of types of knowledge on the nomothetic-idiographic scale. Transdisciplinarity is a pragmatic question of definitions and inherited boundaries of disciplines. This is a secondary issue to that of 'placing' the type of knowledge being generated on a science-arts (or nomothetic-idiographic) scale. Of course the two questions are both theoretically and institutionally related: departmental distinctions derive ultimately from theoretical-methodological ones.

The structure of the knowing process can be seen as fractal: each act or process of knowing reflects every other, but each at its own level, the larger structures reflect the smaller, the higher structures the lower, and so on. Thus each of the three sets of distinctions quoted here exists at a different level, or addresses a different problem. Yet each of them contains in its core the same recurring shape of the movement from understanding to encounter, from the *idios* (i.e. the particular instance) to the general principle abstracted from that instance, and back to the instance in all its particularity. This latter is what one could call the aesthetic as opposed to the scientific moment (the particular as opposed to the general). But this moment is not reserved to artists: a scientist or mathematician may take aesthetic pleasure in the moment of insight (Eureka!) when e.g. an equation resolves or an experiment yields a new interpretation. It is perfectly legitimate, then, to distinguish types of knowledge according to their objects, or usefulness, or academic disciplines, but the knowing process itself will, I would argue, be analogical, and a (philosophical) description of the knowing process itself can fit all these sets of distinctions (Pohl and Hadorn, Habermas, Després, Osborne) but exists at a different logical level from them.

This understanding of Pohl and Hadorn's view of transdisciplinarity again provokes the question of whether their framework is suitable for art-science research. For this research aims beyond instrumentalism towards new ways of thinking about both art and science: towards what amounts to a new ontology. It is, in fact, by resisting the logic of instrumentalism and accountability that art-science can come into its own as a field – a point to be argued in the next section.

0.7 Art-science as transdisciplinary practice: Modes and logics of art-science research and collaboration

> Art-science engages science then, for its conceptual and material armories, in terms of common interests in experimentation and innovation and via critique (Barry 2001).

Although the discussion to this point has been about transdisciplinary research in general, it will now focus on the particular field of art-science as transdisciplinary practice, asking under what logics it has been justified and in what possible modes of collaboration it can be engaged.

Art-science can be considered an emergent field, but at its core are long-standing concerns to shift ideas about the nature and scope of art. The history of art-science has been traced to the *Two Cultures* Rede Lecture of C. P. Snow (Snow 1959), the Bodmer report on the public understanding of science (Royal Society 1985, Bodmer 1986), and the Wellcome Trust *Sci-art* program of 1996-2006, which funded 124 projects (with a sum of £3 million) in order to promote understanding of science among the general public.[5]

The field of art-science has become established for institutions and funding bodies, as it forms part of a larger field of overlapping disciplines at the intersection of arts, sciences and technologies, including new media and digital art, interactive and immersive art, bio-art and wet art, which themselves are adjacent to the inter-disciplines of robotics, informatics, artificial and embodied intelligence, tissue engineering and systems biology (Wilson 2002). Indeed the genealogy of art-science can be succinctly traced to three related genealogies: 1) conceptual and post-conceptual art including performance, installations, public and activist art; 2) art and technology movements; and 3) biosciences and technologies (Barry et al. 2008, p. 38). The primary tension of conceptual art concerned with media and materials, as well as of that concerned with social and political experiment, is, according to Barry et al., a tension recapitulated in art-science (Barry et al. 2008, p. 39). Related as it is to conceptual art, art-science can offer a radical ontological shift in its interrogation of art, science, technology, agency, life and the human. This potential passes by funders and science institutions if they are only seeking accountability and innovation (Born and Barry 2013, p. 260).

But what of the modes of collaboration in art-science? Referring back to the modes of interdisciplinarity outlined by Born and Barry (described above) – i.e. the *integrative*

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[5] It is claimed that the experiments in art and technology E.A.T. (Experiments in Art and Technology) collaborations with Billy Klüver brought art-science into the art discussion. See for example La Prade, E., *The Early Days of E.A.T.* http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=998040&filter%3DAND%28p_IS_Number%3A21537%29 (accessed 31.10.15)

synthesis mode, agonistic antagonistic mode and *subordinate-service mode* (in which the service discipline makes up for a lack in the master discipline) – Born argues that in art-science this *subordinate service mode* can be inverted, with scientists adopting the service role for artist collaborators and providing resources and equipment to further a project conceived of largely in artistic terms (Born 1995). Chapter 5 will indicate that the *Climate Hope Garden* was produced in this mode.

Spanning these three modes is the tension between the problem-focused methodological orientation of environmental research and the practical orientation of some art-science research. This comes into play whenever the collaborative endeavour between artists and scientists is itself a key value (Barry 2008). The collaboration itself is not always in the focus of a work, sometimes it is a means to an end. See for example Arends and Thackara 2003, Scott 2006. It can be argued that the *agonistic antagonistic mode* may be a closer description for some art-science collaborations concerned with shifting knowledge practices at both epistemic and ontological levels.

Under what logics has art-science been undertaken?

Funding for, and participation in, art-science has been justified by three logical arguments. The *logic of accountability* points to the need for increased public understanding of science and socially robust science. The best examples of this would be the Wellcome Trust *Sci-art* program, now the Arts Awards. The *logic of innovation* points to the value of art in boosting creativity in science and technology. The *logic of ontology* argues that if artists and scientists collaborate, they will be able to create a new understanding of the nature of art and science. It is this logic that informs the Arts Catalyst in the UK. The Swiss 'Artists in Labs Program' employs all three logics in its objectives (http://artistsinlabs.ch/en/).

Aside from the Wellcome Trust, there has been and continues to be considerable interest, at least from the side of science, in engaging with artists under the logic of accountability. In their paper *Art-Science: from Public Understanding to Public Experiment* Born and Barry (2013) make the sometimes subtle, and sometimes not so subtle, distinction between a project that aims to improve public understanding of – or increase public engagement with – science and a project that is a public experiment. This, they argue, is the difference between the logics of accountability and innovation and the logic of ontology. Here they refer to Cassin's discussion of the contrasting Greek rhetorical forms of *apodeixis* and *epideixis*. While *apodeixis* means a faithful showing of the finished knowledge or truth, *epideixis* means to make a show, to speak *to* rather than *at* an audience – i.e. to engage the audience rhetorically in a knowing process that will, as such, lead to understanding: 'Where apodeixis follows the

object by confirming "what is or seems to be, epideixis *makes it be*". . .' (Born and Barry 2013, p. 265). In order to further differentiate between science communication and public experiment, Born and Barry use Cassin's distinction between 'the presentation of pre-existing proofs' and 'managing evidence by contriving new types of obviousness' (Cassin 2005, p. 864 in Born and Barry 2013, p. 265). Thus they argue that *apodeixis* equates to public understanding and *epideixis* equates to public experiment:

> As a form of epideixis, public experiments do not so much present existing scientific knowledge to the public, as forge relations between new knowledge, things, locations and persons that did not exist before (ibid).

This relates directly to my work as an artist attempting to create public experiments, and also as a science communicator implementing art under the logic of accountability in order to engage challenging publics (e.g. teenagers) with plant science. Practitioners of art-science who may then be concerned about being instrumentalised under the logic of accountability can take comfort in the words of these authors:

> if the logics of innovation and accountability appeared to play a prominent part in art-science. . . they should be counted as secondary to the ontological logic unleashed by the fertile genealogies of conceptual art and their heterogeneous issue. (Barry et al. 2008, p. 41).

To return to the conceptual theme of climate change research in the public view, it can be argued that an ontological logic is inherent in environmental and climate change research. Models of climate change are imbued with cultural values without even recognizing the fact. Uncertainties both in models and in the claims of scientific knowledge – including climate change research – are rarely acknowledged (Jasanoff and Wynne 1998). The logic of ontology also entails an awareness of the limitations of scientific expertise and the importance of lay and non-expert accounts; these should be recognized not just as perceptions but also as a kind of scientific citizenship (Barry et al. 2008, p. 37). The participation of non-experts in research may have critical implications for policy and practice; according to Barry, it cannot be dismissed either as a pre-determined policy or merely as a response to demands for accountability (Barry 2001). As Brian Wynne puts it:

> This alternative understanding of the basic forces and responsibilities underlying public responses recognizes that they have intellectual substance, which of course is always fallible and arguable, yet their intellectual substance does not correspond with institutional expert categories, since it goes much deeper than simply 'disagreeing with' or 'rejecting' expert views (Wynne 2001, p. 445).

This would appear to justify the kind of transdisciplinary, participatory art-science research with which this thesis engages.

The contemporary discourse of art-science runs tangentially to the discourse in the art world about *artistic research* and *artistic practice as research*. This must be briefly addressed at this juncture, in order to distinguish it from art-science research.

In a performance conversation between Alise Upitis, a curator at the MIT List Visual Arts Center, and Gina Badger, an alumna of the MIT program *Art, Culture and Technology*, Upitis opts for the term *artist's research* over *artistic research*, as it raises the question of agency over role or identity (Badger and Upitis 2012). Badger has trouble with the term *artist's research*, as it reduces a rich conception of process-based art practices and their ways of producing knowledge to a mode where artists are using models of data collection taken from other disciplines in order to conduct research. What she calls *artist's research* is where the processes, methodology, and form of the work emerge out of an investigation into a particular subject – for example, that of MIT ACT affiliate Jae Rhim Lee in her work *The Infinity Burial Project* (2008 – present), which involves the development of an urban eco-burial system. Here the artist collaborates with mycologists, researches social issues, and uses documentary film. Badger argues that this work is research-based, as it relies on research from other disciplines for its development, and the working process itself becomes a vehicle for the creation of new knowledge. Yet unlike science (i.e. the scientific production of knowledge), it follows no rigid methodology (Badger and Upitis 2012, p. 264). In fact, it is characterised by flexible methodologies, which cannot be attributed to other disciplines. It is *extra-disciplinary*, challenging its own conditions and those of other disciplines, and in this manner distinguishes itself from other less confrontational forms of practice (ibid p. 265). For Badger, artistic research produces *extra-logical* forms of knowledge, albeit in relation to history and field of expertise. It seems to me that she is referring here to logics outside of science; but art, music, literature, etc have their own logics: that of the immediate experience of the *medium-as-world* and of the *world-as-medium*. There is an inherent logic in that process, too; but it is a different logic from that of science. It could equally be argued that all expressions of knowledge are *logical* – they just involve different logics.

I would argue that the kind of research Badger and Upitis are discussing, whether *artist's* research or *artistic* research, is not transdisciplinary art-science research but rather the processes and practices of creating an artwork, which obviously involves researching the background and information required. This is achieved by collaborating with other disciplines in a subordinate service mode, in the service of art. Over and above this, an artwork in whatever medium seeks at some level to explore its world; and an act of exploration is per se an act of research, albeit not necessarily of *scientific* research – but that is the issue here. This

raises the question of the modes of collaboration and research that informed the case studies, and whether understanding these modes would bring us any closer to describing the knowledge produced by that collaboration?

The purpose of this introductory chapter was to preface the conceptual context for the case studies and the research questions I have chosen to address. Out of this conceptual context the following research questions emerged.

0.8 Research questions

1. How does the application of this transdisciplinary framework enable the discussion of the knowledge produced by art-science?
2. In what ways do the modes and logics of collaboration impact the research practice?
3. How and in what ways can art-science collaborations engage with lay knowledge on climate change?
4. How can creative participatory methods facilitate social learning and or participant data gathering?

The following chapters will examine these questions in the light of the case studies undertaken for the thesis project. The first section of the next chapter will examine participatory art, including the genealogy of the *social turn* in contemporary art and the logics of engaging in participatory art. The second section will review several collaborative art projects that engage with climate change or are embedded in a development context.

Chapter 1: Participatory and collaborative art

1.0 Introduction to chapter

The projects described in this thesis, *Climate Hope Garden* and *Sauti ya Wakulima* are positioned in the emerging field of art-science, as outlined in the Introduction. This situates them in conceptual proximity to transdisciplinary research. However, they are also related closely to other areas of collaborative and participatory art that are more central to contemporary critical discourse. *Sauti ya Wakulima*, for example, is not only located in the global south, giving rise to the postcolonial discourse of Chapter 2, but to increase the complexity still further, involves the participation of farmers, thus instigating a need to discuss the question of participation.

These discourses are broad and extremely well documented, and in relation to the context of my case studies I briefly define collaborative art and examine some modes of collaboration and participation and some of the social and political logics for engaging in these practices. In pursuit of these aims I will in this chapter address the question of the kind(s) of knowledge produced by collaborative art, and then review three collaborative art projects conducted in a development context. The first is *Supergas*: bio-gas as art in Tanzania. The second is *Farmers Become Filmmakers*, a participatory video project in Malawi. The third is a participatory theatre project about AIDS prevention, with the Bagamoyo School of the Arts, also in Tanzania.

1.1 How does collaborative and participatory art relate to the case studies in this thesis?

Since the early 1990s several discourses have emerged around collaborative, participatory and socially engaged art. From the many terms and definitions in the field I will focus on two: *new genre public art* and *relational aesthetics*. The increasing interest in contemporary collaborative art, described respectively as the 'collaborative turn' (Lind 2007), 'social turn' (Bishop 2012), or 'ethical turn' (Dews 2002 in Bishop 2012), can been seen as a rejection of modernist tendencies of objectivity and individualism, and an attempt to create new categories of knowledge and social relations, particularly in transdisciplinary research for development, that will parallel participation in strict disciplinary scientific research.

The curator Okwui Enwezor argues that the role of the artist is frequently called into question at times of political and social crisis. He maintains that, during such times, the position of the artist in relation to economic, social, and cultural institutions is re-evaluated (Enwezor 2007). While in this perspective our current social, religious and political upheavals might inspire new contemporary art practices concerned with activism and civic engagement, art historian Grant Kester sees this phenomenon as part of a cyclical paradigm shift within the field of art, manifesting itself in the displacement of traditional boundaries with other fields such as urbanism, environmental activism and social work (Kester 2011). According to Kester, two shifts are actually occurring. Firstly, the growing interest in collaborative approaches in art, and secondly, a movement towards participatory process-based experience and away from a 'textual' mode of production, where the artist presents an object (or 'text' in the generic sense of the word) to the viewer. In *The One and the Many: Contemporary Collaborative Art in a Global Context*, Kester (2011) claims that collaborative practices do not supersede the textual approach: they simply articulate it differently, while still exploiting the capacity of modern art to open space for forms of knowledge that challenge cognitive, social or political conventions (Kester 2011, p. 11).

Returning to terminology for a moment, the terms collaboration and participation are sometimes used interchangeably. I see collaboration as the broader term, which encompasses participatory art. An artist can collaborate with one or more actors who have various degrees of power within the processes of production, and some of these actors may be participants in the product. Participation entails a context that someone else has created but allows participants a greater or lesser impact on that context (Lind 2007).

At its most basic, collaboration means working together to achieve a common goal. As few human endeavours are carried out entirely alone, art too has always to some extent been a collaborative exercise; the artist even in the studio is not alone (Holmes 2004). According to Angelika Nollert, the first known group of artists to work together were the Nazarenes, a German Romantic group active in Rome from 1810-1830 (Nollert 2005). The question of authorship has always been of particular importance to modernism in art. Although modernism is defined by the notion of the Kantian individual artistic genius, there have long being artistic tendencies that have questioned and challenged notions of authorship. Indeed the basic premise of participatory art is not new: the theoretical background comes from Roland Barthes and Umberto Eco with their concept of the death of the author (Barthes 1977, Eco 1962). Eco described 'new communicative situations. . . a new relationship between the contemplation and the utilization of a work of art' (Eco 1962, in Bishop 2010, p. 262). If collaboration gave other actors a role in art production, then the notion of participation arose to give the audience a voice, to elevate them from the role of spectator to that of co-creator or

participant. In this perspective, the artwork fully exists only in the act of its reception: Dieter Wellershoff remarked, for instance, in 1968 that, "Reading is a creative process. The poem comes into being in my act of reading" (Afterword to the *Collected Works of Gottfried Benn* Wellershoff 1968, Vol. 2, p. 556). The increase in the importance of participation in art has interesting parallels with the perceived value of participation in development projects. Participation in development began in the late 1980s (Chambers 2008); in art it can be traced to the early 1970s (Lacy 1995), or according to Bishop the 1990s (Bishop 2012).

The participatory art field known as 'new genre public art' (NGPA), has been described in the discourse-defining book by Suzanne Lacy, *Mapping the Terrain: New Genre Public Art* (Lacy 1995). But what are the defining features of NGPA? There are several types of NGPA, but they all have in common a critique of the socially exclusive character of art as an institution. NGPA calls for an integrative critical language through which values, ethics and social responsibility can be discussed in terms of art; it is based on relations between people and social creativity rather than self-expression (Gablik 1995 p. 43). NGPA can have a pastoral aim, that is a mixture of care and education, but it can also be playful, didactic, pastoral, and/or sociological. Yet in order to connect social groups, these groups must first be separated into artists and 'other real people' (Gablik 1995). The 'others' are often not only poor and disadvantaged; they also represent what is 'genuine' and 'real', so they are at once needy and a source of inspiration.

In 1998 Christian Kravagna wrote an essay entitled *Arbeit an der Gemeinschaft: Modelle partizipatorischer Praxis*, a theme which was taken up by several authors including Grant Kester in his 2004 book *Conversation Pieces: Community and Communication in Modern Art*. Kravagna posits that in new genre public art ,'everything but the status of the artist is called into question.' He questions to what extent is 'social action' political and to what extent does a social intent take the place of a political one (Kravagna [1998] 2010, p. 240)? He (like Kester 2011) states that participatory art is a popular approach because 'it allows for the incorporation of "the social" into small bites that are aesthetically easily digestible, but do not require any further reflection' (Kravagna 2010, p. 241). So while new genre public art is critical of institutionalized art, which is described as aloof, bourgeois and decadent, nevertheless it is still a reservoir of creativity that enriches the lives of 'others' (Kravagna 2010, p 245 - 254).

While the term 'new genre public art' was used by Lacy to describe an emerging genre of art, Nicolas Bourriaud (*Relational Aesthetics* 2002) used the term 'relational aesthetics' to describe a particular group of artists[6]. However, the term has since been more widely applied.

[6] For example Rirkrit Tiravanija, Liam Gillick, Dominique Gonzalez-Foerster and Jeremy Deller.

Bourriaud's heterogeneous group of artists proposed social methods of exchange as an alternative to the ideology of mass communication, and as a way of bringing groups and individuals together. These artists do not seek to reproduce the world as we know it, but to create new situations, 'micro utopias', using human relations as their raw material (Bourriaud 2002). Much of Bourriaud's critique concerns the quality of the interactions such artwork creates, and according to what criteria (positive interactions? level of participation?) a 'good' collaboration should be judged (Lind 2007).

Art historian Stephen Wright, on the other hand, dismisses relational aesthetics as 'capricious and exploitative', as it involves people in 'frivolous interactions' for which they are not paid, reproducing class-based power relations (Wright 2004). Art critic and academic Claire Bishop critiques relational aesthetics on more formal grounds, claiming that by creating a false conviviality artists gloss over the tensions and conflicts that inevitably exist between people (Bishop 2004). Lind observes that Bishop's position is an inverted version of Wright's critique: while Wright finds relational aesthetics artworks exploitative, Bishop claims that there is too little tension in them (Lind 2007, p. 22). Both objections would seem to address the framework within which NGPA and relational art are promoted rather than the ideas inspiring the movement itself.

1.1.1 Logics of engagement: political and/or social goals

In *Artificial Hells: Participatory Art and the Politics of Spectatorship*, Claire Bishop (2012) stresses that she discusses artists who are less interested in Bourriaud's relational aesthetics than in the creative rewards of participation as a political working process. She says that this shift to what she refers to as a *social turn* may be more powerful as an idea than as reality, but still artists aim to question the conventional modes of artistic production and consumption under capitalism. Framing her writing in a tradition of Marxist and post-Marxist thinking on art as a de-alienating endeavour, she dates the current 'social turn' in art from the 1990s, in the social upheaval caused by the fall of communism in 1989. The precedents to this movement were the avant-garde in 1917 and the neo avant-garde of 1968.

It is the social function of art that Bishop calls into question. She is particularly critical of the art policy of the New Labour government (1997 to 2010), which funded art projects that were socially inclusive, not in order to encourage research and experimentation, but to ameliorate social ills and develop 'community networks'. New Labour's neoliberal idea of community, however, was a self-sufficient society that did not rely on the welfare state. In this application,

art was not about raising consciousness of structural problems, but was instrumentalised to help people accept the conditions of austerity and privatisation in which they lived.

Yet not all commentators are so critical of socially oriented art. In an example which predates the 1990s, Kravagna sees the work of Stephen Willats as a model participatory project whose social purpose was not an immediate improvement of social situations but a framework of action that enabled change. Willats' *Vertical Living* (1978) was a project in a council housing tower block in West London. Willats engaged residents in a series of meetings that resulted in the creation of posters focusing on residents' problems. These posters were placed on every floor of the building. There was a facility for feedback and further discussion, which proved so useful that the residents continued to develop their own similar structures after the end of the project (Kravagna 1998 p. 253). The social relevance of this practice is clear and is positively evidenced by the residents' continuation of the project. However, Kravagna does not describe the aesthetic decisions (if any) made by the artist or his participants. Nor does he question whether enabling a framework of action can and would enable structural change beyond individual empowerment – a theme to which I shall return in the context of development projects.

The artistic, rather than social or ethical, value of projects is of central concern to Bishop, who describes what Peter Dews calls the 'ethical turn', in which an 'ethics of interpersonal interaction comes to prevail over politics or social justice'. The difficulty of describing the artistic value of work created in this context is resolved by resorting to ethical criteria (Bishop 2012, p. 25). If these collaborative art projects cannot be judged by conventional critical parameters, then there is a tendency to appeal to ethics, postulating a binary good/bad model of collaboration according to whether it does, or does not, properly represent the project participants. In order to subscribe to what Bishop describes as an outdated humanism,

> artistic strategies of disruption are dismissed as unethical because all forms of authorship are equated with authority and indicted as totalising. This thinking results in a stalemate of simplistic oppositions: active versus passive viewer, egotistical versus collaborative artist, privileged versus needy community (Bishop 2012, p. 25).

Bishop's analysis of socially motivated art is interesting, too, when she observes that the urgency of the social tasks at hand has created a situation where 'socially collaborative practices are all perceived to be equally important *artistic* gestures of resistance' (Bishop 2012, p. 13). Especially regarding the case study *Sauti ya Wakulima*, this raises the question to what extent humanist discourse pervades the natural sciences, especially research for development. And does humanist thinking dominate the collaboration or is there still space for disruptive strategies?

Bishop claims that it is crucial to evaluate these works as art, as this is the field in which they are endorsed and disseminated. This question is raised in transdisciplinary theory, whether a transdisciplinary project has to be successful in more than one discipline – or indeed in any discipline, if it has a positive social function. Yet how this social function is evaluated is a central question for socially oriented art-funded projects. Bishop relates how she was at a conference with social workers who, when presented with social art projects were extremely critical of the framing and modes of engagement evidenced. Bishop criticises the perceived social achievements of participatory art projects, which she says are never compared to projects in the social domain, but their point of reference 'always returns to contemporary art, despite the fact that they're perceived to be worthwhile precisely because they are non-artistic' (Bishop 2012, p. 19).

1.1.2 Modes of participation

In the Introduction I looked at some modes and logics of collaboration between artists and scientists. But it is also necessary to examine the relations, particularly power relations with other participants, as the collaborative approach to production should not be confused with the idea of collaboration between artist and audience, or between artist and participants. In participatory art, and relational aesthetics in particular, the relations between the artwork in context, between teams of artists in production, between artwork and audience, or between audience members must all be questioned (Graham 2010, p. 300).

Bishop focuses on two modes of participation, 'delegated performance', where non-artistic people are hired to perform on behalf of the artist, and 'pedagogic projects', which come under the umbrella of education. The limitation of my research in applying Bishop's writings on participatory art is that she is not dealing with transdisciplinary or research-based art collaborations. In order to examine the level of participative intent, several authors cite Sherry Arnstein's ladder of participation (Graham 2010, Kester 2011). Arnstein used examples from city planning to describe eight rungs on 'the ladder of citizen participation' ranging from manipulation and therapy, informing, placation (tokenistic consultation), partnership, delegated power and citizen control (Arnstein 1969). Graham recognizes that in participative art projects, therapy or tokenism are more often achieved than the higher rungs of the ladder.

It has been suggested that each category of interaction, participation and collaboration can be measured against this ladder, which might lead to a more accurate description of the participative intent of the work, and what it realistically achieves. A critique of the level of participation is undoubtedly relevant when examining works that claim to be participatory,

for example *Sauti ya Wakulima*. Another more contemporary method for examining levels of participation comes from new media art and systems metaphors.

1.2 New media and systems metaphors for participation

> The architecture of the system facilitates certain types of conversations (Sack 2005, in Graham 2010).

If collaboration is disputed ground for art in general, the discussion becomes even more poignant in new media art using web-based, personal computing and social media. In this section I will first look at issues of collaboration in terms of information technologies and social media and then with regard to new media art. Both of these fields have vast bodies of literature associated with them and it is beyond the scope of this thesis to do more than select the texts of most relevance to the case studies.

In web-based collaborations the terms sharing, openness, user-generated content and participation have been conflated and confused. In user-generated content and social-media, sharing of content alone does not directly lead to collaboration (Hyde et al. 2012). In the examples of blogging, micro-blogging, video and photo sharing, identity and content are often coupled to an author (user) who posts material, saying, "This is me, this is what I did". The content becomes a social object, but it is still attributable to an individual author. The work stands alone, and even if it has a free culture licence it is not collaborative (ibid).

Social media such as Twitter can, on the other hand, be collaborative if there is a coordinated effort such as an instruction to use a certain hashtag. This new social object creates two layers of content, as each shared individual unit is included in a cluster of shared units. So a shared bookmark or video or a single blog post are part of a cluster of similar content. Although these actions might seem similar to a Wikipedia article edit or an open-source code *commit* (a code edit), they are not the same, because these latter actions lose their integrity outside the collaborative context and are indeed 'only created to function as part of the larger collaborative social object'. Wikipedia for example, has extensive technical and social mechanisms for coordinating itself as a social object (Hyde et al. 2012, p. 54).

It is interesting to ask whether a cluster or aggregation of posts constitutes collaboration. Hyde et al. consider intention crucial to considerations of collaboration, in order to distinguish it from cooperation, interdependence or co-production. This is particularly important in the longstanding discussions about free web labour (O'Reilly 2005, Jenkins 2012), as there is a fine line between 'working with', 'working together' and 'being put to work by'. In order to structure thinking about strong and weak definitions of collaboration,

Hyde et al. (2012, p. 60-62) propose criteria for assessing the strength of a collaboration; these can then be used on continuum scale. The criteria involve questions of *intention*, such as, must the participant actively intend to contribute? Is willed agency needed to contribute? Are there shared *goals, identity* and/or *property* –which I take to mean not just intellectual property but any material benefits from the outputs. Does the collaboration result in *knowledge transfer* between the participants? To this I would add the question: Does knowledge transfer occur with other parties? Then there are questions of *(self) governance*, such as: Are the structures and rules of engagement accessible and can they be contested and renegotiated? Are the participants interested in having control of the mechanism? Who *coordinates* the mechanism? Is it automatic or is human intervention required? Questions of *accessibility* and *equality*: can anyone contribute? Who contributes most? What gender or time issues constrain or enable participation? What is the *network topology* – i.e. how are individuals connected to each other? What *questions of scale* can impact group management and collaboration? Questions of scale can refer to *size* of the group, *duration* – what is the time frame of the collaboration? *Speed* – how time-consuming is each contribution? *Space* – what is the geographical scale? *Scope* – how extensive is the shared goal?

These criteria can be used to assess the cooperative relationship of participants, placing the collaboration on a continuum graded from strong to weak. They should prove useful, for instance, in evaluating the collaboration with farmers in *Sauti ya Wakulima*, which uses social media technology and is situated between information and communication technologies (ICTs) for development, transdisciplinary research and participatory new media art.

As previously mentioned, issues of participation are also of concern in new media art. In her essay *What kind of participative system? Critical vocabularies from new media art* (2010), art critic Beryl Graham asks about levels of participation in new media art, and what kind of system it can offer as a platform for conversation and/or as a facilitating host. While media art can create community or form an easier link for people who would anyway like to be connected, deep or 'real' participation is hard to achieve.

Graham gives the example of a frequently used participatory device in new media projects, that of the keyword cloud. Participants, by frequent use of keywords, create a 'folksonomy', where participants can collaborate in curatorial, but not artistic production. However, if an audience participates in a system designed by others, it can offer them 'something closer to the user being able to change the system in subtle ways' (Graham 2010, p. 296).

Yet this is not open-source, as they cannot change the parameters. A folksonomy can help to change the way data is navigated but this is only a partial change in the system. It is only open-source where source code can be modified and knowledge made available to the

collaborators (Graham 2010, p. 297). A *folksonomy* is a 'folk taxonomy' – a taxonomy whose categories are set not by experts but by a user group who may or may not be experts but who define the categories as their interactions proceed.

Graham applies the vocabulary of new media interaction, participation and collaboration, in order to describe the different behaviours afforded by the media and the levels of control possessed by the audience or participants.

One could also use a computer systems model and talk about a participatory artwork in network terms of centralized, decentralized, distributed or rhizomic characteristics, which work in very different ways in terms of power relations. In participatory art, new media and politics, whether or not the system itself can be changed is an important question. To take the network metaphor further, if participants are considered as nodes, then their participation can be mapped according to the level of control they possess. The hierarchy will then be: Level I – user-generated content; Level II – power to change the way data is displayed (for example a folksonomy); and Level III – power to change the system, a level which demands more access and skills.

Graham uses the vocabulary of conversation to describe the relations between artist, artwork and audience participants. Terms such as call and response, therapeutic monologue, reciprocity, mutual interruptability, graceful degradation and limited look-ahead. This analogy suggests the question: What kind of conversation does the system host? In the conclusion I will use these categories to reflect on the participation levels and power relations of the farmers in *Sauti ya Wakulima*.

1.3 What kind of knowledge is produced by collaborative art research?

In this section I will attempt to summarise some thinking on artistic knowledge as it applies to my case studies.

In *Epistemologies of Aesthetics* (2015) German philosopher Dieter Mersch discusses the relationship between art and knowledge in the context of artistic research. Mersch reminds us that knowledge is based on thought, and poses the essential questions: 'whether art creates (*poiein*) knowledge at all, and if so, how art and *epistēmē* go together, and …how *aisthēsis* and truth interact or conflict with one another' (Mersch 2015, p. 44). Several concepts in Mersch's writing stand out as pertinent to this study: *aisthēsis* (sense perception), 'reflexivity', 'showing', and knowledge from practice (aesthetics of production).

Aisthēsis correlates with knowledge that can be perceived or comprehended by the senses before it is expressed in an argument or changed by writing (Derrida in Fliescher 2015). Thus 'art aims to reflect the perceivable through perception and the experiential through experience' (Mersch 2015, p. 46). Traditional philosophy rejected *aisthēsis* as incapable of truth, separating thought and aesthetics, but Lyotard has argued that the power of art stems from 'a sudden heuristics' or an unexpected approach to problem-solving which makes use of inconsistencies within *aisthēsis*, creating its own evidence (Lyotard 1993). It could be argued that in this way we are dealing with something closer to philosophy, another way of thinking, or something other than thought. This concept is relevant to the audience's creation of meaning in the *Climate Hope Garden*, which, as will be described in Chapter 5, is a work that seeks to offer the audience a way to develop an understanding of climate scenarios through physical perception.

The concept of reflexivity is discussed in transdisciplinary theory, and is also linked by Mersch to artistic practice. My understanding of what he is saying is that it is through practice that art differentiates itself from philosophy and science. Knowledge (*epistēmē*) is thus generated through reflexive aesthetic practice (Mersch 2015, p. 51). Thus the reflexive knowledge of art can be described as that which 'shows', and, 'showing has no true or false dichotomies'. It has rather 'a conjunctionality: a sum of 'this' and 'this' and 'this'…. It does not compete with, surpass or supplant other works in the way natural science theories are displaced by those that later prove or demonstrate their own superiority.' (Mersch 2015, p. 46). This relates to the knowledge produced by the farmers in *Sauti ya Wakulima*, who are 'showing', and thereby creating, a body of knowledge, an archive of first-person accounts that is embedded in individual instances of experience – 'this' and 'this' and 'this'... .

This brings us to the conventional dichotomy of idiographic versus normative knowledge production. This was a tension present in modernist art, inasmuch as modernist aesthetics was coupled to the 'objectifying consciousness' of science (Kester 2011, Gablik 1995). Both artists and scientists were taught not to be concerned with the applications or moral implications of their work. Yet just as the limitations of 'objective' science are now recognised, and there are many calls for 'socially robust science' there is a wide artistic movement outside the gallery system and conventional art criticism that rejects 'the reductive and neutralising aspects of aesthetics and art-for-art's-sake' (Gablik 1995). Among others, this paradigm shift has been called for by David Levin, who maintains that just as transdisciplinary theory calls for integrative modes of thinking which focus on the relational nature of reality rather than on discrete objectified truths or realities, so art is moving away from a spectatorial epistemology 'from seeing to listening', which generates a very different *epistēmē* and ontology (Levin 1993).

From the literature reviewed in the previous sections, we can see that participatory art projects, besides raising the ontological question of what art is today, also raise epistemological issues similar to those of transdisciplinary research. For example, what forms of knowledge are generated and how are they best described? According to the curator and critic Hans Ullrich Obrist, much critical discourse is concerned with judging the epistemic power of art by the standards of science instead of defining separate standards for art (Obrist 2001). By converging on a description of artistic knowledge and giving it equal value to scientific knowledge, and by judging it by its own standards, we can perhaps come closer to an understanding of the kind of knowledge that might be produced by transdisciplinary art-science research.

1.4 Collaborative art in a development context

The *social turn* in art has extended to the development context in various modes, ranging from art-funded social or technical installations (Superflex's *Supergas*) to media interventions such as participatory video (*Farmers are filmmakers for a day*[7]) funded by development NGOs, or a participatory theatre for development sponsored by UNICEF. After briefly outlining some of these projects, I will go on to review more extensively the three projects just mentioned, which form part of the context of the *Sauti ya Wakulima* case study presented in this thesis.

Participatory video and games are, in fact, becoming popular in climate change adaptation projects in Africa, but as yet there are few references to rich pictures. An exception was IEMA Conference 2010 Workshop: Climate Change and Organisations: Soft Systems Thinking and the Rich Picture Toolkit.[8]

Oxfam America, IRI and partners have been supporting a project called HARITA, which uses game-based tools to elicit cost preferences and to facilitate product design with Ethiopian farmers. The IFAD-WFP Weather Risk Management Facility supported the design of a game involving index-based micro-insurance bundled with credit for agricultural inputs. Ethiopian and Malawian farmers (many illiterate and even innumerate) played using coupons, a dice and real money – allowing participants to gain first-hand experience of the consequences of a range of plausible decisions. The survey analysis indicates that the game was at least as good

[7] When I first researched this project in 2011 it was documented as *Farmers are filmmakers for a day* and at some point the name changed to *Farmers become Filmmakers*.

[8] http://www.britegreen.co.uk/20101014%20IEMA%20Conference%20Presentation_Final.pdf

as a conventional lecture approach in conveying key insurance concepts – and better in one key dimension, that of trust (Patt et al. 2009).

Early Warning, Early Action – a card game – was designed to facilitate dialogue between forecasters, Red Cross personnel and vulnerable communities.

The game *Weather or Not*, playable in an auditorium setting, confronts teams (i.e. rows) of participants with probabilistic forecasts: they must decide whether to reduce risk ahead of the event or wait and see – and all participants can see how different teams perform.

On the Swiss scene, the project *Participatory integrated assessment of adaptation to climate change in Alpine tourism and mountain agriculture*, by Jeannette Behringer, Rolf Buerki and Jürg Fuhrer of the Swiss Federal Institute of Environmental Science and Technology (EAWAG), and *Farmer to Farmer* are projects which use video to help farmers learn climate adaptation techniques.

1.4.1 Supergas by Superflex: Biogas as art "tool" in Tanzania

In 1996, the Danish art group Superflex collaborated with an engineer to build a bio-gas reactor which would then be sold to rural smallholders in Africa so that they could make gas out of animal waste and use it for cooking and lamps. They referred to their work as 'socio-economic integration' and aimed to have a clear social relevance for their customers. This they did under the auspices of art, as it gave them room to experiment free from conventions (interview with Asa Nacking 1998). When asked by Nacking why they sought an art context, they replied, "We can use the presentation to create a debate on our attitude towards Africa and the Third World." They partnered with a Tanzanian agricultural organization SURUDE (Foundation for Sustainable Rural Development) and in 1997 set up a test installation in a farm in Tanzania. The following year, there was an exhibition of the project at the Lousiana Museum of Modern Art in Denmark, which had been a major sponsor of the project.

On the project blog, the last post about the project is from 2013, when the next generation reactor was being built and tested in Mexico. It is not clear what the status of the Tanzanian reactor is, but the fact that the project is still generating new iterations shows remarkable longevity. On the blog there are many photographs documenting the reactors and some illustrations by a local artist, as well as a cartoon in which a man is telling his friend how he makes gas from waste using technology he bought from the "Wazungu" (white men).

Apart from a very detailed DIY manual, I found little text by Superflex themselves, but they have several articles by critics and journalists on their website. In *SUPERFLEX: Art and*

Biogas (Larsen 1997), an article for *Siksi The Nordic Art Review*, Lars Bang Larsen calls the project a combination of art activism and 'ethical capitalism' which avoids involvement in 'existing power structures of Danish government controlled development aid' by having financial investors in the project, as with any ordinary company set-up. The goal was to sell biogas technology to Tanzanian farmers rather than donating it, thus inspiring an entrepreneurial spirit. In the aforementioned cartoon the man proudly tells his friend that it was not given, but they (North and South) are helping each other because he bought the technology for 120,000 TZS, which is about 60 Euros, and a mere fraction of the actual costs, which were subsidised by the Museum of Modern Art.

On this score I think token co-funding can be valid, but it should not be passed off as market value. Superflex are not even doing what Kester criticizes them for, which is 'embracing ethical capitalism, and exposing Tanzanians to market forces', thereby treating the farmers 'to the redemptive pedagogy of the marketplace' (Kester 2011, p. 132). In fact the *Supergas* project endorses the structural adjustment policy determining that aid recipients must be reformed because their poverty is clearly a result of a lack of entrepreneurial spirit. Superflex sees commodity exchange as on the one hand equalising social relations, yet on the other as educating and informing its participants. Kester says it is on this level that the project reiterates rather than challenges the discourse of neoliberalism (Kester 2011, p. 132).

Figure 1 Installing the Supergas bio-reactor in Tanzania 1997 (all Photos Superflex)

On the theme of Africa's colonial past, Larsen makes the inexplicable comment, "By virtue of a visual, performance-like touch, SUPERFLEX meets the guilt of European colonialism over the brutalized continent, thus indicating the problematic potential conditions for the biogas project" (Larsen 1997). It is difficult to see how the performative aspects of the khaki uniforms of the artists (pseudo great white hunters, or as Cameron suggests 'genteel adventurers on an eco-holiday'), or the Superflex signature orange and 'S' logo, address postcolonial guilt. Larsen goes on to say that the art is redundant as far as the social project is concerned, and conversely if the 'social service' part ceased then it would still function as a work of art. This is the opposite of Cameron's suggestion that by engaging in a social project Superflex are placing their careers second to the social urgency at hand.

In an article entitled *Into Africa*, Dan Cameron (1999), compares Superflex's integration of high art and social ideals to the ecological art of Alan Sonfist, Helen and Newton Meyer Harrison and the precedent site works of Robert Smithson, but with a social dimension he claims was lacking, particularly in the earthworks of Smithson. By participating in the 'social turn' Superflex resist 'placing the mechanism of representation at the foreground of their work' (Cameron 1999, p. 64). While this might indicate that they are critical of the West's cultural narcissism, Cameron questions whether challenging collective awareness is in itself sufficient to address the widespread conditions of poverty in the world. It appears that this project does not score highly as a socially inclusive participatory art project, as it too closely resembles the aid projects Superflex were trying to distance themselves from and, as Kester suggested, reiterates the discourse of neoliberalism. Nor is there any evidence to indicate that this project would hold up particularly well in an art context (Kester 2011, Cameron 1999). Bishop, I believe, would critique the glossing over of social tensions. However, it is easy to fall into the same trap as Bishop and other critics, namely – according to Lind – that of opining on works that one has only experienced through documentation.

1.4.2 Participatory Video (PV)

> Increasingly affordable communication technologies can help to capture, process, store and disseminate relevant information, thus extending the benefits of knowledge to those who most need it (Suarez et al. 2013).

Participatory video is a set of methods for enabling communities to create their own videos about issues that concern them. The idea is that video is easily accessible and fun, and is a way to bring people together to tell stories and voice concerns. According to Nick and Chris Lunch (2006), "This process can be very empowering, enabling a group to take action to solve their own problems or communicate their needs to decision makers and/or other groups

and communities" (Lunch and Lunch 2006, p. 10). They consider PV a highly effective tool to engage and mobilize marginalized people and help them implement sustainable development based on local needs.

The *World Resources Report, Putting Vulnerable People at the Center of Communication for Adaptation: Knowledge Sharing through Participatory Games and Video Tools* (Suarez et al. 2013) states that researchers in disaster risk reduction recognize the need for end-users of knowledge to also be co-producers of that knowledge. PV enables this, encouraging active engagement and student-centred learning. The process of making, reviewing and disseminating the videos becomes an iterative process 'following the key steps of the reflective cycle that have been successfully applied to many disciplines and demonstrated to improve professional practice and the learning process' (Suarez et al. 2013).

Participatory Video differs from documentary filmmaking in that the community is given authorship and has control over how it is represented. In addition, PV does not have the aesthetic concerns that a documentary filmmaker might have.

The origins of participatory video (PV) as a tool for community development can be traced to the work of Don Snowdon on Fogo Island (Newfoundland, Canada) in the late 1960s. Videos he made with one fishing community were shown to others, and a recognition of common issues came about. The video was also shown to policy makers too remote to visit the island. According to Nick and Chris Lunch (2006), 'policies and actions were changed' as a result of the dialogue created by the film (Lunch and Lunch 2006, p. 11). They do not, however, specify what policies were changed.

Farmers Become Filmmakers

In the context of PV I will now examine the project *Participatory Video for Monitoring and Evaluation of Community Based Adaptation to Climate Change: Farmers Become Filmmakers* (http://tinyurl.com/Mphunga-video2).

Project aims

The project took place in Malawi in 2008 and involved a series of workshops on climate change by the Red Cross, including a PV workshop. The rationale for the video was that a film produced by villagers with a local perspective, language, and approach could be an effective way of disseminating community-based adaptation to climate change.

In order to train the villagers in the use of the camera, a short video was made with several direct-to-camera monologues explaining the problems of flooding: mud washing in with the flood water and the lack of a bridge over the crocodile-populated local river. Two of the

contributions included an appeal for help from outsiders to build a bridge or to provide quick-growing tree seedlings. See https://www.youtube.com/watch?v=FSquE0WKHuM.

After a workshop on how to write a storyboard, the video group wrote a script and produced a seven-minute video in six parts showing possible adaptations to climate change. The themes were:

- crop diversification by e.g. replacing maize with rice as a staple crop
- planting elephant grass and digging storm drains against flooding
- keeping ducks instead of chickens, which cannot float in the floods
- storing crops in bags that can be moved to higher ground
- irrigation farming; increasing yields by using a treadle pump to get water from the river
- implementing a flood warning system of whistles so that everyone can shelter at the Catholic church, which is conveniently built on the highest spot in the village.

The video was then shown on a laptop to groups of farmers in four surrounding villages. These farmers answered a pre and post-screening questionnaire about their willingness to use adaptation methods in order to evaluate the video's effectiveness in transferring information about climate change. The questionnaire showed that 55% of the respondents showed willingness to change their behaviour after seeing the film. In addition, 88% of the filmmakers reported they had enjoyed the filmmaking process, as they felt empowered, enjoyed providing information for other villagers, and regarded it as good for their community feeling.

Figure 2 Video stills and production documentation from Farmers Become Filmmakers Photo F. Baumhardt, 2008

Critique of project: The project report noted that, in future, capacity building would be necessary to ease the coordination burden on the Red Cross. It was also perceived that the project could have been more participatory, with filmmakers being involved in the film-showings in other villages. Additionally, the organisers did not have a video projector to show the films (or there was no electricity for it), only a laptop with internal speakers, making viewing for twenty people rather difficult.

As a pilot exercise, *Farmers become Filmmakers* demonstrated conceptual feasibility, but open questions remain about long-term benefits and dependency on outside equipment and technical support. There are suggestions for how to repeat the process in other countries to enable 'horizontal knowledge transfer' (Baumhardt *et al*. 2009), but no model was suggested that might enable farmers to produce and disseminate videos themselves.

Long-term learning was evidenced by a quote from a farmer six months post-film-screening in his village:

> I have started keeping my maize in bags. In January 2009 our village was affected by flood. I was able to carry the bags to the temporary shelter without difficulties. I did not lose my food; however, those who keep their maize in granary lost the food. (Baumhardt et al. 2009)

While farmers can obviously learn from a tip or idea, in my estimation the video made by the farmers was too short to provide real or lasting learning on the part of the viewers. Each segment was only a minute long without enough pauses, filler-shots or repetition for learning to take place. The film length is suitable for showing to funders, or for posting on YouTube, but if farmers in a Malawi village are going to gather specially to watch a film, then they can be expected to have a longer attention span than seven minutes. For an improved learning effect, the film viewing would need to be embedded in a series of discussions, with a reflective process taking place in the viewing villages, possibly also with the participation of the filmmakers. For the film producers, the learning effect would clearly have been greater, as it would have been an engaging, iterative process. From their own feedback, the aspect they enjoyed most was deciding which topics to present to other villages.

1.4.3 Art for Development – Participatory action research on HIV/AIDS through a popular theatre approach in Tanzania

The project *Participatory action research on HIV/AIDS through a popular theatre approach in Tanzania* (Bagamoyo College of Arts et al 2002), has been proposed by Pohl and Hadorn (2007) as a good example of transdisciplinary research involving the arts in a development

context. It was a joint project of the Bagamoyo College of Arts, the Tanzania Theatre Centre and UNICEF Tanzania: a participatory theatre approach that aimed to engage communities in open discussions about the causes of HIV/AIDS transmission and then to change behaviour on the basis of their new understanding.

Tanzania had, as of 2002, a severe AIDS epidemic, with many children infected and most new infections occurring in the 16-24 age group.[9] A particularly high-risk group was young people who were not in school. While this group was the key to slowing the spread of the epidemic, they were also difficult to reach, and inadequate resources had been targeted to reaching them. Despite the great burden of the disease, people were still reluctant to talk about HIV and the cultural practices and other factors that contributed to the spread of the disease. Thus, traditional research methodologies only tended to scratch the surface of people's real feelings and behaviour (Mabala and Allen 2002, p. 333).

The premise of art for development, or popular theatre, is that theatre, whether dance, song, drama, storytelling or poetic drama, has the power to sensitise and 'animate' people to recognise their problems, analyse them, seek solutions and change their behaviour. Popular theatre also enables people to discuss and evaluate their own efforts to educate themselves, and to make behavioural changes (Mabala and Allen 2002, p. 333).

The procedure for this theatre project by Richard Mabala and Karen Allen was to give a two-week training to two artists from each community. A total of 200 men and women under the age of 24 were trained in 'a popular theatre methodology, from data collection and analysis to performance and leading a discussion. They also learned facts about HIV/AIDS and life skills' (Mabala and Allen 2002, p. 335). These artists went back to their communities and trained another six to eight persons, who then went on to do the research in each community. They gathered data on barriers to condom use, dangerous initiation and sexual practices. The trained artists then transformed these issues into theatre performances presented in the community and at regional arts fairs. In fulfilment of the project goal, the theatre was credited with provoking much discussion and bringing many shrouded issues to light, and even changing one community's policy about all-night dances.

The published project report, cited above, contained no description of the theatre method itself or of the performances, so it is not possible to establish whether they functioned as theatre, or whether only the social function was achieved. The documentation is entirely biased to the social science merits. Although one of the aims was to 'equip young people with skills of art for development', there were no details of what the difference might be between arts skills and facilitation skills. The self-esteem of the artists apparently rose and some were

[9] 8.1% of the population was at that time HIV positive (UNAIDS, 2000).

asked by community leaders to perform theatre on other social issues. An extremely positive aspect was that this project became the first step in a far wider undertaking: it was followed by the building of youth centres and the training of peer leaders to teach life skills to young people in their communities.

1.5 Socially engaged (collaborative? participatory?) art and climate change

In 2009, prompted by the prospect of another round of climate negotiations, several major art exhibitions took place in Europe on how the visual arts were exploring the environmental crisis. In London *Radical Nature: Art and Architecture for a Changing Planet 1969-2009* at the Barbican offered a forty-year history of creative engagement with the environment. The Royal Academy exhibition *Earth: Art of a Changing Planet* was probably the most political event the Royal Academy had ever staged; it included work by Edward Burtynsky, Cornelia Parker, Anthony Gormley and Clare Twomey[10]. One of the strong influences on my own thinking about art and climate change came from attending the COP15 in Copenhagen in December 2009. In addition to *RETHINK relations* – a series of art exhibitions throughout Denmark – the streets of Copenhagen were filled with colourful, noisy activist art performances and installations, and the conference venue itself even became a site for art interventions.

Figure 3 The arts and activist group AVAAZ.org intervene at the COP proceedings, Copenhagen, 2009. Photo J. Schläpfer

[10] The RA no longer has documentation on their website but a good review is available at https://fugitiveink.wordpress.com/2009/12/06/earth-art-of-a-changing-world-at-the-royal-academy/ (accessed 31.10.15)

The *RETHINK relations* exhibition at the Den Frie Center of Contemporary Art and the National Gallery of Denmark, both in Copenhagen, provided several memorable aesthetic experiences. One was Thomás Saraceno's floating plastic bubbles, *Biospheres 2009*, inflatable spheres, some containing plants, and one that one could crawl into, were suspended high above the gallery floor.

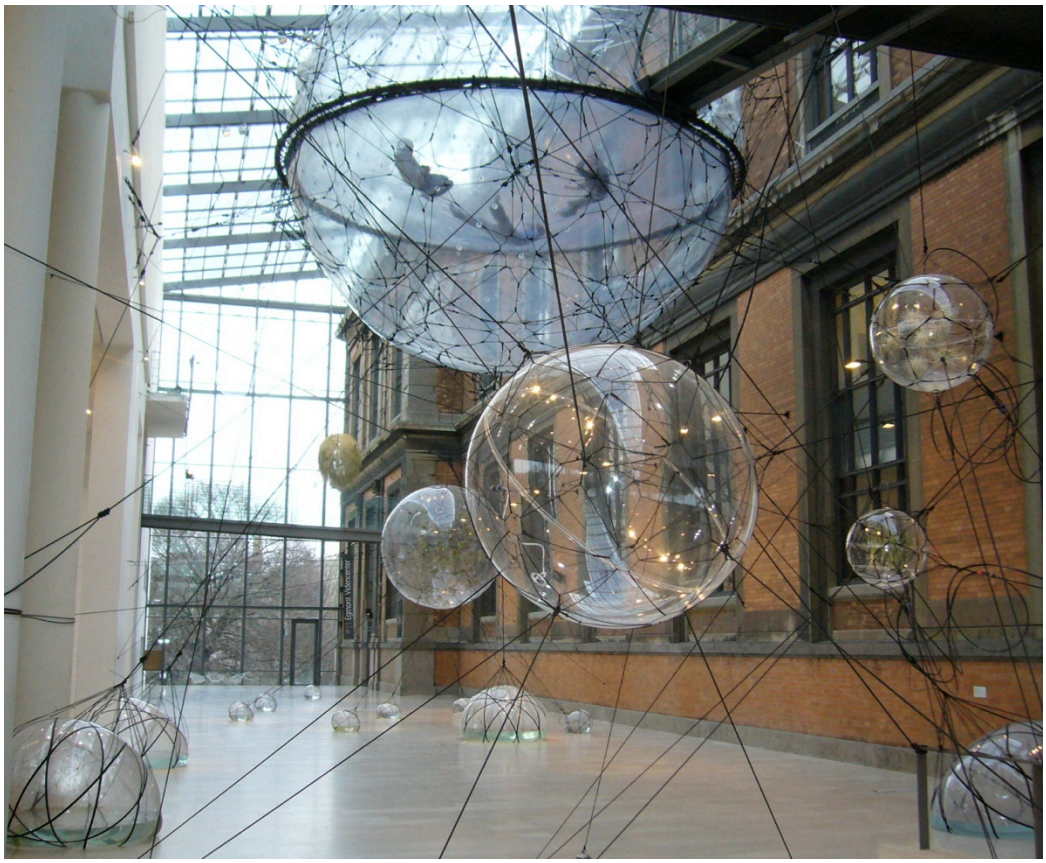

Figure 4 Biospheres 2009 by Thomás Saraceno in the National Gallery of Denmark. Photo J. Schläpfer

Figure 5 Details from the installation Biospheres 2009 by Thomás Saraceno in the National Gallery of Denmark. Photo J. Schläpfer

Walking on the inflated floor was very unstable and gave one a sense of precariousness in the sphere, or being an organism in a pod or cell, leading to personal questions of future survival

and how to know the world under your feet. I had a realization similar to that of the journalist Madeline Bunting when she was in this same space, that the real crisis at the moment is not just climate but epistemology (Bunting 2010). How do humans understand their place in the world? This pondering raises larger questions about the role of artist in climate change: Can art provide the experiences necessary to enable this understanding? It is clear that we do not need more information about climate change; what we need is to shift our behaviour. But why should artists be charged with this task? Well, some artists are obviously willing to take up the challenge and others not. Cornelia Parker has been quoted as saying that she 'doesn't do' climate change in her art, and her piece in the Royal Academy show, *Heart of Darkness*, was conceived as a response to the "hanging chads" fiasco when Al Gore lost the 2000 US presidential election.[11]

Figure 6 *Heart of Darkness* by Cornelia Parker 2004. Charcoal from a Florida Wildfire (prescribed forest burn that got out of control), 323 x 396 x 323 cm. Image from the artist and Frith Street Gallery, London downloaded from http://www.fadwebsite.com/2009/12/11/gsk-contemporary-earth-art-of-a-changing-world-at-royal-academy-of-arts-through-to-31st-january-review-ana-vukadin/.

What I find interesting about this piece is that, although Parker claims it is not about climate change, it is about both political shenanigans (injustice even), and environmentally irresponsible behaviour, both of which characterize climate change.

In an interview in *Arts and Ecology*, the critic and curator Sîan Ede asks how artists can fail to make art about the environment – no one lives in isolation, but it is not an agenda that should be forced on artists (Ede 2010). Keith Tyson, an artist also featured in the *EARTH* exhibition, sees his role as

[11] The hanging chads were the pieces of paper stuck in ballot forms in Florida, preventing them from being counted. See https://en.wikipedia.org/wiki/Chad_(paper) (retrieved 3.11.15)

> not to advocate solutions; art is not about protest. It is something much deeper and more subtle – to make us reflect and re-think what it is to be a human being in the 21st century. What do we want to be? (Keith Tyson quoted in Bunting 2010)

This questioning of what we want to be is the inspirational factor, not only in the artwork in Copenhagen, but also in the *Eden Project* in Cornwall, UK. The vision and scope of the Eden Project is impressive, and – although more *public experiment* than artwork – it is worth describing it briefly, as it is formative for the context of the *Climate Hope Garden.*

The *Eden Project* is the brainchild of Tim Smit, who wanted to create a space for storytelling about the future. The project consists of two vast biomes built in an old china clay open pit mine in Cornwall. It opened in 2001 and since then has had over 16 million visitors.[12] The physical core of the project is the biomes and an exhibition and classroom space, but what makes the *Eden Project* so compelling is its narrative: how something so beautiful and extraordinary was built out of a wasteland, how it has spurned so many social and educational projects, and how visual artists, musicians and poets have been, and continue to be involved in its work.

Figure 7 The clay mine before start of construction, Cornwall 1995. Photo the Eden Project

[12] https://www.edenproject.com/eden-story/about-us/sir-tim-smit-kbe (accessed 3.11.15)

Figure 8 Overview of Eden Project with new visitor centre in the foreground. Photo Tamsyn William, Eden Project 2015

I visited the *Eden Project* in March 2015 and was impressed in the first instance by the visitor infrastructure – massive car and coach-parks, great signage, covered walkways to queue at the entrance, an adequate number of toilets, café at the entrance, and a huge number of ticket desks. This might sound banal, but as a museum professional I know how important it is to get the visitor arrival experience right: it sets up the whole visit. One walks down from the entrance building into the terraced outside gardens (old mine) and then enters the massively impressive biomes, which are linked by a café and shop area.

There is a Mediterranean and a Rainforest biome, the latter being 15,590 sq m with 1185 plant species growing at temperatures ranging from 18-35° C.

Figure 9 The biomes are architecturally spectacular, and the skywalk provides an exciting visitor experience inside the rainforest biome. Photo Eden Project 2015

From a botanical point of view the collection is adequate but not in the same league as the botanical gardens at Kew or the tropical biome in the Zürich Botanical Garden. However, the *Eden Project* emphasizes the connection to food and other plants we use from the rainforest. Thus the exhibition mediates a strong relation to human life and culture, rather than a sense of the exotic as observed by an outsider. This is achieved through small, low-key exhibits that link the rainforest to products people know: rubber trees with rubber-boots and flip-flops and old car tyres with a seating area. Project staff and volunteers are in plentiful supply, leading tours and doing demonstrations and workshops. This gives life and vibrancy to the plant theme, rather than staging it as a quiet meditative individual experience.

Figure 10 Rubber exhibit in the Rainforest Biome. Photo Eden Project 2015

The project is in the tradition of public education and social improvement exemplified by San Francisco's Exploratorium, a museum that aims to excite people about the natural world without conveying information in a moral way. In an analysis of the Eden Project in *Museum and Society*, sustainability researcher John Blewett interviewed many of the project's senior staff. He quotes Jo Readman, Eden's Director of Education and Messaging, who explains:

> The message we are trying to put across is, '*you can make a difference. It is about celebrating and enjoying the environment you live in. Be positive about the future – you can do something*'. A lot of other places, in their education policies, say look everything is going wrong and it's all our fault. We've got climate change. We've got war and we've got famine and we've got poverty. Yes we have and they are all dreadful things but there is something you can do about it. So we look at what other people are doing and we look at what the individual can do by starting way, way, way back down the line by connecting to their environment, by connecting them to the

> rest of the world. Unless we connect people to that we can't take it forward (Readman, quoted in Blewitt 2004, p 177).

The Eden Project's educational practice emphasizes intentionality, shaping conduct by altering cultural values and ways of thinking, supporting connectivity, and encouraging people to reflect on their own relationships with plants and each other. The project aims to enable an 'experiential understanding that is as emotional, visual, kinetic and spiritual as it is linguistic or intellectual' (Blewitt 2004, p 180). Its philosophy is based on a constructivist theory of learning (Hein 1995, Falk and Dirking 2000) that eschews the didactic and sees museum exhibitions as eliciting multiple meanings and stories. These are themselves created through multiple means, including planting, art installations, live guides, books and pamphlets, workshops, lectures, retail consumption, performances, signage and music. According to Blewitt,

> The meaning of these stories, following the constructivist perspectives are understood to be relational, plural, contingent and open to challenge, being negotiated through visitors' cognitive frameworks, interpretative communities and strategies. Knowledge is situated and provisional (Blewitt 2004, p 178).

When engaged in conversation by guides or performers, visitors sometimes use Eden as a means of retrieving their own memories, of telling their own life stories or narrating critical incidents from their personal life. These interactions could be described, in terms used by media theorist John Carey, as 'the sacred ceremony that draws persons together in fellowship and commonality' (Carey 2009, p 18). Carey speaks of a ritual model of communication in which experts and laypeople engage on an equal footing.

This, too, is the goal of the *Climate Hope Garden*, which deviates from the *Eden Project*, however, not only in scale and scope, but also in employing a rather more aggressive approach, showing *best case* and *worst case* scenarios as contingent on future human behaviour. Blewitt raises the question whether this is justified, and asks if 'disorientating dilemmas' and 'cognitive conflict' are necessary to change a person's perspective or extend 'environmental conceptions' (see Mezirow 1991, Ballantyne 1998 in Blewitt 2004). This question is still relevant to my practice, as I prepare to install another iteration of the *Climate Hope Garden* in 2016.

In this chapter I have examined some of the discourse around collaborative and participatory art and socially engaged participatory art. I have focused on *new genre public art*, and *relational aesthetics*, looking at some of the social and political logics for engaging in this type of collaboration. Using analogies from social media and programming I have also set up a reference point for evaluating the level and extent of participants' ability to affect and

contribute to a project involving digital media. I have outlined what knowledge production in arts research might mean, in order to come closer to defining the knowledge produced by transdisciplinary art-science research. The arts review created a context for the type of art collaboration in a development context proper to the case study *Sauti ya Wakulima*. The review of the Eden Project and discussion of climate change art provided a context for the *Climate Hope Garden*, which will be discussed in Chapter 5 with reference to the type of transdisciplinary knowledge produced in the processes of collaboration with scientists and interaction with the audience. Chapter 2 will now proceed to examine participatory research for development and the postcolonial context of research in Tanzania.

Chapter 2 Participatory research for development and the postcolonial context

2.0 Introduction to chapter

In this chapter I will describe the multi-level research context of the case study *Sauti ya Wakulima*. As the project is in Tanzania, the particular issues of research in a postcolonial context must be examined, including the role of NGOs, enmeshed as these are with research for development and the setting of policy agendas. I will argue that NGOs have become the human face of structural adjustment in Africa, allied with powers they might otherwise have questioned. In opposition, a civic anti-globalisation movement has arisen, also working with a diverse range of NGOs, creating sites of conflict and contestation. It is with these sites that artists tend to engage, relating NGOs to international development and contemporary art practice.

From the vast literature on research for development I will focus here on what is most relevant to the concerns of this chapter: participatory research and Information and Communication Technologies for Development (ICT4D). These fields are tangential to socially-oriented participatory art, transdisciplinary art-science, and media art, which will be addressed in the next chapter. The much-critiqued lack of a theoretical basis in research for development is particularly interesting here, as is recent thinking about how to create further theoretical research frameworks in ICT4D. The chapter concludes with a few ICT4D project examples.

2.1 Research in the Tanzanian context

Tanzania is a former British and German colony which became independent in 1961. With a GNI per capita of $860[13], there is much development activity, and foreign as well as local

[13] http://data.worldbank.org/country/tanzania (accessed 15.4.15)

NGOs are ubiquitous. Between 1990 and 2010 Tanzania received $26.85 billion in aid, some of it (by 2008 51%) as general budget support (GBS) which goes to the central government, but still a large amount is distributed by NGOs, giving them an inordinate, undemocratic share of power[14]. In his paper *Silences in NGO discourse: the role and future of NGOs in Africa*, the Tanzanian scholar Issa Shivji (2007) argues that colonialism left by the front door and returned through the back door in the form of neocolonialism, forcing Africa to succumb to the new imperialism of economic globalization. The current power held by NGOs in Africa is a result not only of colonial and postcolonial history since independence, but can more recently be linked to Tony Blair's Commission for Africa, which declared:

> Africa's history over the last fifty years has been blighted by two areas of weakness. These have been *capacity* – the ability to design and deliver policies; and *accountability* – how well a state answers to its people (Shivji 2007, p. 23).

The state is demonized by such assertions, which effectively take policy-making out of its hands, reducing it to the level of other stakeholders, including NGOs. Civil society is often confused with NGOs, but in the African context the two are generally distinct. The confusion has serious political consequences, removing self-determination from the people at both government and grassroots level. Furthermore, as most NGOs are donor-based, the agenda for development within African countries is often set by external agencies, albeit well-meaning ones. The other issue with neutral NGOs driving policymaking is that policymaking is inherently non-neutral, so the question arises: whose interests are being served by *neutral* NGOs?

In order to understand the current role of NGOs in Africa it is necessary to acknowledge the historical context of colonialism and the creation of nation states. After four centuries (1415-1850) of brutalization by slavery, in which by some estimates 40 million people perished[15], the continent was divided into nation states by the European colonial powers. These states were based on physical geography, not social or ethnic bonds.[16]

Shivji contends that the colonial state was an alien apparatus imposed on the colonized society. It was a despotic state without civil society, governing native peoples by coercion. With independence (starting roughly in the 1950s), these structures of governance were handed to a European-educated elite, requiring the new governments to create and develop a

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[14] http://unu.edu/publications/articles/unintended-consequences-of-foreign-aid-tanzania.html (accessed 4.12.15)

[15] This number is disputed by historians, Lovejoy 1989 estimates 11,800,000 slaves were exported during the Atlantic slave trade and the same number again were captured and died along the way. And this does not take account of the East African coastal trade in slaves.

[16] The Berlin Conference 1884-85 http://en.wikipedia.org/wiki/Berlin_Conference (accessed 18.5.15)

nation with no middle class. The middle class, repressed by the colonial state, would in other circumstances have been an agent for development.

2.2 International development and modernisation

US and European efforts to maintain a sphere of influence through a policy of development aid has, dependence theorists argue, enriched the countries of the north at the expense of the South. In Tanzania, the *Ujamaa* movement of Julius Nyerere advocated self-reliance in southern economies, but by the 1980s there was a backlash from donor countries against the perceived radicalisation of the development process, leading to a new liberal policy of 'structural adjustment' (Rist 1997).

The debt mountain incurred by copious foreign lending to African countries during the 1960s and 70s was negotiated in the 1980s, but at a high price for Africa. The policy of structural adjustment dictated that in order to receive aid or support from the IMF, countries had to conform to a market regime that would have been impossible to implement so fully even in the US or Europe. That meant they had to surrender control of their internal affairs, privatise publicly owned companies, suspend trade protection, reduce public services and social welfare, and open their economy to foreign investment (Kester 2011, p. 118).

The results were, and are, increases in unemployment, social inequality and disorder, social tensions and ethnic differences. This in turn has created a lack of resilience to disasters, necessitating humanitarian aid. It is in this sense that NGOs have become the human face of structural adjustment, allied with powers they might in principle have questioned. Kester puts the situation trenchantly: "This of course is a typical example of a hegemonic power attempting to blunt or deflect criticism of its actions through the use of a humanising alibi" (Kester 2011, p. 119).

One of the insidious policies of neo-liberalism is to hobble or limit the power of public agencies or institutions such as public sector schools and universities, social-service programs, or regulatory and legislative bodies in order to close any spaces where systematic and structural inequalities might be acknowledged and addressed. The exception to this is state approval of fundamentalist Christian churches, which are in any case often ideologically compliant. This phenomenon can be observed in the US as well as on the African continent.

Yet in opposition there has arisen an anti-globalisation movement of civic groups that work with a diverse range of NGOs, creating sites of conflict and contestation. It is with these sites that artist engage, relating NGOs to international development and contemporary art practice. Kester asks in this context what attitudes artists might take towards NGOs and government

agencies. Do they reinforce neo-liberal orthodoxy, or do they expose the contradictions of development aid?

2.3 Climate change and agriculture: the perceived need for participatory research

Small-scale agriculture is already being affected by climate change in Tanzania, as current changes in the amount and frequency of precipitation are affecting production. Although farmers have always had to adapt to weather uncertainty, their knowledge about how to do so necessarily lies within the range of local normality and observed patterns. These patterns are now changing and cannot be read by farmers as well as they could previously. According to many sources, the impact of observed and projected climate changes on agriculture is expected to continue, especially in tropical and sub-tropical areas and on farmers who are resource poor and lacking in resilience (CDE 2011, 3rd SCAR Foresight Exercise 2011, CGIAR 2011).

In order to facilitate adaptation, it is necessary first to identify the potential impacts for small-scale farmers. The Swiss Center for Development and Environment (CDE) recommends supporting the revitalization of extension services based on the principles of community participation and participatory technology development (CDE 2011, p. 3).

There has been a broad move in recent years towards farmer-led research, as formulated, for example, by Fetien Abay of Mekell University, Ethiopia (Abay 2009). She claims that farmers are more motivated to participate in research if they co-define the question. Climate scientists also recognize the need for participatory research that not only values and uses indigenous, locally based knowledge. High-resolution computer simulations of maize growing in Brazil, the Central African Highlands and Ethiopia show that areas with crop gains or losses are highly localized and sometimes farmers who gain are 'only kilometres from those who will lose completely' (Jones 2005). This means that adaptation studies and recommendations cannot be made at the regional or national level but must be local (Jones and Thornton 2003, in Jones et al 2005, p 23; Reid 2003, Reid & Huq 2005). Hence these authors argue for a local participatory approach (Jones and Thornton 2003): farmers will learn not only from their own experience but also from that of their neighbours, as similar climate change will occur at other locations. This raises the question how social learning of this kind might be facilitated.

According to David Tàbara a new view is required of how human information and knowledge systems operate, how they should be organized and how they should relate to the functioning of social ecological systems in the organization of science, education and policy' (Tàbara 2013 (B) p 112) His view is based on social learning theory pioneered by Vygotsky, whose theories of social learning although written in the 1930s were lost (or repressed?) until the 1950s. His publication *Mind and society: The development of higher psychological processes* (1978) has deeply influenced the way we think about learning in context (John-Steiner & Mahn 1996, Bandura, & McClelland, 1971)

Jean Lave and Etienne Wenger propose a more precise term than 'social learning' as they say all learning is socially situated. Their conceptual bridging concept 'legitimate peripheral participation' describes learning as an activity that takes place as integral to social engagement and 'defines a landscape of community membership'. Their words are chosen carefully to describe a type of learning that includes more or less engaged 'ways of being, located in the fields of participation defined by a community' (Lave and Wenger 1991 p 36).

According to Tàbara we should talk about knowledge systems– not simply 'knowledge'

> because this concept refers to multiple sets of interrelated knowledge components and their interactions which have their own internal boundaries, dynamics and logic, and which are the result of social-ecological processes. If we place learning at the heart of transformation, recognizing that we can only transform in the right direction through learning, a transdisciplinary, integrative, open approach that blends insights from theory and practice, and from multiple disciplines and sources of knowledge and expertise, becomes essential (Tàbara 2013 (A) p 112)

Against this background, the UNESCO International Council for Science is very definite about the need to incorporate other forms of knowledge into formal scientific knowledge:

> While previously they were perceived simply as resource users, indigenous peoples are now recognised as essential partners in environmental management. However, differences between scientific and indigenous worldviews continue to create barriers to meaningful collaboration, as does the widespread assumption that science is superior to other knowledge systems (ICSU Report 2002).

Furthermore:

> the research community, with the exception of some disciplines specifically focused on studying traditional societies and traditional knowledge such as ethnology . . . has not yet engaged in ways of linking science to other knowledge systems. To do so would bring important advantages to both sides, and provide to those in need of

> knowledge for pursuing sustainable development goals a broader range of empirical information (ibid.).

The *Sauti ya wakulima* methodology developed below offers a promising tool for the attainment of precisely that goal – enabling farmers to become their own reporters and data collectors, and connecting scientists with them. By giving farmers the tools and creative freedom to document their lives and practices, *Sauti ya Wakulima* generates a broader range of empirical information than would a purely scientific investigation, yet it remains connected with science, and that connection, as well as the underlying method of information gathering and communication, involves activities that belong essentially to the sphere of the arts.

2.4 Research for development

Our research was funded by the North-South Centre of the ETHZ, (which is now merged into ETH Global and the World Food System Centre). In the *Research Master Plan 2008-2011* for policy sector development and cooperation, the Swiss Agency for Development (DEZA) outlined its objectives, one of which was to strengthen research capacities in partner countries. It is for these reasons that the present research was positioned in a development context.

Research for development has a long history. In the 1960s it evoked a trend for surveys using social and empirical methods. In his discourse-defining work *Revolutions in development enquiry* (2008*)*, the practitioner and theorist Robert Chambers comments that by the 1970s the large-scale surveys favoured by the World Bank were beginning to be criticized. These multi-subject questionnaires undertaken by development workers from the North with the rural poor of Asia and Africa sought to apply classic scientific methodology, with treatment and controls, to large numbers of rural poor. According to Chambers, the surveys were costly and prone to many errors, not least to investigator effects. The questionnaires were drawn up in university offices in the global North, and, if there was a multi-disciplinary team, each researcher added their own questions to the set, not challenging the questions of others. Accordingly, the surveys produced data that reflected the concepts and categories of outsiders, rather than the social reality of rural people. These 'artificial chunks of knowledge did not identify causal relationships or explore social relationships such as reciprocity, dependence or exploitation' (Chambers 2008, p. 6).

By the end of the 1970s and 80s researchers had begun to use semi-structured interviews and transects as an alternative to surveys for gathering information. In this way they could, for example, identify priorities for agricultural research. Yet these methods were not respected by

the establishment (e.g. northern funders). Researchers such as Collinson claimed to have found out in a week enough information about farming in East Africa to identify research priorities, but he was obliged to conduct a three-month survey in order to corroborate the rapid rural assessment evidence (Collinson 1979, in Chambers 2008). The challenge was, and still is, to find ways for researchers to learn about rural conditions in a way that is accurate and cost-effective and recognizes inherent biases. Often the useful information from social anthropologists and from extensive survey questionnaires comes coincidentally and informally during fieldwork and not through the formal process at all (Chambers 2008, p. 73). Such problems are also part of the 'economism' of development agencies whereby 'soft' information has to be made acceptable, through pseudo-scientism, to hardened decision makers (Mohan 2006, p. 12).

Rapid rural assessment methods may include secondary data, indigenous technical knowledge, direct observation, semi-structured interviews, sketch mapping, and interviews with key informants. Out of these methods, and from a new awareness of the importance of local knowledge, there came in the late 1980s a wealth of new, linked approaches known as *participatory rural assessment* (PRA) and the more inclusive *participatory learning and action* (PLA). Ideologically PRA and PLA both seek to empower poor and subordinate people, 'enabling them to express and enhance their knowledge and take action' (Chambers 2008, p. 85). The eclectic pluralism of their methods involved three major components reinforcing creative diversity: the first facilitated behaviour and mindset; the second combined visuals, tangibles, groups, and an understanding of group visual synergy; the third consisted in sharing without boundaries. These approaches 'raise questions around power, roles, realities, and whose reality counts' (Chambers 2008, p. 85).

Whose reality counts is indeed a good question. Participatory rural assessment researchers, for example, describe PRA research events as 'informal,' but this notion of informality is culturally dependent. Furthermore, western ideas of play do not necessarily translate into other cultures. Western models of cognition assume that knowledge is mediated by language, but most knowledge is generated in practice. PRA relies heavily on linguistic representations of knowledge, which may be peculiarly western. In a PRA study, findings are translated by the research group, thereby undermining the value of local knowledge (Mohan 2006). This has direct implications for *Sauti ya Wakulima*, where the data was analysed by the (European) researchers.

The second of the methods mentioned above, participatory learning and action system (PLAS), relates directly to the case study *Sauti ya wakulima*. Pioneered by Linda Mayoux, it is an eclectic and constantly evolving methodology that enables people to collect and analyse the information they themselves need on an ongoing basis, to improve their lives in a way that

they decide (Mayoux 2007, in Chambers 2008). The visual tools used are diagrams integrated with participatory principles, linking individual and group learning. Applications have included women's empowerment in India, participatory monitoring of a research station in Uganda, and impact assessment of micro finance in several countries (Chambers 2008, p. 96).

However, research for development has been criticized, for example by Issa Shivji and Maia Green, whose arguments will be considered below.

2.4.1 Lack of theory in NGO and participatory research for development discourse

> Development NGOs have taken up the 'missionary position' in Africa consolidating the neo-liberal hegemony in the global context of independent nation states (Shivji 2007 p. 14).

Shivji argues that much NGO discourse eschews theory and emphasizes and privileges activism. Action is given priority over thinking, which implies a lack of holistic thinking. Problems are addressed in a project-based, issue-driven, political/economic-interest-driven manner that does not allow for long-term research based on theory and historical perspectives, and even ignores the very social, historical and political interests being researched. As Shivji pithily says, one cannot 'make poverty history' unless one knows the historical roots of that poverty and the wealth that is its counterpart (Shivji 2007, p. 34).

Participatory research grew out of the awareness that power and knowledge are inextricably linked (Chambers 1997, Goebel 1998, Sibanda 2011). The concept of 'local knowledge', and with it the restriction of funding to development research involving stakeholder participation, evolved in order to compensate for the perceived imposition of northern scientific perspectives on development projects. In practice, however, participatory research raised serious questions about who defines the categories of 'expert' and 'non-expert', and how. Notions of the mysterious and exotic permeated views that the other was unknowable, and its rationality unfathomable (Campbell 1997). From the point of view of research, this western attachment to mystery was seen to prevent dialogue, as complex societies were reduced to 'discrete entities entirely separable from each other in space' (Kanneh 1999, p. 7). In *Beyond participation: strategies for deeper empowerment*, Giles Mohan (2006) contended that research was pursued within realms of knowledge that existed prior to the research process, the western, rational and familiar contrasting with the local, multiple and strange. Local

knowledge is often characterised as 'more organic', but this may be more the result of extreme poverty than of an intimate relationship with nature.

In a thorough critique of participatory research for development, Maia Green, in her paper *Participatory Development and the Appropriation of Agency in Southern Tanzania* (2000), claims that the construction of 'local' knowledge as a key to development strategies of local participation derives from a misunderstanding of basic sociological theories and from out-of-date anthropology (Green 2000, p. 74). Green argues that local knowledge has been fetishized, and the assumption that empowerment happens at a conscious level means that poor communities remain dependent on development intervention (Green 2000, p. 85).

Many sources of literature on participatory development rely on philosophical constructions of participation that would lead to the emancipatory empowerment of poor people *if they participated*. Green argues that 'constructing a causal relationship between participation and empowerment relies on a spurious relation between knowledge and agency, in which individual agents are empowered at the level of consciousness, in a vacuum divorced from actual social and political action' (Green 2000, p. 68). Moreover, if these approaches use participation for knowledge production rather than program management, the poor are left as passive agents who will then require development organisations to intervene and bring about social transformation.

Development in these terms is not a process of change leading to economic and social transformation, but rather depends on moral transformation or consciousness-raising on the part of the poor – in other words the requirement of 'becoming more like us' noted by Kester. Agency, in this paradigm, can only be gained by means of imported structures for participation. Echoing Shivji, Green says that the relationship between knowledge and agency evolved 'in a development domain free from empirical study and social theory' (Green 2000, p. 68, see also Reilly 2011).

The 'moral imperative model' of development assumes that the poor live in kinship networks in a form of peasant solidarity. Concurrent with our experience in rural Tanzania, Green states that collective action in Tanzania usually occurs at extra-village level; there is no such thing as 'local', and that focusing on the local and micro context, rather than the meso and macro, echoes the colonial policies of indirect rule. Mohan (2006) also raises the point about the poor being homogeneous, which is often not the case.

The larger context of trade politics or national regional agricultural policy is frequently ignored. For instance, it may be the restricted access to capital markets that is limiting rural opportunities and not, as we postulated at the start of our research process, lack of knowledge about how to adapt to climate change. 'A person's capacity for agency depends on political

and economic rules and resources, not merely on their access to knowledge' (Bebbington 1994, p. 201); for 'knowledge is not an abstract category of resources … utility of knowledge is constrained by social institutions' (Green 2000, p. 84).

Postcolonial studies provide a critique of Eurocentric discourses about the global South and how the voices of the marginalized might be recovered, yet Mohan argues that a great deal of this writing is an abstraction of cultural processes removed from the material conditions of the poor, and postcolonial critiques are unable to 'suggest alternatives to the dominant epistemological framework against which they argue' (Mohan 2006, p. 7). Yet a viable critique of Western constructions is crucial for practitioners of participatory development.

As we have seen, from Green and others, current participatory development valorises local knowledge, yet even when a conscious effort is made to access indigenous or local knowledge, the reverse often occurs (Mohan 2006, p. 7). Moreover, structural problems are often ignored, and knowledge and individual agency are simply assumed to endow the rural poor with power to influence realms that are, in fact, entirely outside their control.

2.4.2 Transdisciplinary research for development

In Chapter 1 a distinction was drawn between interdisciplinary research and transdisciplinary research, the latter being concerned with co-producing knowledge with lay experts such as farmers, particularly in a development context. In this section I will emphasize some related issues that are particularly pertinent to the Tanzanian context.

As we have seen, a central issue in a research and development context is that of power. Having power means having the ability and resources to negotiate and adapt interests during the process of knowledge (co-)production. To distribute power means not to privilege contributions from one discipline or social actor over another (Pohl et al. 2010, p. 271). Power is often linked to the issue of expertise, and in transdisciplinary research this is multi-layered. In the project under review, the layer of neocolonialism introduced above can be added to the usual issues of power between expert (researchers) and non-expert (farmers). Related to this, according to Dahdouh-Guebas et al. (2003), is the transfusion of sustainability research with concepts of neocolonial science. Indeed it seems that transdisciplinary research itself, because of the blurring of the boundaries between classical epistemological realms, is driving scientific research to take on the nebulous role of assisting in policy-making (Dahdouh-Guebas et al. 2003, in Pohl et al. 2010). This connects with the critique of technocracy levelled at transdisciplinary research by Osborne (2015) – see Chapter 1.

The issue of nomothetic and idiographic knowledge was also raised in Chapter 1. The role of expertise in generating nomothetic and/or idiographic knowledge may be very case-specific. One must look at the results and evaluate how knowledge production relates on the one hand to strategies and decisions, and on the other to the improvement of methods and models (Krohn 2008, p. 376). Krohn argues that stakeholders are driven by idiosyncratic concerns, but I wonder if this is always true: the farmers in Tanzania were very concerned that other farmers should be able to learn from their experiences and expertise.

Wuelser et al. (2012) suggest a framework for structuring complexity in sustainable development research. Expanding on the tripartite division of knowledge (target, systems and transformation knowledge) proposed by Pohl and Hadorn to account for the solution of complex problems, they note that the typical notion of scientific knowledge as generic knowledge of facts needs to be expanded considerably to account for the different forms of knowledge inherent in issues of sustainable development (Wuelser et al. 2012, p. 88).

2.5 Information and communication technologies for development (ICT4D)

Information and Communication Technologies (ICTs) are enabling tools including *traditional* and *emerging* devices such as interactive community radios, traditional and alternative media, television, cellular phones, computer and network hardware and software, the internet, satellite systems, and podcasting.

The rapid proliferation of technology and information networks is expanding the range of participatory methodologies for development (Chambers 2010). As argued by the World Bank, agricultural development depends to a great extent on how successfully knowledge is generated, shared and applied, and for that, interactive and collaborative forms of sharing and exchange are required (World Bank 2007). However ICTs can only facilitate, but not in themselves encourage, coordinate, or implement complementary use of different knowledge sources. It is this, however, that is best calculated to bring about the continuous process of innovation that is so vital in driving development in agriculture, while at the same time bridging social and geographical distances (Ballantyne 2009). Heeks identified *data*, as well as *economic*, *social* and *action resources*, as the four categories required for an information chain to work in ICT-based development contexts (Heeks 2002).

Cees Hamelink, citing Kaplan (1999), argues that development should not be conceived as a process of engineering that depends on the delivery of information and knowledge, but rather

as a process that 'enables people to participate in the governance of their own lives' (Hamelink 2002, p. 8). Hamelink postulates that 'the real core question is how to shape 'communication societies'. In fact, for the resolution of the world's most pressing problems, 'we do not need more information processing but the capacity to communicate' (Hamelink 2002, p. 8).

There has been an increase in the use and application of new communication technologies, such as internet use, in Africa from 2000-2008 of over 1000% (ICRISAT 2009). Yet unlike other continents, telecom reform and regulation in Africa has been resisted, resulting in one of the most expensive telecommunications services in the world. For example, the RIA demand-side survey found that in the lowest income bracket, three-quarters of mobile phone users spent, on average, between 11% and 27% of their income on mobile communications, rather than the standard 2–3% of income spent in developed economies. In the case of Tanzania, Souter (2005) estimates telecommunications expenditure in the range of 10–14% for poor households (Souter 2005, in Gillwald 2010). This just refers to mobile phone costs. The average retail price for basic broadband in sub-Saharan Africa is US$366 per Mbps/m, compared to US$40 in Europe and India (Williams 2008, p. 2 in Gillwald 2010).

The agriculture for development field was at first criticized for being slow to promote the uptake of new technologies (Gelb et al. 2008). Despite the proliferation of literature in the global North claiming 'development 2.0' (Quaggiotto and Wielezynski, 2007; Thompson, 2007; Heeks, 2010), there is still a need for wider adoption of ICTs in the development context. For example, in a recent study in Ghana, Asiedu-Darko and Bekoe (2014) observed that accessing agricultural information through ICTs was not popular with farmers and required pragmatic measures by the government, including adult education on the use of the technologies. The ratio of access to agricultural outreach officers was 1:1500, so farmers mostly relied on friends, relatives and other local sources of agricultural information. This has been a drawback of the adoption of agricultural technologies (Asiedu-Darko and Bekoe 2014). Other sources of farming information were, for example, radio and television programmes such as the Ministry of Food and Agriculture's (MOFA) collaboration with a local radio station, creating a programme called *You and Agriculture*, aiming to educate farmers on agricultural activities. The phone-in segment of the programme allowed farmers to call in to ask questions and contribute to the discussions. A system of vans driving around with agricultural information had been donated by the Canadian International Development Agency, but the project was faltering due to logistical problems. Their study concluded with the recommendation that farmers could make better use of SMS, with agricultural extension officers being given phone credit to communicate with the farmers (Asiedu-Darko and Bekoe 2014).

There are numerous examples of pilot ICT projects, and new and social media tools are clearly affecting the political sphere in developing countries, but the extent of their impact on agricultural development is not yet well understood (Aday et al. 2010).

Recent discourses in ICT4D have included the concept of 'open development', which refers to the possibilities afforded by '"open" information-networked activities'. This dialogue stems from both the issue of open source in IT systems, and long-standing development concepts of open governments, democracy, participation and inclusion (Smith, Elder and Emdon 2011). In this context 'open' is shorthand for information-networked activities that have 'more information freely accessible and/or modifiable and more people who can actively participate or collaborate' (Smith, Elder and Emdon 2011, p. iv). As with the impact of social media on the political activist sphere, open development has a potential for disruptive transformation (Avgerou 2010), as it involves a change in who can participate in development activities, shifting the balance of power and control. It opens possibilities for more participation and strong beneficiary-driven collaborations. The lower costs may mean that those who previously lacked knowledge or resources can now mobilize (Hagel et al. 2010). In the development context, this requires a conceptual shift from viewing the poor as consumers to seeing them as active producers and innovators (Heeks 2009, Liang 2010). According to Unwin, the potential shifts in power associated with the new networks of open development may threaten the interests of many private sector actors who have played a role in ICT4D (Unwin 2011).

Yet it is not a foregone conclusion that this disruptive transformation will necessarily benefit the poor and disempowered. A study in Bangalore showed that digitization of land records led to land grabs by the already rich, rather than benefiting the poor (Benhamin et al. 2007). The pervasiveness of the internet means that personal data is increasingly shared and stored by both the private and public sectors, raising issues of privacy rights and who controls what information (Mayer-Schonberger 2009).

In her essay *The Poverty of ICT Policy, Research, and Practice in Africa* Alison Gillwald provides 'an African response' to some of the major narratives in the literature on ICT for development and poverty alleviation (Gillwald 2010). She attributes the relatively poor ICT policy outcomes in Africa, particularly regarding its deployment for poverty alleviation, to

> the poor quality and lack of critical research that acknowledges the political dimensions of policy reform and economic regulation. Such research would be able to meaningfully inform and capacitate policy formulation, regulatory practice, and business operations to produce positive growth and development outcomes (Gillwald 2010, p. 79).

She goes on to criticize the 'ICT euphoria in development circles over the last decade', where, she says, 'there is little non-anecdotal evidence in Africa linking communications sector policy reforms aimed at increased penetration and lower costs of communications to growth, to development, and particularly, to poverty alleviation' (Gillwald 2010, p. 80).

Gillwald is also critical of the narrative on innovation and creative access. She claims the success stories tend to focus on technologies, individuals, and single-company innovation. The often-isolated success stories are largely of single projects, individuals, or at best, communities. "There are few stories of successful national or regional upliftment having been achieved through the use of ICTs, despite the rhetorical commitment to this by governments in Africa" (Gillwald 2010, p. 83). In fact, she continues, "Evidence suggests that we are likely to witness more poverty alleviation through the application of ICTs in commercial endeavours than through the fabulously innovative, but still localized, ICT4D technology pilots" (Gillwald 2010, p. 86). A sobering thought indeed, albeit still stated within the economic paradigm.

Applying Amartya Sen's capability approach, which 'highlights expansions of freedoms in areas such as social and governance networks that encourage us to look beyond economic measures of development' (Sen 1999), Smith, Spence and Rashid (2011) argue that mobile phones are making contributions to capabilities and freedoms in economic, social, and governance spheres. They quote Liang (2010), who argues, "We also have to recognize that ICT technologies are a serious redistribution of the means of thought and expression" (Liang 2010, p. 67 in Smith, Spence and Rashid 2011). However, they exclude the cultural and ethical capabilities associated with mobile phones from their paper, as they claim there is insufficient data available on these aspects.

Katherine Reilly's critique of the ICT4D discourse in her essay *Designing Research for the Emerging Field of Open Development Information Technologies & International Development* (2011) is redolent of Shivji's and Green's critique of theory – or its lack – in development research. However, her arguments seek, within the emerging field of *open development*, to move on from the outdated discourse of productivity and empowerment through appropriation of technologies towards the concept of *cognitive justice.* This latter idea is that no one form of knowledge should dominate at the expense of others: different forms of knowledge should exist in dialogue with each other (van der Velden, 2005, in Reilly 2011). According to Reilly, van der Velden defines cognitive justice as 'the diversity of knowledge and the equality of knowers' (2006, p. 2 in Reilly 2011). Reilly critiques the concept of empowerment as having become instrumentalised in the development field. Although empowerment seeks to give people critical thinking skills so that they can both

learn for themselves and question the system in which they learn and thus shape it around their goals (Kabeer 1994):

> The risk is that empowerment becomes a strategy within a particular field, and thus it becomes a tool of mobilization into a perspective. When empowerment becomes a means to mobilize, it is actually disempowering, because it constructs subjects such that they can occupy a particular agenda. Empowerment is important for enabling change, but we must question its limits when it becomes part of a practice of power (Reilly 2011 p. 48).

Reilly's research framework for such development hypothesizes that all research begins with a set of 'ontological priors', i.e. a set of assumptions about our political and social reality that determine what kind of questions we ask. How we then answer those questions depends on our 'epistemological commitments', our beliefs about how knowledge can be produced. 'In turn, our epistemological commitments drive our methodological choices: how we design research and how we gather data' (Reilly 2011, p. 48). Reilly argues that in ICT4D research *ontological priors* are often either the assumption that development should enable the Global South to be inserted into the information society, or that development should empower local actors to resist the globalizing forces of the information society. Open development, she contends, should, in fact, start from the assumption that development aims to ensure cognitive justice, so that the protagonists of development can determine its direction for themselves (Reilly 2011, p. 49).

These arguments certainly raise the question of what our *ontological priors* were when setting up our research framework. I recognize, for a start, that we were motivated by discourses of empowerment, and my artist colleague Tisselli was motivated by the concept of technology appropriation. Our epistemological commitments had both positivist and interpretivist tendencies. Yet Reilly's argument overlooks the impact of the heuristic process on its 'ontological priors'. No knowing process can or does start from nothing: it starts from assumptions or hypotheses, which it seeks to verify. But the process of verification – and this is the important point here – continuously addresses those assumptions, modifies them, and will finally very often discard them. Only then is the moment or process of knowing complete. This warrants further reflection, which will be undertaken in Chapter 7. But as a conclusion to this chapter, I will give some examples of ICT4D projects.

2.5.1 Some examples of ICT4D projects

The *Howtopedia* (howtopedia.org)[17] was developed by a group of Swiss academics and offers an online, open-source platform full of practical construction, household and farming ideas that anyone with internet access can download.

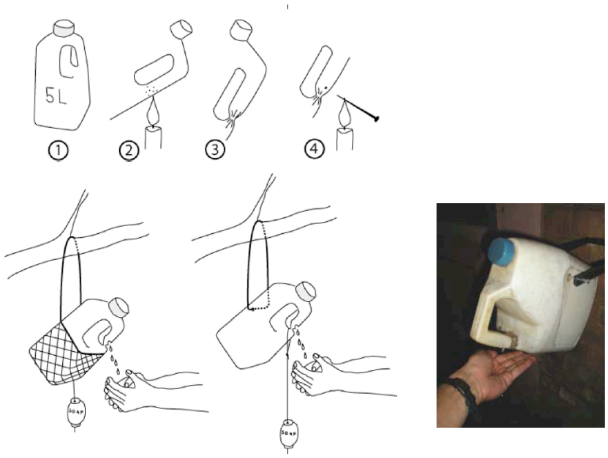


Figure 11 Example of simple instructions for low-cost gadgets and tools. Image: howtopedia.org

The Wiki has about 300 articles, from 'How to start a business' to 'How to make a wheelbarrow'. Although there are many good ideas, and the page is still technically active, the articles have not been translated into other languages, and the site has not been edited since 2011. This project seems to be a great idea which would benefit from wider distribution.

Initiated by Hendrick Knoche from the University of Lausanne, *Voices in the field* (Knoche 2011) is a proposed smartphone application, which allows farmer-to-farmer communication about crop prices and yields, biotic and abiotic crop problems, and soil moisture sensing. The perceived problem was that farmers did not have information that they could trust, and the project proposed to solve this with a network of data collectors on such information as soil moisture and ground water. This information would then be fed into crop simulation models that could result in scenario-embedded predictions such as worst, best and average case. The data would be retrieved by means of mobile phones, for which the farmers would buy an app. The app would allow speech and icons to deliver information to illiterate users.

Speech recognition technology can enable agricultural extension officers, or even communities, to create relevant data resources in a digital format – e.g. through audio wikis [10] or discussion forums – thereby extending existing mass media coverage by community radio, for example (Knoche 2011). There appear to be a number of good – albeit technically complicated – ideas here, such as connecting to radio stations, but it is not clear why the farmers would trust the mobile phone as a source of information. In a presentation in 2011 at

[17] (http://en.howtopedia.org/wiki/Main_Page accessed 21.10.15).

the ETHZ, Knoche was still in the development stage and I have not been able to establish if there are any results of the proposed field trials. Certainly nothing has been published online.

The RANET Kenya Project (www.meteo.go.ke/ranet/ accessed 21.10.15) is a series of community radio stations that function as information centres about weather, health and other development information. Each station is equipped with PCs with worldspace digital receivers and PC adaptors, allowing information to be downloaded from the internet without a service provider. Since 2001 the project has set up four radio stations and 22 information centres. Started by the African Centre of Meteorological Application for Development (ACMAD) and the University of Oklahoma in 1999, RANET is operational in Africa at different levels of involvement in different countries, and also has pilot activities in Asia and the Pacific. For instance, one project in Zambia has distributed rain gauges and mobile phones to farmers, who should send an SMS with rain data to a central collection point. This allows the system to be two-way, with the farmers contributing as well as receiving information. In a report on ICT Update, it was stated that an important part of the project strategy was to encourage local ownership of the radio station or satellite receiver. RANET never funds a project in full; locals have to find some of the funding.[18]

In a project on clean water provision in Tanzania, Google.org and UN habitat h2.0 initiative (www.h20initiative.org) funded the HUMAN SENSOR WEB (HSW 2009-2010). The goals were to inform and empower citizens through a network of monitoring stations at community wells, where citizens could monitor and report on service provision by sending an SMS about the condition of the well. On a billboard next to the well was the number to call and the geocode number of the well. The project design sequence was that this report would be verified and visualized on the project web platform, then passed on to other users (via SMS) and the service provider. In reality, there were a number of difficulties, including a mismatch between the persons who collected the water (the women) and who owned the phones (the men). This meant that the women had to remember both the phone number to text and the geocode number of the well until they got home, and until the phone was available. There was also a concern about trust in the water board, for if the phone number was not anonymous there might be repercussions. The issue of articulate as opposed to machine-readable SMS was also not resolved (Miscione 2011).

[18] (ICT Update 27.11.2006 http://ictupdate.cta.int/mobileen/Feature-Articles/RANET-Bringing-weather-services-to-remote-rural-areas accessed 21.10.15)

Figure 12 Well with billboard showing well code number and SMS number for water collectors to send information to. Photo HSW 2009 (www.h20initiative.org)

2.6 Summary

In this chapter I have attempted to draw together some of the themes I consider important for artists engaging in transdisciplinary research related to development projects. Adding to the complexities of creating new knowledge in a transdisciplinary arena are the additional layers of complexity and responsibility created by becoming involved in a postcolonial country still suffering from the neo-liberal economics of structural adjustment, and with a government suffocated by NGOs helping it onto a path of good governance. I have argued that local people need to generate their own categories, concepts and criteria for understanding and changing their lives. If the framing of research for development projects is based on pre-existing knowledge structures that separate the 'Western rational' from the 'non-Western exotic' (or 'strange'), questions arise about the role of researchers and 'other' participants, and about the appropriate mode of engagement with rural farmers. Reflection is important, but there is a danger in being overly critical of our role as researchers from the Global North: by being too self-critical of our postcolonial knowledge, we behave as if we did not have anything to offer, thus preventing dialogue and learning from arising at all. The Tanzanian people are by now well used to northern do-gooders and must be allowed credit for being able to discern which projects they would like to be involved in, and which they would prefer to leave aside. It was onto this contested ground that we brought our notions of participation from the field of participatory art and media.

The next chapter will introduce the participatory and collaborative art context and examine three examples of participatory art in a development context.

Chapter 3 Methods: *Sauti ya Wakulima* - Case Studies Chambezi and Ubungo

3.0 Chapter introduction

The aim of this chapter is to examine the case studies conducted with the methodology of *Sauti ya Wakulima*, which is Swahili for 'The Voice of the Farmers'. This is a collaborative knowledge project with small-scale farmers in Tanzania who create their own online archive of their farming practices by using mobile phones to upload images and voice recordings to a dedicated website. One project was in the Bagamoyo district of Tanzania, based at Chambezi agricultural research station, which involved rural small-holder farmers. The other project involved urban farmers in the Dar es Salaam area of Ubungo. Both projects were started at the same time in early 2011; while the Chambezi project is still running, the Ubungo project ended within the first year. The projects represented collaboration between the Swiss Federal Institute of Technology (ETHZ), with senior researcher Dr Angelika Hilbeck, and the University of Dar es Salaam, with senior researcher Dr Flora Ismail. The two PhD researchers were the present author and Eugenio Tisselli. In this chapter I will use the pronoun 'we', as the fieldwork was a joint effort. The quantitative data analysis was done with Dr Hilbeck; the transdisciplinary framing and analysis is my own work, done under Hilbeck's supervision. The project was initially funded by the North-South Centre of ETH Zurich as research for development.

3.1 Aims of case studies

As stated in the Introduction to this thesis, the research project aimed, against the background of a documented need to include farmers in research about themselves, and a need for local farmers to learn from each other,

- to bring creative participatory methods from the arts to a development context in order to facilitate social learning and farmer-led data gathering

- to apply the principles for designing a transdisciplinary research framework to an art-science research project
- to put transdisciplinary theory into practice and verify the framework as a model of transdisciplinary practice.

One of the main questions I wanted to answer when starting this research was whether a structured framework could be applied to a collaborative project, and whether the resulting data could be organized within this framework. The question could then be addressed: Exactly what kind of knowledge is produced by this type of transdisciplinary art-science research?

3.2 Context: climate change in Tanzania

With 47.7 million inhabitants (2012 census), Tanzania is one of the largest and most populous countries in East Africa; and with a GNP of USD 768 (IMF 2014), one of the poorest countries in the world. Agriculture is the dominant sector in the Tanzanian economy, employing about 80% of the population and producing 30% of the GNP. It is mostly practiced by small-scale subsistence farmers, with rain-fed crops. With its inequitable land distribution, and over-dependence on rain-fed agriculture (Gordon-Maclean 2009), Tanzania is predicted to be severely affected by climate change, which will cause recurrent droughts and inevitably bring widespread poverty. Indeed climate change is already happening in Tanzania, as an increasingly irregular rainy season affects crop success. East Africa is subject to the weather events caused by El Niño and La Niña. As the Pacific Ocean warms due to weaker trade winds there is more evaporation and El Niño causes more rainfall. La Niña events occur when winds are stronger, blowing moisture away and causing a reduction in rainfall (Gordon-Maclean 2009 p. 11). Observations of rainfall over Tanzania show statistically significant decreasing trends in annual, and June/July/August/September and March/April/May rainfall. Since 1960 annual rainfall has decreased at an average rate of 2.8mm per month (3.3%) per decade (McSweeney et al. 2010, Rowhani 2011).

Biotic and abiotic pests are also increasing as a result of the changing climate patterns. This problem was addressed in the present project by engaging farmers to document and report these issues in a format that could be accessed by their local agricultural officer and by non-local climate scientists.

Investigating capacity to adapt to and cope with consequences of climate change in Tanzania

While in the North we still speak much about the coming of socio-ecological changes due to climate change, many communities in Tanzania have been coping with climate change for many years. Adaptation is a way of reducing vulnerability, increasing resilience, moderating the risk of climate impacts on lives and livelihoods, and taking advantage of opportunities posed by actual or expected climate change wherever possible. A wealth of expertise on adapting to and coping with climate change exists already in many traditional rural communities in the developing world. However, knowledge is often isolated due to the localized nature of responses. Improving communication and knowledge transfer between vulnerable affected communities can, therefore, be a key to development.

Various approaches are being broached at development and aid organizations in Europe, such as the Institute of Development Studies (www.africaadapt.net/AA), Linking Climate Adaptation Network (www.eldis.org/go/topics/dossiers/climate-change-adaptation), and the Stockholm Environmental Institute (http://sei-international.org). In 2011 the International Institute for Environment and Development (IIED) undertook a five-nation study that stated:

> Time is running out for Tanzania to adapt. The researchers predict that impacts of climate change in Tanzania's agriculture sector will reduce the nation's total GDP by 0.6-1% by 2030. But they warn that unless there is meaningful adaptation in the sector this could rise to 5-68% by 2085 as greater climate shifts take hold and trigger a chain of impacts that spread through the economy like falling dominoes. 'If Tanzania's farmers and farming practices do not adapt, the impacts of climate change will be extreme and they will ripple through the country's entire economy as so many other sectors are dependent on agriculture,' says economist Muyeye Chambwera, who co-authored the research.[19]

3.2.1 Urban and peri-urban farming in Dar es Salaam

The importance of urban and peri-urban agriculture to the food security of over 4.3 million people can hardly be overestimated. Rural agriculture primarily supplies rural communities with food and allows for their subsistence. Due to lack of logistics for fresh food

[19] www.iied.org/five-nation-study-sheds-light-costs-adapting-agriculture-climate-change (accessed 30.10.15)

transportation and storage, rural farmers contribute little to the daily supply of fresh produce to city dwellers. They mainly provide staple crops or non-perishable foodstuffs such as maize, cassava, coconuts, oil, etc. To put this into perspective, Dar es Salaam is the largest city in Tanzania with roughly 4.36 million inhabitants (of the approx. 47.7 m total population of TZ)[20]. With a population rate increase of 4.39% annually, the city has become the third fastest-growing city in Africa and the ninth fastest in the world. The metropolitan population is expected to reach 5.12 million by 2020[21]. All the inhabitants of Dar es Salaam and suburbs are dependent on urban and peri-urban farming for their supply of fresh food (International Development Research Centre 2002).

Additionally, nearly forty percent of the total population of Dar es Salaam engages in urban agriculture either directly (through the growing of produce and rearing of livestock), or indirectly (through buying and selling at local markets), with residents working in the informal sector being more intensively engaged in urban agriculture directly and earning their livelihoods from these activities (Yonazi 2009). Urban agriculture offers an attractive livelihood to the urban poor: an urban farmer's average annual profit has been estimated at 1.6 times the annual minimum salary in Dar es Salaam (Sawio 1993).

Key challenges to urban agriculture include lack of access to land for farming, lack of access to clean water for irrigation, and limited technical assistance in areas such as pest management and marketing. The most important factor identified through assessment work conducted over the past year by the NGO Sustainable Cities International is that urban farmers lack security of land tenure on their plots. At present, it is common for such farmers to occupy open spaces without legal title of ownership, access, or use of land. Farmers face a high risk of losing their plots to make space for higher-rent land uses. There is also the threat of illegal sand mining, as many of the areas near rivers in Dar es Salaam have sandy soil. The sand is used in building and road construction for private and government projects. This insecurity inhibits farmer investment in their operations, which consequently limits their economic viability.

Urban agriculture has yet to be legitimized as formal and legal land use in any master plan for Dar es Salaam. In 2011, the Ministry of Lands, Housing, and Human Settlement Development (MLHHSD) announced its intention to create a new master plan for Dar es Salaam. In preparation for the new plan, each municipality has to develop a strategic plan for urban agriculture and demarcate zones for these activities. Sustainable Cities International has been invited by Dar es Salaam City Council (DCC) and MLHHSD to play a key role in

[20] http://data.un.org/CountryProfile.aspx?crName=United%20Republic%20of%20Tanzania (accessed 30.10.15)

[21] (www.citymayors.com/statistics/urban_growth1.html accessed 25.6.15)

facilitating the stakeholder engagement process, to provide input to the strategic plans, and to share expertise across municipalities and local farmer groups. The inclusion of urban agriculture in urban planning, so that urban agriculture is legitimized as a land use and secure land tenure arrangements are developed, is essential for the creation of integrated urban economic, social and ecological systems. Urban agriculture is an important part of poverty alleviation and can enhance food security, economic livelihoods, and the nutrition of urban populations. It is a powerful asset that can address the pressing requirements of urban societies as they struggle to find new options for forms of development that fit their needs.

3.3 Research methods – research framework set-up

The project used mixed methods from social sciences, participatory art, and participatory research for development. The first challenge was to design the research framework, which involved identifying the research questions and categorizing them according to the chosen transdisciplinary forms of knowledge. The second challenge was to write funding applications to both science and art funding bodies. The design of the research framework and the design of transdisciplinary grant applications are considered here as outcomes and further discussed in the results chapter (Chapter 4).

After a successful grant application, the field research was then carried out. This involved meetings with farmers, farm visits, a rich picture workshop, and setting the farmers up with mobile phones. Further field visits and phone trainings were done. The data collected was then sorted and coded initially after 18 months and then after 36 months. In order to 'verify the model', the results of the *Sauti* methodology were repositioned in the transdisciplinary framework according to the type of knowledge they best represented. The research methods are summarized in the table below and then described in detail in the following sections.

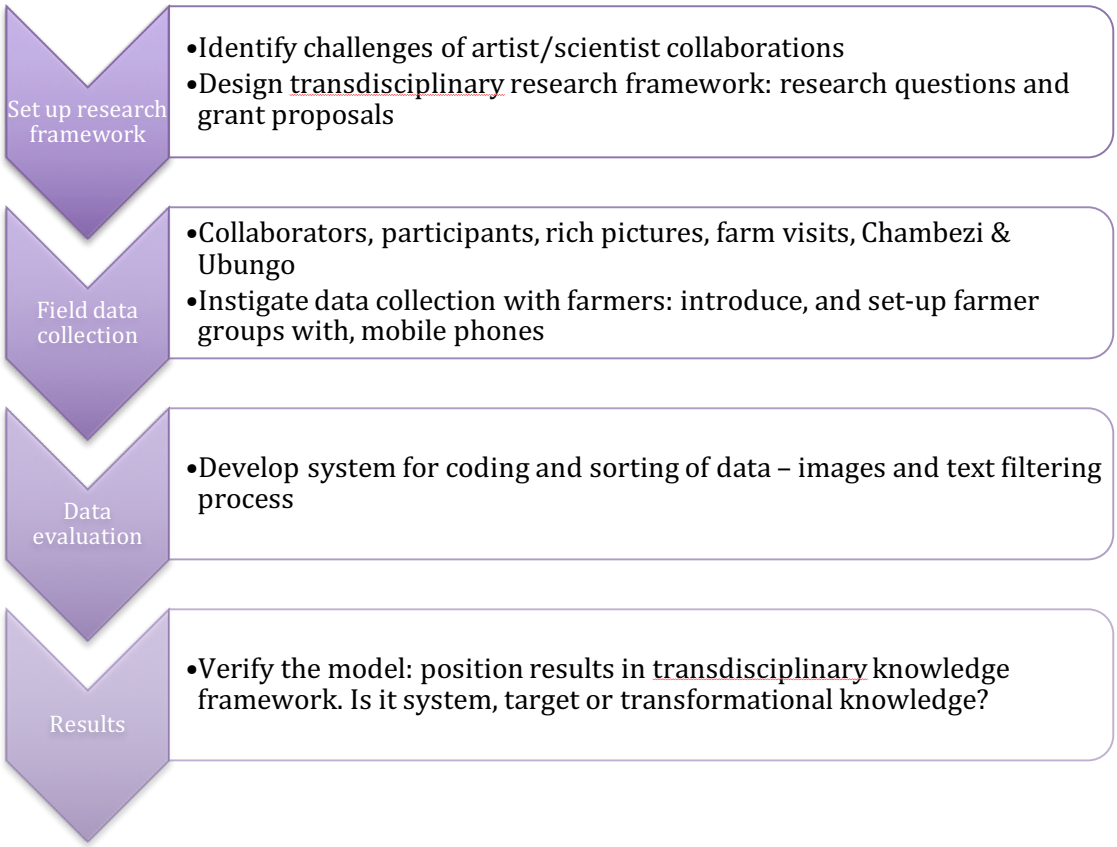


Table 1 Research procedures. Analysis J. Schläpfer 2014

3.3.1 Design transdisciplinary research framework

As outlined in Chapter 1, there is an established body of research on designing transdisciplinary research between and within scientific disciplines or between the natural and social sciences and humanities. The present project examined some of the possible structures and modes of collaboration created when the principles for designing transdisciplinary research are applied to a research design that includes artists and artistic methods. The preliminary questions asked were: What kind of knowledge and outcomes are produced? Can the data gathered by rural farmers in Tanzania be integrated into formal scientific knowledge? For example, can real-time postings inform the conception and design of research projects tailored to local conditions and needs?

Transdisciplinary research is one mode of collaboration between artists and scientists. The interest is in how researchers from different backgrounds, with different understandings of the nature of evidence, can define research questions and evolve research methods together, and present results in formats to which both (or all) subscribe. As described in the Introduction, the research questions were set up according to the transdisciplinary research framework of

Pohl and Hadorn (2007), which defined the types of transdisciplinary knowledge they might generate: systems knowledge, target knowledge or transformation knowledge.

The principles for designing transdisciplinary research were addressed in the following way:

- Principle 1: *Reduce complexity by specifying the need for knowledge and identifying the participants involved*. The need for knowledge was identified from relevant literature, together with prior Tanzanian research. Farmer participants were chosen from a cohesive group and limited to five men and five women.
- Principle 2: *Achieve effectiveness through contextualization.* Contextualization was addressed by the project being instigated on the ground, where the farmers are. It became part of their everyday life. They did not have to travel in order to participate, but if they did, the phones could go with them. We ensured that the technology functioned in the Tanzanian context. The research/development context was familiar to the farmers, as they all participate in field trials for cassava.
- Principle 3: *Achieve integration through open encounters*. The farmers had creative freedom to choose their own content to post and they could show their results to other farmers' groups.
- Principle 4: *Develop reflexivity through recursiveness (iteration).* The project was open-ended from the outset, and postings have continued to date for nearly five years and are still ongoing. Regular weekly meetings take place between the farmers and the agricultural officer at the research station. Repeated visits have been made by researchers. Data was analysed after 18 months and again after three years.

3.3.1.1 Research questions

Research questions were defined according to the type of knowledge they addressed.

- *Systems knowledge*: Are the Tanzanian farmers already affected by climate change? How are they adapting to possible changes in climate? How are their farming practices currently represented to the outside world? How do they share information about farming practices?
- *Target knowledge*: How can a participatory mobile phone project strengthen the community and instigate social learning? How can a community archive assist farmers' communication with local authorities – here in the person of the agricultural extension officer? Who benefits most from the project?

- *Transformation knowledge:* Can this type of data gathering inform natural sciences? Can a mobile phone project contribute to the processes of agricultural field trials such as the participatory breeding of cassava?

3.3.1.2 Transdisciplinary grant applications

In total, three project proposals were written. The first, by Schläpfer and Hilbeck, was an application to KFH (Rectors' Conference of the Swiss Universities of Applied Sciences), where the call was for transdisciplinary research and "mutual learning" for development projects. We proposed a *Creative Research Exchange: Communication of coping and adaptation strategies for climate change in tropical regions in East Africa*, to work with teachers and community groups on developing teaching materials for learning about climate change. The initial concept was inspired by projects such as the Swiss artists-in-labs, and we wanted to extend their collaborative ideas and have artists and scientists design the research questions together. There is considerable literature calling for trans- or interdisciplinary research involving science and humanities. Some of this literature has been reviewed in Chapter 1.

The second project proposal and grant application to the Swiss Development Corporation (SDC) (see Appendix) was informed by the principles for designing a transdisciplinary research framework as outlined above.

We were interested in seeing if these principles could be usefully applied to transdisciplinary art and science research – which tools are useful and which don't apply, or perhaps need to be underpinned with methods from the arts.

The project was funded by the ETH North-South Centre until mid 2011, after which it received continued support at a low level from a Swiss-based development organisation (Bread for All) until the end of 2014. By the end of 2014, the project had expanded to Kenya, and the Kenyan part of the *Sauti* methodology has now become an integral component of the mode of operation of the Kenya-based NGO Growth Partners Africa, which promotes agroecological production methods and trains smallholder farmers in their practice in Kenya. The Tanzanian part of the project is now self-funded by the farmers and by voluntary contributions.

Four transdisciplinary grant applications were made. These can be viewed as an aspect of the research methods and procedures, but I also consider them to be outcomes of the Ph.D. research. I will now outline them in more detail.

The first application was in May 2010 to the Federation of Swiss Universities of Applied Sciences. The title was *Creative Research Exchange: Communication of coping and adaptation strategies for climate change in tropical regions in East Africa - Project proposal for co-financing request from the KFH under the promotion of research partnerships between Swiss Universities of Applied Sciences and Developing and Transition Countries.* For a PDF of the application, please see Appendix. We first submitted a concept note and were then selected as one of 25 projects to submit a full proposal. It was submitted as a preliminary research project with the following aims:

- to engage with a group of Tanzanian farmers to create a web-based platform/database where local knowledge, storytelling and ideas about adapting to climate change can be shared not only with other rural groups but also with development projects and climate scientists
- to build on proven methodologies of participatory design and content creation (images, interviews) and propose adaptations for the Tanzanian situation
- to establish what can be done with technology people already possess (e.g. simple mobile phones) or a basic upgrade so that costs are minimal and the project truly sustainable
- to establish connections with other multi-media climate-change adaptation projects with the goal of linking data from their projects onto one platform to promote sustainability of disparate projects
- to participate in the best-practice dialogue started by UNDP, which recently published an adaptation guidance tool, *A Toolkit for Designing Climate Change Adaptation Initiative*[22]
- to create a proposal for a long-term research project including an expanding database of adaptation stories which could be useful for climate scientists.

The proposal narrowly missed selection for funding. Therefore a second, amended research proposal was submitted in October 2011, again initially as a concept note to the KFH. This time we included the urban farmers as a separate project. The project title was: *To develop a sustainability concept and build networking capacity for multi-media data gathering for citizen data collection on food growing and adaptation measures to climate change already being undertaken by farmers and urban food growers.* The proposal was rejected as being insufficiently scientific.

[22] http://africa-adapt.net/AA/Uploads/Resources/3f3f18d918d946f8b246034343e31591_CSDI.CollaborativeChange.pdf

A third application with the same concept as for the KFH was submitted to the North-South Centre of the ETH Zurich and received funding in December 2010.

The fourth grant application was a concept note submitted to the Swiss Development Corporation in May 2011, specifically to expand the urban farmers project. For this purpose we joined with an NGO, the Tanzanian Food Garden Network. The main objective of the project was to facilitate the legitimization of UA as a secure land use in Dar es Salaam, and thus ultimately to contribute to increasing economic, social and environmental benefits from UA. This would be achieved through

- documentation and quantification of the contribution of urban and peri-urban informal food production to total food security of the greater Dar region
- facilitation of the creation of a system of land access and land tenure for urban farmers
- organisation of urban farmers by formally establishing the Tanzanian Food Gardening Network and building its internal capacity
- demonstration of land tenure and land access arrangements through the implementation of pilot projects
- facilitation of capacity-building efforts among stakeholders.

The main activities were:

- training farmers in use of multimedia mobile phones to create an audiovisual database with site and production map of UA
- facilitating dialogue and feedback from stakeholders during municipal plan and master plan development
- facilitating municipalities to develop strategies to secure land tenure and land access for farmers in areas zoned for UA
- investigating precarious food safety status and production bottlenecks in vegetable production, and identifying areas for intervention.

The application was rejected without feedback, as there were over 120 applications, so we were not able to evaluate the grounds for rejection. Yet it is a good example of how our transdisciplinary grant applications became increasingly more integrated as we proceeded. This concept note to the SDC combined the disciplinary skills of artists and scientists and was locally driven via the Tanzanian Food Garden Network and the researchers at the University of Dar es Salaam. I still believe it has merit and could be pursued.

3.4 Field data collection

The mobile-phone-based methodology used in the *Sauti ya Wakulima* project was developed by Eugenio Tisselli and is described in the following text box:

The Methodology of *Enabling Reciprocal Voice* (ERV) used in *Sauti ya Wakulima*

This section describes the methodology developed by Eugenio Tisselli which was applied in the *Sauti ya Wakulima* project. It is a methodology to create enabling environments for reciprocal voice by transforming modes of usage of mobile phones and the Internet. It stems from the *megaphone* project created by Antoni Abad and Tisselli 2004-2010 (www.megaphone.net), which they applied to communities of motorcycle delivery boys in Rio de Janiero, wheelchair users in Barcelona, and Sahrawi refugees in a long-term refugee camp in Tindouf, Algeria. From 2011 onwards Tisselli reprogrammed the app and developed the methodology.

The main aims of ERV methodology are:

- to help a group establish a shared communication praxis through which the voices of its members can be heard, and
- to strengthen reciprocal relations within the group.

ERV Methodology is intended to be applied to groups that are at risk of social exclusion, enabling them to project their *voices,* and express their views, aspirations and needs. The methodology seeks to transform the modes of usage of the communications technologies involved in it. It pursues the strengthening of reciprocity by challenging the individualistic values inscribed in mobile phones and transforming them into communal devices within each particular social and cultural context.

Technological components of the ERV Methodology: Mobile app ojoVoz

Smartphones are the key technological component of ERV methodology. By using smartphones, participants can send messages to a shared web-based platform. These messages are composed using a mobile app (called *ojoVoz*) for the Android operating system specifically developed for that purpose. The app allows participants to easily compose and send messages consisting of the following elements:

- a picture taken with the smartphone camera
- a voice clip recorded with the smartphone microphone
- a keyword, or *tag*, chosen from a list or typed using the smartphone keyboard
- a geographical location corresponding to the place where the message was composed
- this location consists of latitude and longitude values, obtained automatically by the built-in smartphone GPS.

Once a message has been composed, the application allows participants to send it to a shared web platform immediately or at a later time.

Web platform

The messages composed and published using ojoVoz can be browsed on a web-based platform which, by default, is openly accessible to the public. This platform allows users to browse through messages under different criteria: date, keyword or geographical location, or a combination of these filters. The web platform also allows users to comment and provide feedback to published messages. Registered users may edit and delete messages, and perform general housekeeping tasks.

Many thanks to Eugenio for providing the information for this text. This methodology is fully described in Eugenio Tisselli's PhD thesis: *Reciprocal Technologies: Enabling the Reciprocal Exchange of Voice in Small-Scale Farming Communities through the Transformation of Information and Communications Technologies,* submitted to the University of Plymouth in 2015.

3.4.1 Collaborators

The scientific and artistic collaboration began with Juanita Schläpfer (author, artist and science communicator) and Dr Angelika Hilbeck (agroecologist and entomologist), who proposed a research for development project about communicating climate change in Tanzania. Professor Flora Ismail, Head of the Botany Department of the University of Dar es Salaam was chosen as the first collaborator, as she had previously collaborated successfully with Hilbeck. Professor Ismail had conducted field trials of drought-resistant cassava and tomatoes, working with farmers and a research station in the Bagamoyo district of Tanzania. She had a good working relationship with a community of farmers and was perceived by Hilbeck as someone who would likely be open to collaboration with artists. The second collaborator to be chosen was Eugenio Tisselli, a programmer and artist who had recently joined the Z-Node program at Zurich University of the Arts (ZHdK) and had prior experience in the development of mobile phones as community communication devices.

Modes of collaboration between artists and scientists

The chosen mode of collaboration was to design research questions together as a transdisciplinary team. In doing so, we aimed to apply established principles for designing a transdisciplinary research framework to an art-science research project that addressed a real-life problem. The principles of our collaboration – outlined in the Introduction to the thesis – were:

- to agree on participatory methodologies (rich picture drawing workshop, use of mobile phones for data gathering, interviews with participants)
- to evaluate the material from the perspectives of two value systems, the artistic and the scientific
- to write a joint paper elaborating on methodology, and
- to create joint synthesising conclusions.

We wanted to present the results both as a published scientific paper and as films, and the community archive itself as project documentation. I am interested in the collaborative process, with artists, scientists and farmers engaging in mutual and social learning. I was also concerned with the perceived value of the farmers' data gathering, and wanted to implement calls for full integration of local knowledge in scientific studies. I wanted to know if the farmers' data-gathering process could contribute to social learning among the farmers and between farmers and other actors. Tisselli is interested in the appropriation of technology by social groups, how they tag and classify their images and video and create a folksonomy. We

were both interested in how the creative freedom afforded to the farmers motivated them to participate and to continue – to this day – the work of creating a community archive of their lives.

3.4.2 Participants

The main local collaborators were the farmers and the agricultural extension officer Mr Hamza Suleyman. The farmers were an already existing group which regularly met at the agricultural research station and were all part of the University of Dar es Salaam's field trials. There were thirty farmers in the first meeting who all participated in the preliminary discussion, and voted on whether to participate in the research project and rich-picture workshop. Ten of these, five men and five women were later chosen to be in the mobile-phone project. Mr Hamza chose the participants on the principle of having representatives from each village.

The farmers were to report on how climate change was affecting their farming by taking images, video, tagging and sound recording with the mobile phones and sending these to the project website with the app designed by Tisselli. Their participation was (is) voluntary and not remunerated. Mr Hamza receives a small stipend for coordinating the project. A further actor is the local council in Bagamoyo, which has taken over the mobile phone costs, allowing the project to be sustainable.

3.4.3 Field study procedures

1. The transdisciplinary research questions were implemented and the field study procedures were informed by methods from participatory research for development and soft systems analysis.
2. Collaborators in Tanzania were identified.
3. The farmers from Bagamoyo, Tanzania were identified as the partner group by the University of Dar es Salaam (UDSM), which works with them on a continuous basis through a farmer school and agricultural research station – Chambezi Research Station.
4. An assessment was made of the technical feasibility of the mobile phone part of the project (Eugenio Tisselli).

5. A meeting was held with faculty and students from the Department of Botany, UDSM.
6. A meeting of the farmers was arranged at the research station. Thirty farmers were invited, (gender balanced) and the project was introduced, documented with video.
7. Following the project introduction, a non-verbal participatory assessment of the farmers' problems relating to climate change was made using Rich Pictures, a method from soft systems analysis (explained below).
8. Seven farm visits were made by the team and local agricultural extension officer. Farmers were interviewed about their perception and experience of recent climate change. The visits were photographed and documented with video.
9. At each visit the farmers were shown how to use the mobile phone and given the chance to take a picture and upload it.
10. A project mobile phone was given to the agricultural coordinator in Bagamoyo with further instructions and a follow-up visit the following week.
11. A visit was made with a botanist from UDSM to an urban agriculture site in Dar es Salaam and to the District Agriculture Office.
12. A list of scientific parameters for a possible joint study was drafted with UDSM.
13. Further activities after the first field trip included: securing donation of laptops (UBS), contacting potential on-site partners (the NGO 'Sustainable Cities') attempting to solve map resolution problem (Google). Preparation for Africa Adapt Symposium, Addis Ababa.
14. Project was presented by Schläpfer and Tisselli at *Africa Adapts to Climate Change Symposium*, Addis Ababa, Ethiopia.
15. Second field trip to Tanzania, training for farmers and meeting with urban farmers in Dar es Salaam.
16. A second project proposal was written incorporating principles of transdisciplinary research as defined by Pohl and Hadorn.
17. Analysis of 10 months' data from farmers.
18. Writing and submission of report and journal paper published.
19. Farmers received copy of report and feedback.

3.4.3.1 Rich Picture Workshop Methodology

After the initial introduction to the project the farmers were offered a participatory drawing workshop based on the Rich Picture process, which is from the Soft Systems Methodology

developed by Peter Checkland (1981). Rich Pictures are drawings, sketches or doodles that have no definite syntax and can be done as a group in order to develop a shared understanding of a complex or ill-defined problem. The drawings should include a representation of the participants, structures and systems surrounding a complex issue. According to Monk and Howard (1998):

> The finished picture may be of value to other stakeholders of the problem being described since it is likely to capture many different facets of the situation, but the real value of this technique is the way it forces the creator to think deeply about the problem and understand it well enough to express it pictorially (a process known as Action Learning).

In the theory of action learning developed by Revans (1980), humans generate knowledge and meaning from an interaction between their experience and their ideas. Noë (2004) argues that pictures are not just objects of perception but that the process of picture making is an enactment of experience. This overall argumentation justifies the workshop, whose aim was to encourage visual thinking about farming and climate change and to develop a shared understanding of these complex issues within the farmer group – or, to put it differently, to encourage reflection about adaptation to climate change that was more profound than brainstorming and writing lists of words, another often-used method (Chambers 2010).

The first set of tags for the mobile phones was created from the list of issues which ensued (see Chapter 4, Results). This methodology was chosen because it is non-verbal and encourages participants to think about the issues at hand on a deeper level. The farmers were shown an example of a Rich Picture and encouraged to include themselves and the structures and systems which are part of their farming practice in the pictures. Paper and coloured pens were distributed and the participants divided themselves into groups of three, four or five and worked on one A3 sheet in each group. After 45 minutes a representative of each group showed the drawing to the others and explained what they had drawn. This was translated by the botanist from UDSM.

3.4.3.2 Farm visits near Chambezi, Bagamoyo

In January 2011, we (Schläpfer, Tisselli and Hilbeck) travelled for the first time to Tanzania to conduct a series of interviews with farmers living near the town of Bagamoyo, with the purpose of engaging them in the creation of an online, collaborative knowledge base about the effects of climate change, using smartphones as tools for observation and a web page to

gather the recorded images and sounds. Accompanied by Dr Flora Ismail from the Botany department of the University of Dar es Salaam, and Mr Hamza S. Suleyman, the local agricultural extension officer, we met a group of farmers who regularly gather at Chambezi Agricultural Station, explained the purpose of the project, and asked them if they were willing to participate. Although none of them had accessed the internet before, they had all heard of it, largely through their children. They quickly understood that the images and sounds uploaded from the smartphones would be visible not only to them, but to anyone who visited the project's web page. After deliberating, the farmers voted unanimously in favour of taking part.

After the initial meeting, we visited the participating farmers. These visits to their farms had two purposes: to assess the project's technical feasibility and the farmers' level of familiarity with mobile technologies, and to learn about their observations on change of weather patterns and climate and its effects on their crops. We chose the Nokia 6110 Navigator smartphone because of its multimedia capabilities, small size and relatively low price. This phone also includes a GPS module, which would make it possible to integrate geographical information. During the visits, we found out that access to the GPRS18 mobile network was robust enough on the farms to send multimedia messages via email from the smartphone. Most of the farmers we met owned at least one basic GSM mobile phone. However, they were not familiar with smartphones or the internet.

Second field trip

During our (Schläpfer & Tisselli) second visit in March 2011, we established the project's dynamics together with the farmers, and carried out the first training session on how to use the smartphone and the project web page. A group of five men and five women chosen by the community would take turns to share the two available smartphones, exchanging them on a weekly basis. When a farmer's turn to use the phone came round, he or she would have the task of using it to contribute contents to the knowledge base. These contents consist of units, which we call messages or 'posts', comprising a picture, a voice recording and an optional keyword. A special application running on the smartphones makes it easy to capture the multimedia elements. It also integrates geographical information into the message, if available, allows the addition of one or more keywords, and sends all the elements to a web server, bundled together as an email message. By using pictures and voice recordings, farmers can portray a wide variety of objects, situations and persons, and complement visual evidence with their own spoken narrations.

Adding keywords to audiovisual contents is a bottom-up form of sense-making, also known as tagging. Initially, the farmers agreed on a set of fixed keywords (or tags) that would guide their process of documentation. They chose the names of their main crops: amaranth, cassava, coconut, cowpeas, maize, mango, okra, orange, papaya, rice, sesame, sweet potato, tomato and watermelon. All of these tags appear on a multiple-choice list on the phones. However, the application allows farmers to enter a new tag whenever necessary. Finally, geographical information enriches the multimedia messages by locating them on a satellite map of the area.

Farmers got together not only to exchange the phones but also to see and discuss the pictures and voice recordings that the group had uploaded during the week. There, they accessed the project web page, using a laptop computer with a mobile broadband connection. The design of the web page is simple and straightforward, making it easy to navigate. Pictures and sounds can be browsed by date, or by clicking on one of the tags which appear on the tag cloud on top of the page (Figure 13). The tag cloud acts as a search interface, and represents the project's folksonomy, the aggregation of the tags used by farmers to describe each message. Additionally, clicking on a picture will show the exact location where it was taken, on a satellite map provided by Google Maps.

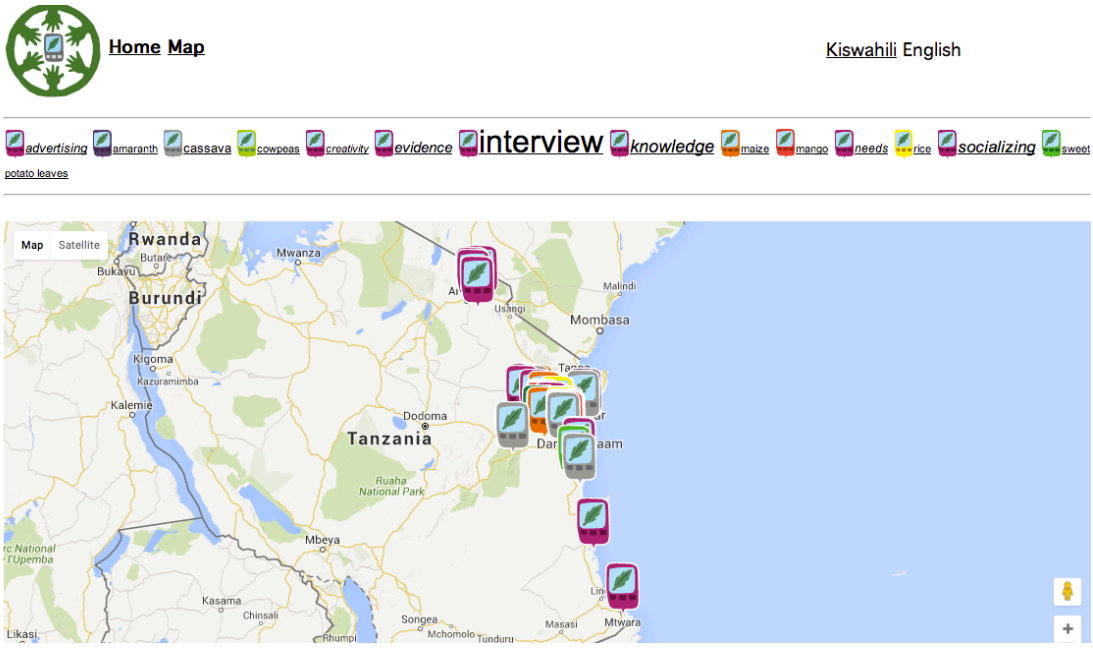


Figure 13 Screen shot from sautiyawakulima.net, showing tag cloud and location of posts on the map. (30.10.15)

3.4.3.3 Urban-farmers – Ubungo, Dar es Salaam

During the second field trip we also met farmers who farm within the city limits of Dar es Salaam. These farmers are migrants from the countryside, who for the most part grow green vegetables on land owned by the government water board. They are technically illegal (squatters) and their vegetables are 'illegal', as they are watered with the unsanitary water sources of local rivers. These conditions mean that they have no land security (although some had been there for 20 years). Moreover, because their vegetables are illegal they are not allowed to sell them openly at the vegetable markets and have to sell between midnight and 2am to wholesalers. Because they are unlicensed, the prices they receive are correspondingly low. It was not, in our brief encounter, possible to establish exactly what their daily income was, but Nymora (2005) estimated it as around 1-2 U.S. dollars per day. This corresponds to Stefan Dongus et al. 2006, who estimated net monthly income for an urban farmer in Dar es Salaam as $60 per month. (I noticed that they did not drink the bottled drinks we had brought, but rather took them away with them, along with the newspaper sheets we had passed out to rest the white drawing paper on, which they carefully folded to take away.)

Despite their perilous status, with no land security and very low income (Dongus and Drechsel 2010), urban and peri-urban farmers in Dar es Salaam supply 90% of the fresh green vegetables to a city of four million inhabitants. (Tanzanians eat fresh greens such as spinach, cassava leaves, pumpkin and sweet potato leaves every day. The tough or hairy leaves are pounded and cooked with onions; the result is both nutritious and delicious.) There is very little refrigerated transport in Tanzania, so logistics require that perishable greens be grown near markets.

Dr Agnes Nymora, a horticulturalist from the University of Dar es Salaam and the city Agricultural Outreach Officer, a dedicated woman who had around 500 farmers on her round, arranged the meeting. Unlike the agricultural officer in Bagamoyo, she did not meet with the farmers as a group, but went round to see them individually and give advice. Even though Agnes had told them we were a research group, the farmers thought we were from an NGO and had written up a list of equipment and tools they wanted, including a choice of brands of water pump depending on how much money was available (they spend an average of five hours a day carrying water).

We met with the farmers at the edge of their plots, and sat on tree stumps in the shade. We had discussed with Agnes the idea of doing the Rich Picture workshop as in Bagamoyo, but she was uncomfortable with this. It was unclear why, so we decided just to have a discussion with the farmers about the major issues facing them as urban farmers. They could then write

down on paper a priority list of issues. They worked individually or in pairs, and Agnes collated the lists. Climate change did not appear on any list. (Access to clean water, land security problems – due to development or illegal sand mining – and legal access to markets to gain fair prices were the top three issues.) We informed them about the mobile phone project in Bagamoyo and asked if they would like to be involved in a similar project. There was agreement about joining the project, but there was angry disagreement about which groups should get one of the two phones; in the end it was decided by geography – one group from either side of the stream. The phones were left with the farmers in waterproof boxes with spare batteries. The farmers agreed to meet and exchange the phones every two weeks. Despite receiving the same level of instruction as for the rural farmers, the urban farmers did not post images with the same frequency, skill or enthusiasm as the farmers from Bagamoyo. By the time of our second visit to them, one of the phones (and groups) had disappeared. On our third visit Tisselli took the second phone back, as it was reportedly faulty, and the project duly collapsed. The reasons for the failure of this part of the project will be discussed in the results chapter.

Further field trips

At the end of May 2011, we (Tisselli) made our third visit to Chambezi. We provided further technical training to the farmers in order to strengthen their mobile and internet skills. We also suggested to the group that they use the phones for interviewing other farmers; it transpired that they had already started to do this of their own accord. A new tag was introduced: *interview*, which later became the project's most frequently used item. In fact the farmers began a very active period of interviews that reached three important peaks of activity in the agricultural shows at Morogoro in August, Bagamoyo in September and Dar es Salaam in October. On our fourth visit in September (Tisselli), we concluded the first phase of *Sauti ya wakulima* by interviewing the participating farmers, in order to make a first impact assessment and learn about their views on the project's usefulness, and their suggestions for improving it.

In a visit in Spring 2012 Hilbeck reported results back to the farmers and got their feedback about the continuation of the project. The farmers reported that they wished to carry on with the project and that they had found a way to cover the costs of uploading data.

3.5 Data evaluation methods - *Sauti*

Due to the heterogeneous nature of transdisciplinary research projects, The *Principles for designing transdisciplinary research* do not include suggestions for data evaluation. I therefore looked to ethnographic methods (O'Reilly 2012) and 'grounded theory' as developed by Barney Glaser and Anselm Strauss in 1967 for how to interact with the data of the farmers' postings. Kathy Charmaz and Richard Mitchell (2001) describe the use of grounded theory in ethnography as allowing ethnographers to interact with their data, not just their subjects. Rather than applying concepts from earlier work to the data, the analysis begins with coding but becomes iterative as more codes arise during the process. It is an emergent process which highlights the importance of an appreciation and knowledge of context – 'a sensitivity to unstated and unrecognized meanings and an awareness of layers of meaning in language' (Charmaz and Mitchell 2001, p. 165). I understand the application of grounded theory in ethnography as outlined by Charmaz and Richard Mitchell to be compatible with the *Principles for designing transdisciplinary research*. Indeed, the two areas seem to share values and there are semantic similarities in the way these are stated.

Methods of analysis

From January 2011 until April 2014 the farmers in Bagamoyo posted over 2625 tagged photos, mostly with audio recordings. This created an iterative process, as suggested by transdisciplinary methodology and grounded theory, as well as by a methodology carried out by researchers in the field of visual anthropology, which proceeds from an overview of photographic material to a case-by-case analysis supported by an informant's oral or written description (Collier and Collier 1986). The data was analyzed after 10 months and then again after 36 months, at which point the coding categories changed slightly and the questions became more specific. In the second round of analysis we looked specifically at one crop, cassava, as it is a staple crop and its success or failure depends on the occurrence of the short rainy season. There is some evidence that the loss of this rain period is the most apparent change in the weather pattern. Another reason for focusing on cassava was that many of the farmers are involved in field trials for a participatory breeding project. We also counted the total numbers of mentions of climate change. This second data analysis was at the same time a response to the collaborative process, as Hilbeck and Tisselli wanted a more scientific analysis of the data so that the project had better chances of obtaining funding from science funding bodies.

3.5.1 Methods of analysis of agricultural content of audio-image postings for the first analysis after 10 months – 400 posts by the farmers

The farmers posted a tagged image to the website. They could also record an audio track which would be viewable under the photo. A master's student in agronomy from Tanzania translated the Swahili audio track into English. Her transcript text was then viewable as text in English under the audio track and image (see Image 1 below). All translated audio/image postings (a sub-set of total postings) were organized in an Excel spreadsheet along the time axis of the posting dates with the evaluation criteria spread across. The evaluation was based on agro-environmental criteria: healthy plants or crop plants affected by various biotic and abiotic factors; disease and pests (biotic); drought and floods (abiotic); and other. All translated audio material was provided in the last column of the spreadsheet in full (see Annex). Through this organization of the spreadsheet it was possible to see the time and location of the particular reported events. A further colour coding of the entries allowed for quick visual evaluation regarding the prime content of the audio messages: red for biotic and abiotic problems, blue for advertisement of products, and green for advice and learning/teaching.

Figure 14 Example of farmers' posts. Screen-shot sautiyawakulima.net 19.3.12

3.5.2 Method for second round of analysis after 36 months of data collection – 2625 posts by the farmers

I. The audio was translated by a Tanzanian agronomist and transcribed in English under the photo, on the website. The metadata (tag, date and time) and the transcription were extracted from the database into an Excel file.

II. Each of the 2625 posts' tags were looked at to see if the post had been tagged for cassava, climate change, drought, floods or pests. The text was also checked for mentions of these.

A filtering process

A coding system was developed in collaboration with Dr Angelika Hilbeck. The data analysis was carried out by myself and verified by Hilbeck, who checked a portion of the data.

The coding categories were:

- cassava tag (is tag cassava?)
- cassava x pests (cross referencing)
- cassava x virus
- cassava x drought
- cassava x flood
- cassava harvest positive comment
- cassava harvest negative comment
- cassava planting change
- cassava research/innovation
- rain (positive)
- drought
- floods
- climate change adaptation
- Is the image cassava?
- date of image
- actual tag
- translated and transcribed audio.

III. Any post that did not have a value in one of these categories was then eliminated, leaving a set of 336 posts for further analysis.

IV. The photos of all posts tagged "cassava" were checked to see if they actually were cassava.

V. The filtered-out set of 336 images, where the text mentioned climate change or pests and diseases, was examined and analysed for content image match and how the images might contribute to creating a bigger context of the situation for farmers in the Bagamoyo region.

VI. Graphs were then created, comparing the incidences of mentions of drought, floods or pests to weather data over time to see what the correlation might be.

VII. The photos were analysed with their texts referring back to the research questions and what type of transdisciplinary knowledge they might indicate.

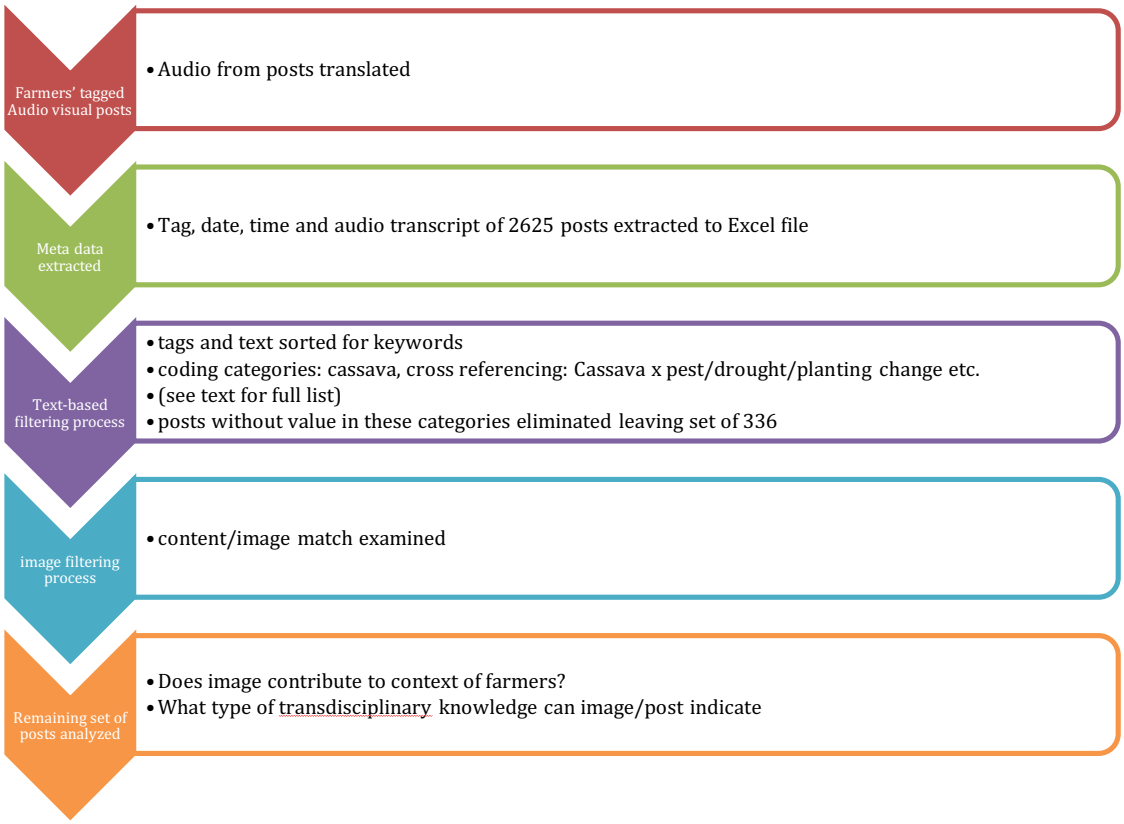


Table 2 Flow chart of filtering process of farmers' audio-visual posts. Analysis J. Schläpfer

Quantitative analysis of farmers' posts after 36 months

In an attempt to answer the question posed by the transformation knowledge research question *How can creative participatory data gathering be integrated into formal scientific knowledge?* the data was analysed in a quantitative way using a text-based filtering process

and focusing on posts where the content or image was about cassava or climate change. The focus was on cassava, because it is a staple crop and its growing cycle depends on both the short and the long rainy seasons. The farmers claim that the short rains now regularly fail as a result of climate change.

As described above, the posts were first analyzed using a text-based filtering process:

- tag, date, time and audio transcript of 2625 posts extracted to Excel file
- tags and text sorted for keywords
- coding categories: cassava, cross referencing: cassava x pest/drought/flood, planting change or adaptation to, or mention of, climate change
- posts without value in these categories eliminated leaving set of 336
- all 336 images were examined to see what the correlation was between image, tag and text
- a set of 132 posts was selected where the tag was cassava, or cassava was mentioned in the text, and/or the image was cassava (or farmers meeting about cassava).
- on closer examination of this data set, 90 were tagged cassava; 43 of these were tagged correctly as cassava (image match), and in 47 the image was of something else
- 42 had image cassava and text cassava but no tag cassava.

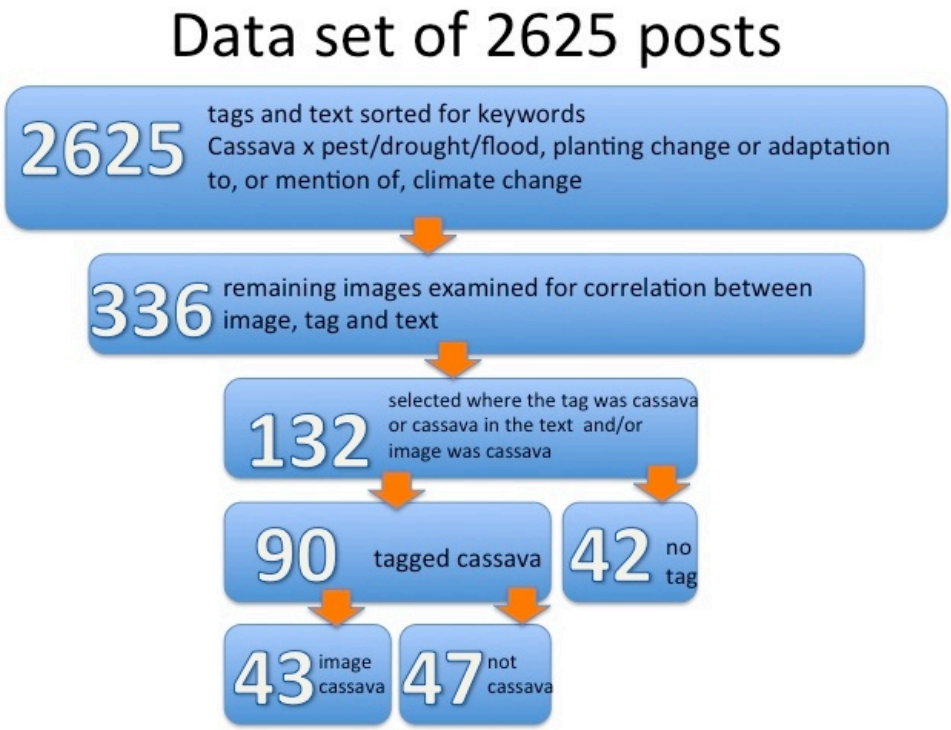


Table 3 Schematic of filtering process for posts. Analysis J. Schläpfer 2014

Objectives for interpretation of results

1. To evaluate if this is a suitable method of data gathering to answer any of the following questions:

- How were the farmers adapting to climate change?
- How was their production of cassava affected by changing weather patterns?
- Was there a correlation between reporting of biotic and abiotic factors and actual weather data?
- Were the farmers correctly tagging their posts so that the themes could be found?

2. Is it possible to sort the results in a way that captures their richness but filters out *noise*?

3. To categorize the results according to the categories of systems, transformation or target knowledge set out in the design of the research questions.

The methods of analysis, which have been described in this chapter, resulted in two related layers of results. The results of the analysis from the filtering process are presented in a set of graphs and tables. In order to address the question as to what kind of transdisciplinary knowledge was generated, these results, as well as a selection of the farmers' images, will be repositioned in Chapter 4 within the framework of the three types of knowledge defined by Pohl and Hadorn (see above and Introduction). The outcome will be analysed and discussed in the Conclusion.

Chapter 4: Results of research design process and Tanzanian fieldwork

This chapter presents the results of the *Sauti ya Wakulima* case study, covering both the rural farmers at Chambezi and the urban farmers in Ubungo. The first part of the chapter considers the results of the field work – Rich Picture workshop and farm visits. The second part returns to the transdisciplinary research framework and seeks to validate the model by repositioning the results of the *Sauti* data analysis within the transdisciplinary knowledge categories of systems, target and transformation knowledge. The conclusion discusses the potential of the framework as a model for designing, evaluating and assessing transdisciplinary art-science. Two questions arise here:

- Does the received transdisciplinary research framework adequately describe the new knowledge produced by transdisciplinary art-science research?
- Do the categories of knowledge posited by that framework require expanding?

4.1 Rich Picture workshop

As described in the methods (Chapter 3), we engaged the farmers in a 'rich pictures' workshop. Rich Pictures is a method from Soft Systems analysis (Checkland 1981) that can help identify complex problems. We chose this method partly as a solution to language difficulties and partly because we wanted to use open methods and provide the farmers with an opportunity to think about farming and climate change as a complex web of interacting issues. It has been stated of this methodology that the greatest benefit of Rich Pictures is gained by the participants (Monk and Howard 1998). This methodology appealed to me as an artist, as my perception is often closely linked to drawing or non-verbal representation. The literature also indicated that this method had been successfully used in a development context with groups from different cultural backgrounds (Chambers 2010). It enabled farmers to understand and reflect on perceived changes in weather patterns. They provided narratives of the observed changes, with seven drawings produced by six groups, four of which were mixed; one was all male and one all female. The pictures varied from quite detailed maps with a key to the pictograms used (Fig 15 & 17) to very simple representation of a dark cloud and crops (Fig 16).

Figure 15 **Chickens, mango trees and maize plants drying for lack of rain. Rich Picture from Farmer group 1, Chambezi 2011.**

Figure 16 **There is a black cloud but it is bringing little rain. There is a key to show the parts of the drawing. Rich Picture from Farmer group 2, Chambezi 2011.**

Figure 17 The big plants are cassava; those on the left have rain and are healthy; those on the right have a red sun and no rain, and the black roots show the tubers when they are affected by virus. The red insects are Batu-batu (whitefly). Rich Picture from Farmer group 3, Chambezi 2011.

Five out of the six groups mentioned that there had been a change in the short rainy season in recent years (3-6). Specifically, the usual dark clouds would come and so they would plant cassava (cuttings), and then the winds would change and blow the cloud away and it would not rain, often causing the loss of that planting. This phenomenon was confirmed in the farm visits on the following day, when one farmer told us he planted cassava five times, and each time the winds blew the rain away so he planted cowpeas instead.

Two drawings had images of insect pests (batu-batu)[23] and two showed details of cassava tubers with black or brown patches, indicating rot from cassava mosaic virus. A repeated image was rain and healthy crops and next to that a red-hot sun and dried crops. There was no mention of flooding. The drawings showed common concerns across the groups of the relationship between pests, diseases on crops and the weather conditions. In Figure 17, the diseased plant had black roots and whiteflies on top. While it is not clear whether the farmers recognized a causal relationship between the two, they did correctly observe their coinciding appearance and the lack of both factors with the healthy plants. Clearly, they did see a connection to the rains or rather the lack thereof and the pest-disease co-occurrence. These were the primary focus of the drawings and not social systems such as markets or storage

[23] The Swahili for insect is wadudu or mdudu, but these farmers used batu-batu for whitefly.

problems, both of which issues also arose during the farm visits and later in the message postings.

Figure 18 Drawing with a big black cloud covering the sun. At the bottom there is a key to show what the drawings mean. Rich Picture from Farmer group 4, Chambezi 2011.

Figure 19 Rich Picture workshop at Chambezi Agricultural Research Station; farmers divided themselves into groups. Photo: J.Schläpfer, Chambezi, Tanzania 2011.

Figure 20 Sharing results with the whole group – the farmers are aware of gender politics and sang for the "mama" to come up and talk. Photo: J.Schläpfer, Chambezi, Tanzania 2011.

Results of Rich Picture Workshop – practical summary

What went right: The farmers were slightly sceptical at first but appeared to be comfortable enough to participate. There was enough time allotted to the drawing process, during which the farmers talked in groups as they were drawing, and appeared to have had a good time drawing, discussing their issues, and presenting to the whole group. It was not surprising that the issues depicted were similar for each group.

What went wrong: We started the drawing description in the upstairs meeting room but had to switch locations because of the extreme heat. This resulted in some of the instructions getting lost in the process of moving around. For example, we forgot to tell them to put themselves in the centre of the picture and neglected to tell them to draw lines between market and distribution systems. Perhaps as a result of the lack of instruction, the farmers drew structures and weather systems but not distribution systems, workers, or time spent working. On a purely practical level, the pens could have been thicker and we need not have offered so many colours; also, the paper could have been bigger.

Figure 21 Sharing results with the whole group. Photo: J.Schläpfer, Chambezi, Tanzania 2011.

Figure 22 Sharing results of the Rich Picture workshop. Photo: J.Schläpfer, Chambezi, Tanzania 2011.

4.2 Farm visits

The farm visits in January 2011 on the first field trip evidenced the biotic and abiotic problems facing the farmers in Bagamoyo district. All farmers said that the last three years had been particularly bad, with drought caused by the winds changing and blowing away the clouds that were supposed to have brought the short rains.

Farmer and family	Mr Hamisirajabu, family of 4
Land	0.5 acre
Crops	Crops: cassava, orange, cashew, coconut, mango, cowpeas, ground nuts and pigeon peas, maize, sweet potato, chickens, and goats
Biotic issues	If plants are infected by virus, he uproots and burns them and gets cuttings from healthy plants. Says there are 2 kinds of virus, heavy and light. When there is more rain, then less disease, less whitefly (batu-batu.)
Abiotic issues	The farmer dug a well during rains, but now it is dry so he has to buy water for family use. No water-saving measures, as they are too expensive. Neighbour drilled well but there was no water.
Field trials?	Has research variety of cassava – Kimbari
Climate change adaptation	Noticed climate change: earlier there were long rains 3x per year, now only one which is not heavy. Past 3 years – sees a heavy cloud and thinks it will rain, but then wind comes and blows cloud away and then no rain. How to adapt? If no rain then depends more on animals and coconuts. Oranges used to be good but now not. This year he planted cowpeas, ground nuts and pigeon peas, some variety of maize that does OK without much water.
Crop rotation?	Does crop rotation: cowpeas > sweet potato > cassava

Table 4 Farm visit interview notes example 21.1.11

Figure 23 Mr Hamisirajabu's house. Photo: J.Schläpfer, Bagamoyo District, Tanzania 2011.

Figure 24 Mr Hamza and Mr Issa inspect the nearly dry well on Mr Hamisirajabu's land. Photo: J.Schläpfer, Bagamoyo District, Tanzania 2011.

Figure 25 White fly (batu-batu). Photo: J.Schläpfer, Bagamoyo District, Tanzania 2011.

Figure 26 Cassava mosaic virus, carried by the white fly. Photo: J.Schläpfer, Bagamoyo District, Tanzania 2011.

Figure 27 Storage pest in cassava tuber shown by Mr Issa. His remedy is to hang the sacks of cassava over the smoke from the cooking fire. He loses at least a third of his crop to post-harvest losses. Photo: J.Schläpfer, Bagamoyo District, Tanzania 2011.

Figure 28 Renalda Msaki tries out the mobile phone with Eugenio Tisselli. Photo: J. Schläpfer, Bagamoyo District, Tanzania 2011.

Both the Rich Picture workshop and the farm visits could be categorized as systems knowledge, as they were dedicated to gaining baseline knowledge of the farmers' situation.

4.3 Verifying the model: positioning the results in the transdisciplinary framework

The transdisciplinary research framework, with its three types of knowledge proposed by Pohl and Hadorn (2007), has become standard in its field (Messerli and Messerli 2008). Many research groups have used the three types of transdisciplinary knowledge to integrate knowledge from several disciplines and apply it to practical problem solving (Hubert et al. 2008, Kiteme and Wiesmann 2008, Messerli and Messerli 2008, Stauffacher et al. 2006, Hinderlang et al. 2005, Walter et al. 2008 – all in Hadorn et al 2008). In this project I have used the framework in the standard mode to define research questions and set them out according to the type of knowledge they might generate. I have then taken the data from the farmers and categorized it according to Pohl and Hadorn's three types of knowledge, not using the framework as it has hitherto been used, to integrate types of knowledge for a practical purpose, but rather as an analytical tool for matching the data to the research questions and thereby mapping the kinds of knowledge enabled by participatory data gathering. Unlike other transdisciplinary research, the present project involved little data gathering by the scientists or artists themselves. Our role was rather to facilitate the farmers' data gathering and evaluate it. The results of the data coding and analysis of the farmers' posts were positioned within the transdisciplinary framework according to the form of knowledge they might generate. For reference, I have included the questions again here as a table. Each question is then discussed below.

Form of knowledge	**Research Question**
Systems knowledge	• Are the Tanzanian farmers already affected by climate change? • How are they adapting to possible changes in climate? • How are their farming practices currently represented to the outside world? • How do they share information about farming practices?
Target knowledge	• How can a participatory mobile phone project strengthen the community? • Can such a project instigate social learning? • How can a community archive support the farmers' communication with local authorities / with the agricultural extension officer? • Who benefits most?
Transformation knowledge	• Can this type of data gathering inform natural science? • Can a mobile phone project contribute to the processes of agricultural field trials such as participatory breeding of cassava?

Table 5 Types of transdisciplinary knowledge relating *Sauti ya Wakulima* research questions

4.3.1 Systems knowledge research questions

Are the Tanzanian farmers already affected by climate change?

The farmers evidenced that there has been a change in weather patterns over the six years previous to 2011 (Rich Pictures, farmers interviewing each other). The short rains in October/November had all but failed to materialize. They noticed a change in wind pattern, which corresponded to observations of La Niña (Gordon-Maclean 2009). These events were recognized as 'not normal' and attributed to climate change:

> *"I am at Mataya and this is Mrs. Hamisi Rajabu, a coconut grower. Due to effect of climate change she has experienced a fall in her yields." 20 March 2011*
>
> *"This lemon tree has been pulled after it has dried up due to sun. This is a loss for farmers resulted by climate change." 16 April 2011*

From this it is hard to know if the coconut yields and the lemon tree are victims of climate change. The database of posts would need to be compiled for a longer period of time to provide robust local evidence of climate change. However, an under-utilized opportunity offered by this method of data gathering is that the farmers are still posting regularly four years after the start of the project. This is much longer than the data-gathering phase of most research for development projects.

Creating an evidence basis of adverse crop production factors

Biotic problems

Pests: Postings about pests are far more frequent (49) than about diseases (7). However, as with diseases, the causal factors (here organisms) are not clearly specified. Most images also failed to depict the causal agent properly. There is room for improvement in the quality of the images, as the smartphone camera cannot focus at macro level. Comments included:

> *"This pest is destroying all of the leaf vegetables: sweet-potato leaves, spinach, pumpkin leaves and leaves of legumes." 23 March 2011*
>
> *"We are still at Vigoda valley found in Buma. The rice farmers are still trying their best to fight these pests (grasshoppers) by spraying some pesticides."*
>
> *"As you have seen it from Makondeko valley to Mwembengedere valley to Mwanatungo valley, they are all facing the same problem. This means that today is the third day since these pests (grasshoppers) have come to this place. We are*

therefore informing the government that the pests are still persisting despite their efforts made to eradicate them." 4 June 2011

Figure 29 Unidentified pests. Screen shot sautiyawakulima.net

Figure 30 Evidence of pests. Screen shot sautiyawakulima.net

Figure 31 this is a good example of the limitation of the phone camera which cannot take macro images. Screen shot sautiyawakulima.net

Diseases: Over the entire period only seven entries were made documenting adverse effects of diseases. Affected crops were watermelon, cashew, rice, coconut, and cassava. Most entries occurred between April and June.

Figure 32 Unidentified disease of watermelon. Screen shot sautiyawakulima.net

Figure 33 Unidentified disease of rice. Screen shot sautiyawakulima.net

Abiotic problems

Drought : This is the single most frequently mentioned factor hampering agricultural activities before a rainy season. In 2011, based on the postings regarding drought or floods, we were able to pinpoint the beginning of the rainy season at mid-April, which is about a month later than usual. Given the fact that all farmers told us that the short rainy season in the preceding fall of 2010 had really failed, it is understandable why the majority of posts until mid-April were about dry wells, dried plants, and outright cries for help, as no water was available any more.

> *"These are tree seedlings which have been affected by droughts. We would like to request for assistance in improving the existing wells so that we can combat droughts ...." (16. March 2011)*

> *"These are farmers mediating the whole issue related to the drought. They said that the only solution is to have wells. They have wells but most of them are not in a good standard. They are calling upon the government and sponsors to help them in improving those wells so that they can succeed in their activities." 21 March 2011*

Floods: The situation changed dramatically by 16 April, when postings started reporting severe flood damage.

> *"Today's rain, has cause a lot of disasters. As you can see this field with young maize has also been destroyed." 21 April 2011*

During the month of April, postings of both drought and flood damage can be found. Crops damaged by drought were unable to recover or were then affected by flood rains.

> *"These vegetables were planted during dry season and now the rains have even destroyed them more." 24 April 2011*

The small rains in fall 2011 fortunately turned out to be more significant than the previous year and started on 12 November.

The single biggest abiotic issue posted in Bagamoyo district was water – either its lack or its excess. From the dated postings, the critical time is the period before the long rains begin, when everything is dried out – not only soils (often sandy) but also wells. This situation turned from drought to flood when the rains began in mid-April, about a month late, and then came down as in torrents, which added to the damage caused by the drought. The flooding rains, furthermore, came down on a dried-out soil that was not capable of absorbing so much water in so short a time. Hence, most of the urgently-needed water initially just gushed off the land and caused almost more damage than good.

Drought was particularly bad as the previous small rains, typically occurring around October-November (2010) had hardly materialized and were reduced to a few sparse rainfalls that were nowhere near sufficient to put through a crop of cassava or maize, which requires substantial amounts of water. After April, drought and flooding were hardly mentioned in the postings. Apparently, the situation somewhat normalized again.

These events were recognized as "not normal" and attributed to climate change. In particular, the substantially reduced small rainy season caused major problems for farming communities, as their wells – usually primitive, improvised and self-dug – no longer functioned effectively. This forced some farmers to either give up maize and cassava production in the small rainy season or be confronted with failed crops. As maize and cassava are staple crops necessary for basic sustenance, this could have quite dramatic consequences for the food-security status of the affected communities.

However, in May and June, pests took the lead position in the list of problems voiced by the farmers. Specifically, grasshoppers were repeatedly mentioned during June as a prime problem for rice plantings. Diseases, in contrast, were not recognized as a prime problem, which is surprising, given that we saw a considerable number of cassava plants affected by cassava mosaic virus disease or cassava streak virus disease. Although farmers we spoke to were aware of this problem, it appeared not to cause sufficient damage to the underground

tubers – and hence yield reductions – to make it onto the postings. In July, as harvest time approached, storage problems were mentioned for the first time. Spraying with pesticides is generally seen as the only effective solution to pest problems – hardly any alternative is mentioned. One woman posted a recipe for a botanical pesticide.

How are the farmers adapting to possible climate changes?

The weather changes noted above might be due to human or non-anthropogenic causes, but in either case, the farmers are diversifying and developing flexibility and resilience to offset climatic vagaries. Farmers in Bagamoyo district are growing a wide range of crops, including at least 25 annual and 10 perennial plants, which they typically intercrop. They are also keeping small livestock, including chickens, ducks and goats, and experimenting with keeping wild game birds.

If staple crops such as cassava or maize fail, farmers plant other short-term crops – for example, cowpeas, which have much shorter cultivation times and require much less water. Agroforestry and intercropping are being recommended by some of the farmers who post frequently. Many are also engaging in animal husbandry and crop diversification.

> *"She is not only involving herself in farming activities but also animal keeping, this is a strategy to tackle climate change." 20 March 2011*

The farmers at Chambezi have formed a collective and are supplementing their income by processing coconuts and producing oil, adding value to their raw materials. Some of the women are also experimenting with making coconut oil soap.

How can this mobile phone method help farmers represent their farming practices to the outside world?

The website sautiyawakulima.net, and the mobile phones as a means to post to it, have given the group of farmers from Bagamoyo a presence and a voice that they would not otherwise have had. It allows farmers to represent themselves and gather information with and from each other. They assigned one person to take the project laptop to the agricultural fair in Morogoro and report everything he saw in particular innovations that seemed relevant to the Bagamoyo farming situation. Other farming communities praised them as being progressive and modern. The farmers left at home were thus able to share the experience and see and listen to the presented innovations at the Morogoro farm fair.

There are still many issues with internet access in Tanzania, where data downloading is expensive and limited by hardware and the electricity supply, so the potential of this means of representation has not yet been exploited to its fullest. However, the situation of mobile phone coverage changes fast and expansion is impressive. All in all, the mobile technology has expanded in Africa at a speed that no other technology has done before. Consequently, the potentials of any mobile phone-based innovations are huge and dramatically increasing continent-wide (Tisselli 2015, Chapter 2 pp 65-100).
The creative licence given to the farmers, in that they were free to deviate from simply documenting climate change, and the nearly unlimited uploading potential have created a fascinating picture of their lives, to which no outsider would otherwise have had access (see slide show on accompanying DVD). The project has gained the attention of the Bagamoyo Mayoral Office, who praised the innovation in the farmers' agricultural practices and their participation in an innovative IT project. That their voice has been heard may have future consequences, as it is rumoured that a new airport is to be built in the area, on or near land currently owned by some of the newly articulate group, and there are plans for a new, very large port to be built by the Chinese government.

How can this method help farmers share information about farming practices?

During our second field trip, the farmers were introduced to the concept of interviewing each other and the tag *interview* quickly became the most popular of all. Praising good practice by interviewing colleagues has now become a common theme of posts. This is done in their own vernacular language, making it culturally accessible to other farmers.

Many new crops and methods are presented at the annual agricultural fair in Morogoro, and a particular advantage of the mobile phone documentation method was that the farmers were able to create videos, interviews and photos on subjects which they thought would interest the group in the run-up to the fair. In the posts, everything from crocodile farming to the equally exotic cauliflower was suggested as a new crop. The quote from a farmer holding a cauliflower was lovely:

> *"We eat the green part, but the white part, I don't know what you can do with it except sell it, the Europeans buy them…"*

Creating an evidence base of positive crop production

It was to a certain degree surprising that the farmers used the methodology to post quite a large number of posts on healthy, good-looking crops. Or, when events took a lucky turn,

they felt the need to express their gratitude. Farmers gain a lot of pride from having a good crop stand and generating healthy produce for sale and consumption.

> *"I am still at Bagamoyo, these women are now preparing the rice pouches. I am happy that I have finished, all who talked to me will see it from the internet what Bagamoyo people get from their land." 24 April 2011*
>
> *"Thanks be to God on behalf of these farmers of the Kigoda valley. From yesterday rains the dams are full of water and people are using it in transplanting paddy. Although the rains were late, these small farmers are now sure of getting food." 27 April 2011*

Healthy plants were posted as confirmation/proof of success for either particular innovative production techniques or to recommend a particular new crop as a good crop for generating income (e.g. carrots, sunflowers). An innovative production technique was the production of maize on terraces or the building of small hills round individual maize plants – both measures aimed to manage or conserve limited water resources and stop erosion.

4.3.2 Target knowledge research questions

How can a participatory mobile phone project strengthen the community?

This project has shown that when there is already some group cohesion, as in the case of Chambezi, the phone project can strengthen community feeling. It is important to note about the Chambezi group that they are already a self-selected group of farmers from several different villages. Green (2000) states that collective action in Tanzania usually occurs at extra-village level, that is, above the level of the village. The villages concerned are not, as the crow flies, very far apart, but many farms have poor access via dirt roads, so some come with motorbikes to the regular meetings at the agricultural station with Mr Hamza, the agricultural outreach officer, whom they all trust for advice. They are involved in agricultural field trials and had already started a coconut oil cooperative. As a direct result of this mobile-phone project, the "phone farmers" invested in a solar-powered mobile-phone charging station. This unit is on a pushcart, and in addition to charging their own phones, they can make money by selling their electricity to villages in their area.

However, if there is weak cohesion – as is the case with the urban farmers in Ubungo, Dar es Salaam – this method cannot create community, without perhaps a far higher investment in resources.

Can such a project instigate social learning?

As discussed earlier, the social learning bridging concept of 'legitimate peripheral participation' describes learning as an activity that takes place as integral to social engagement and 'defines a landscape of community membership' (Lave and Wenger 1991). This can apply to the farmers' social learning in the instances of creating the posts individually, or in small groups, and then viewing the posts together as a group. Sometimes they were directly involved in content production and other times were peripheral to it, but nevertheless witness to its production.

To answer the question *What does this project contribute to social learning?* it is best to directly quote the learning effects reported by the farmers themselves:

- *It helped us to become familiar with different kinds of problems.*
- *It helped us learn from each other, and also from farmers who may be far away.*
- *One picture helped to identify a mango fungus.*
- *I learned how to better plant maize through a picture sent by a colleague.*
- *I received timely advice after uploading pictures of grasshopper pest.*

The farmers at Chambezi get together every Monday and look at the previous week's posts together. They used the platform for teaching and consulting fellow farmers on good and negative aspects of farming and problem-solving options. One comment was that this activity has focused their meetings more on practices (rather than gossip). Thus the learning can occur directly farmer-to-farmer, if one posts advice and another sees it; also, one farmer's posts can be watched online by the group, facilitating group learning and new forms of interaction.

Several hundred posts contained some form of advice or lessons learned from others. Many showed gratitude for advice received, in others the interviewer actively requested the interviewee – after having noticed a "good" crop or practice – to give her/his advice on why that crop was grown or why it looked so good. The interviewers displayed a keenness for learning and respect for those who provided it; they called for knowledge sharing within the community. This seemed a newly discovered merit of the methodology, fulfilling a dire need of the farmers that had not otherwise been met. This is knowledge embodied in specific socio-ecological contexts and practices (Tàbara 2013 (B), blending practice knowledge from the farmers with theory from the agricultural officer.

Example of problem-solving options:

> *Interviewer: 'This is a machine that is being used to remove groundnuts from their shells. Have you made this machine yourself or have you bought it?'*
> *Interviewee: 'I have made it myself.'*

Interviewer: 'So do you mean that this is your own creativity?'

Interviewee: 'Yes it my own creativity which was motivated after facing challenges in removing groundnut shells.'

Interviewer: 'What are the materials used to make this machine?'

Interviewee: 'It is made from tree barks and a tin from a drum.' 7 October 2011

Figure 34 Homemade groundnut shelling machine (detail). Screen shot sautiyawakulima.net

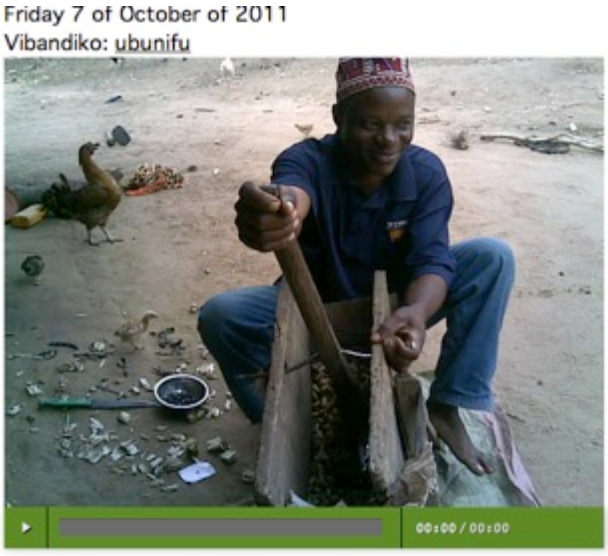


Figure 35 An excellent example of problem-solving with hand-made machine. Screen shot sautiyawakulima.net

> *"This is corn that I grow on terraces after getting advice from my colleague. I got advice on cultivating on terraces during the winter and not in sesa as previously." 28 June 2011*
>
> *"This is a plant whose seeds can be used together with pepper and garlic, grinded and then filtered in some litres of water to produce a liquid which can be used as pesticide instead of using the industrial pesticides." 5 September 2011*
>
> *"It's a form of animal keeping that encompass both domestic and wild birds. It's a good way that we can learn from Mr Wakiragai and even invite people from other places to learn from him." 30 April 2011*
>
> *"This is a small coconut processing group of the Chambezi communities. They prepare these coconut oil by drying the coconuts, milking and sieving the oil twice. So this oil is very valuable and sold for TShs 6000 per 350ml bottle." 21 March 2011*
>
> *"It is very interesting that these people have managed to use the sandy soil for agriculture purpose just by using urea and manure." 20 November 2011*

Growing maize on terraces or hilling individual maize plants was a repeated lesson learned and stated as such by the farmers. This is recognized as a good measure for multiple purposes: preventing waterlogged maize, soil erosion, and conservation of soil moisture for longer periods. It is advertised on several occasions. Further, agroforestry is becoming increasingly practised and recognized as an adaptation to the changing climate. Farmers experiment with varieties given to them and do 'their own research'.

> *"Thanks Mr Hamza, as it is for the agriculture officers who use their education to teach us on how to plant variety of crops, I also thought of doing my own research and this is what you can see that. In this field, there are sunflowers, maize and beans, this is one of my research… Moreover, the good thing is that sunflower can be planted in the same field with maize and still doesn't affect the yields." 4 June 2011*
>
> *"We still need more knowledge in cassava farming as we have seen that other regions that grow cassava as we do are harvesting much compare to us. We are also growing simsim (sesame) but still our produce is not as good as in other places so more knowledge is required. Livestock and pest animals have been a big challenge to our crops. If this is taken care of and the agriculture officers provide us with good seeds we are likely to improve in our farming activities." 3.3.2011*

Figure 36 Suggestion for nitrogen fixation. Screen shot sautiyawakulima.net

Figure 37 The platform was also used to advertise good sources of input material (seeds, seedlings, fertilizers, etc) for farming; several posts concerned the promotion of specific agricultural input products or the selling of produce. Screen shot sautiyawakulima.net

How can a participatory mobile phone project support the farmers' communication with local authorities and/or with the agricultural extension officer?

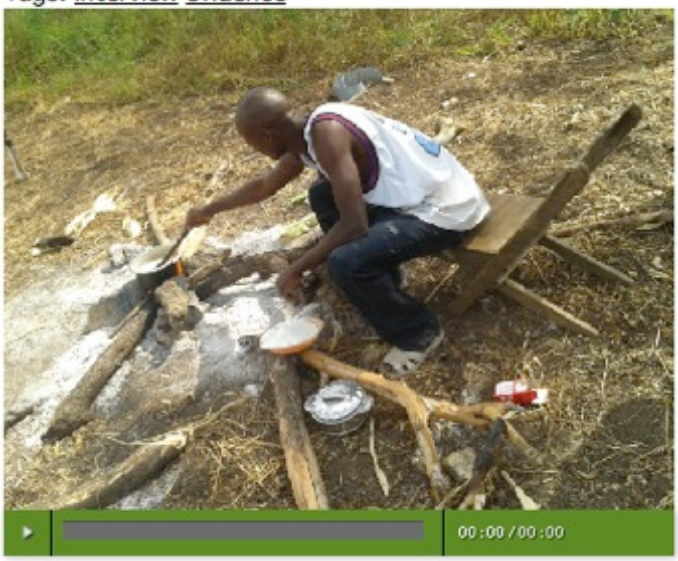
In an area where the ratio of extension officers to farmers is woefully inadequate, this method has shown evidence that it can facilitate communication with the agricultural officer. For example, Mr Hamza saw that grasshoppers were affecting a certain area and was able to visit and give advice. Another example is that, due to the farmers' willingness to innovate and diversify with new varieties, new mango trees brought a previously unknown type of fungus with them. Unable to properly explain the disease, a farmer was able to post a picture, the fungus was identified, and then he could be given assistance.

The advice of the agricultural research officer is often repeated and praised in the posts, and farmers are advised to follow the advice of Mr Hamza. Online communication is not two-way with the agricultural officer, so the logical next step might be to have the agricultural officer sending SMS alerts of planting times or advice about pests.

There were also some instances of the farmers wanting to communicate with the local authorities to expose criminal activity, for example undercutting prices by selling vegetables without a wholesale licence.

Figure 38 Tagged as evidence: the farmer posting this is angry at the illegal activity. Screen shot sautiyawakulima.net

Friday 28 of June of 2013
Tags: interview evidence



This is one of the people who buy crops illegally, he does not have permit to do that. When he is asked why has he placed the post while he does not have permit he said that he is processing it, this is against the village plan and he is requested to remove that sign post up to when he gets the permit to buy crops.

Figure 39 The farmer confronts the illegal vegetable buyer. Screen shot sautiyawakulima.net

Friday 28 of June of 2013
Tags: interview evidence

As you can see this post, these are the people who lie to farmers and buy their crops at low price while they do not pay any tax to the government and cause shortage of food to the farmers, they are in Talawande village. The government should make follow up on this issue.

Figure 40 The farmer wants the government to take action. Screen shot sautiyawakulima.net

Who benefits most?

To the question *How was the project useful for you?* farmers answered:

- We contacted other farmers by interviewing them.

- We are now kind of journalists.

- It can help us do business, by advertising our products on the web page.

- The web page can improve the communication with the extension officer.

- The project brought cohesion to the group, through the meetings and discussions.

- Phones can be used for other things besides calling other people.

- Computers can be used by the people in the villages to help them solve their problems.

(Interviews by Tisselli June 2011)

In the first instance the farmers are the beneficiaries of this project in terms of knowledge sharing, communication with the extension officer, community building and becoming visible by having a voice in the world. The knowledge sharing achieved by the farmers was particularly important to them. By interviewing and photographing each other, they have been able to create a commons of information available in their vernacular to share with their compatriots. Their version of social learning might then function as a model for a social safety net, a local communication platform, which can be expanded and employed as the effects of global climate change continue to impact small-scale farmers. Communication with the agricultural outreach officer was also a key benefit mentioned by the farmers. This aspect has a lot of potential if the officer has the capacity to frequently view the posts and then respond in a timely fashion. Towards the end of 2012 the farmers asked if there was a way they could get a quicker response to their queries, as there was some concern and frustration that their officer, Mr Hamza, did not have the capacity to respond quickly.

The benefits of group cohesion are also a key aspect of the project. The farmers reported that they have recently focused more on discussing agricultural issues when they met as a group – rather than gossip, which of course also has social functions. As has been previously noted, the group already had significant cohesion before the start of the project, but the phone group have also expanded their business activities since the start of the *Sauti ya Wakulima* project by buying a solar-powered phone charging station, which they can wheel from village to village.

The farmers have also been empowered by feeling good about being able to use technology and become digital players. By taking their laptop and showing the project website at the agricultural fairs they are working on dispelling prejudices about being from a ‘backwards and underdeveloped’ area of Tanzania. However, individual or even small group

empowerment should of course not be confused with the power to affect social or economic structural changes, and the farmers have negligible democratic power.

As with all research projects, the benefit to the researchers must also be considered. Aside from a grant enabling several research trips to Tanzania and a conference in Addis Ababa, this project has provided partial material for two PhD theses and several academic papers and conference papers. By presenting the project in various contexts from development conferences to art shows, and from transdisciplinary research conferences to science communication symposiums and natural science research meetings, Eugenio Tisselli and I have brought this project to a wide range of actors in the hope that our practical experience of transdisciplinary art-science research and goals of 'enabling voice' will inspire others to ask different questions.

4.3.3 Transformation knowledge research questions

How and in what ways can this type of data gathering inform natural science?

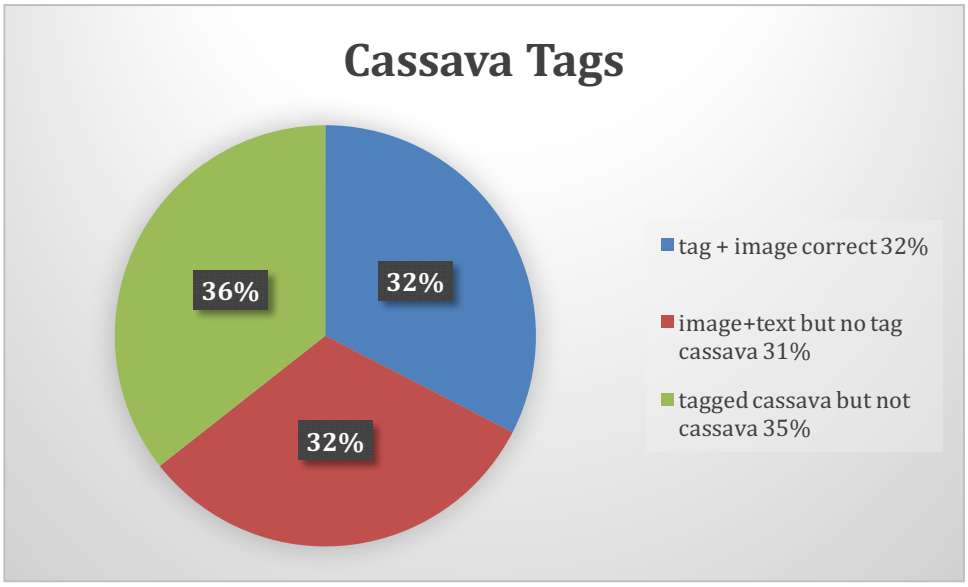
In order for the data from this project to be used in natural science research, the following issues must be addressed: How is the data stored? Can it be easily accessed? To what extent is the data produced scalable and relevant for other smallholder farmers a) in Tanzania, and/or b) continent wide? That is to say: Can some nomothetic lessons be learned from this case study despite its situational conditions, or can lessons be learned because it is embedded in a real-world context (Krohn 2008)?

Let us look first at data storage. The posts are stored on the website server as html files. At present only the server administrator has access and can extract the text, tags and date and time of posting into an Excel file. In order to search a post of interest and match it with its image, one has to go to the website, find the date and go through all the posts for that date, which may extend to several pages. This is occasionally further complicated in that the days or the date spoken by the farmer does not always correspond to the posted date; this could be because the farmers save up posts and then send them in a batch when they have free or low-cost Wifi. The database and tag search function would need to be optimized for easy extraction of text and images together. The posted images are sometimes accompanied by spoken audio, which is then transcribed and translated by an agricultural student. This process is time-consuming but probably more accurate than a speech-to-text software would be for multiple users.

The results from the second round of analysis of over 2500 posts after 36 months focused on the staple crop cassava and the incidence of its mentioning in relation to climate change. Of

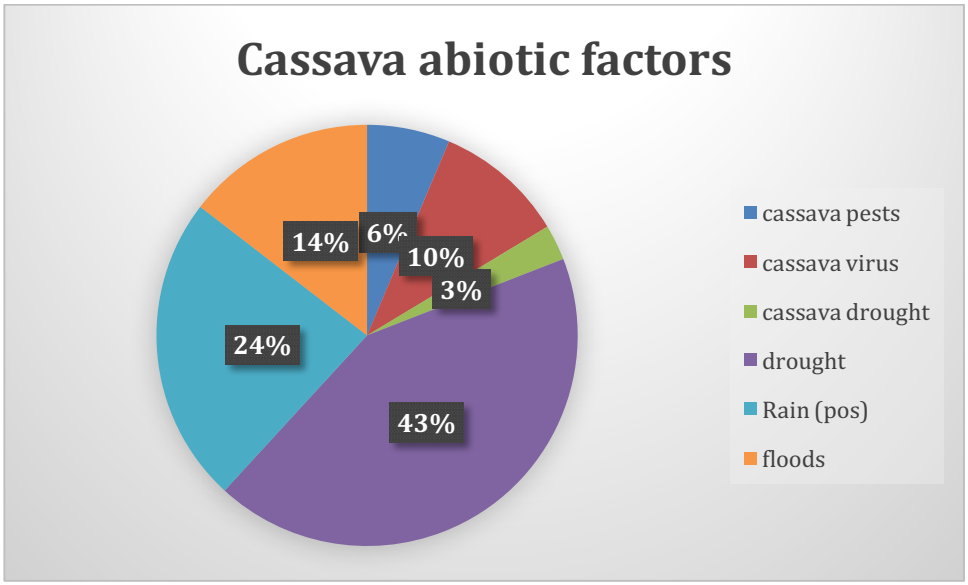
the 132 posts left after the filtering process, where the text mentioned cassava or the tag was cassava, in 32% of cases the tag and image matched, in 31% of cases the tag was something else, but the content (image and text) were about cassava, and in 35% of cases the tag was cassava but the content did not give a clear indication that it was about cassava. This accuracy rate of around 30% is probably quite high, given the loosely structured nature of the farmers' posting system.

From the second filtering process of 336 posts, which looked at text keywords, 43% mentioned drought far more frequently than any other factor; this rose to 46% when posts were included that combined *drought* with *cassava*. The words *climate change* appeared 46 times in the whole data set of 336. However, clarification is needed about what the farmers meant when posting about rain and other abiotic issues. It is prima facie likely that they were thinking about climate change or related adaptation issues: for example, several comments were on the subject of crop diversification and expanding into animal husbandry, both strategies to minimize losses due to various weather or pest issues. The farmers' posts show the potential of a methodology such as that used in *Sauti ya Wakulima* to contribute to scientific studies where a broad long-term picture showing a community's own understanding of its adaptation to climate change is sought. In order for this to move beyond local knowledge, the project would have to be repeated in several other areas of Tanzania (or elsewhere), and compared. That it could be so repeated, however, confirms rather than detracts from the project's scientific potential.



Graph 1 Cassava posting tag ratios. Analysis: J. Schläpfer 2013

In a second filtering process looking at text keywords, I took the data set of 336 posts (from the 2625 posted over 36 months) and gave them a value according to the following categories: flood, drought, rain (positive comment), cassava x drought, cassava x virus, cassava x pests. This resulted in the following ratios:

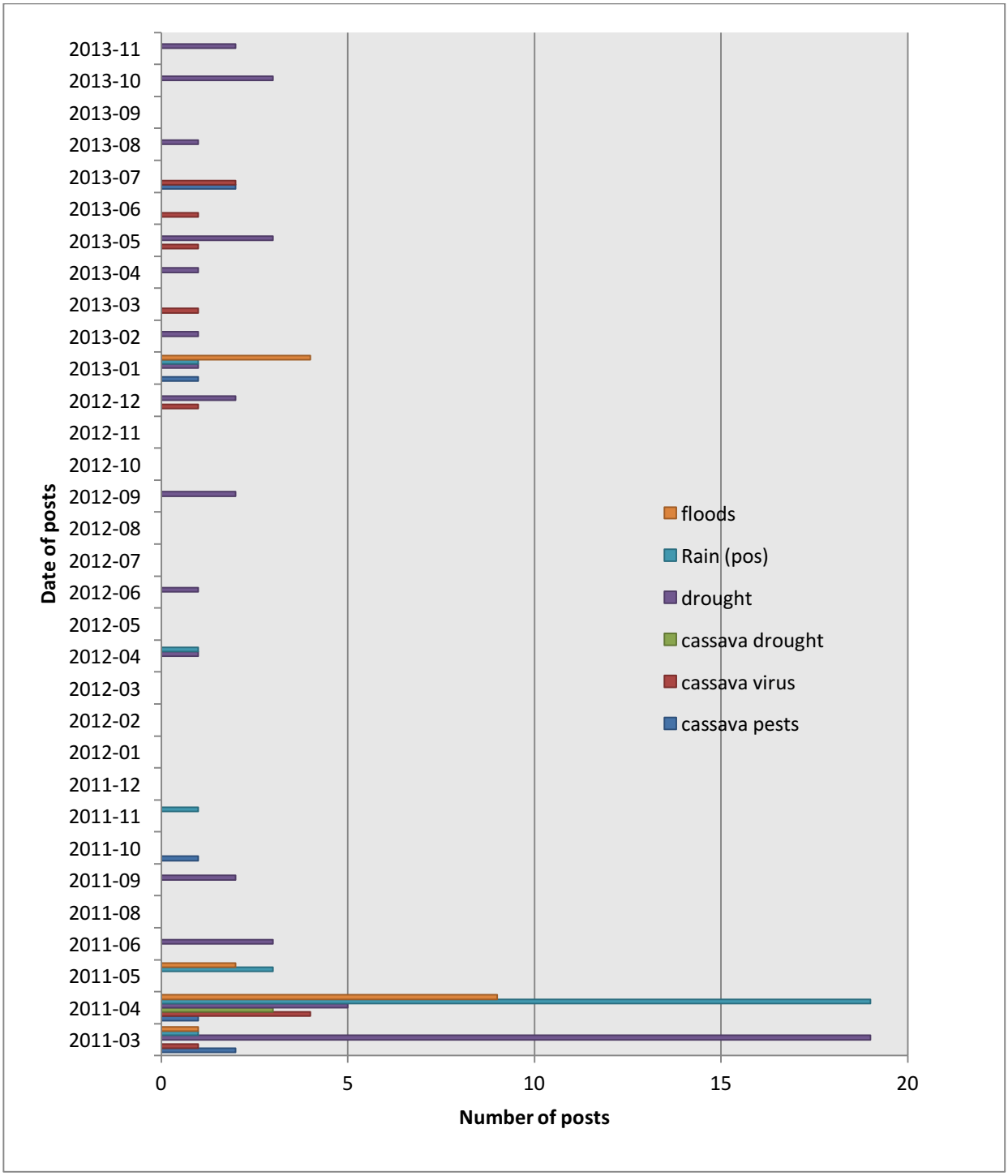


Graph 2 Ratio of posts with text concerning cassava and biotic or abiotic factors. Analysis: J. Schläpfer 2013

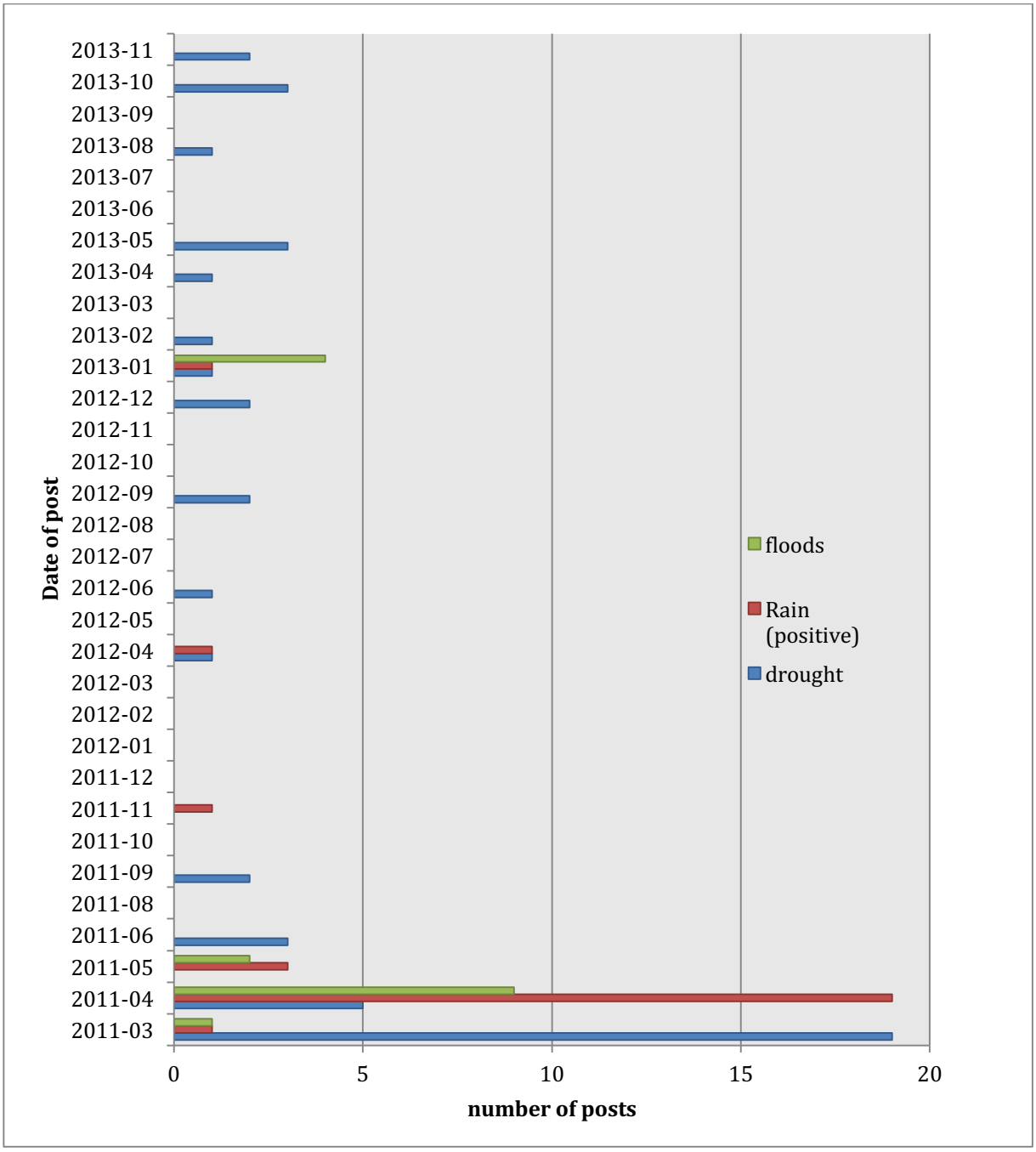
From this we can see that, with 43%, drought was mentioned far more frequently than any other factor and 46% when combined with cassava drought. There were more mentions of rain in a positive way than there were mentions of flooding, but the positive or thankful comments often went quickly to lamenting too much rain. Of course, what is good for rice farmers is not always good for maize farmers.

The following graph (Graph 3) shows the same data over time, where we can see that drought is a theme in March 2011, countered by rain in the following month of April. From the end of 2012 until the end of 2013 we can see a clustering of mentions of drought and cassava virus or pests. Posts about rain or drought peaked at the beginning of 2011, when there had been a lack of short rain the previous fall. This was also the start of the project, when farmers might have been posting more enthusiastically about climate change.

It can be seen that the overall frequency of posts decreases over time, but the frequency of climate change and weather posts decrease proportionally more. This could indicate a general waning enthusiasm or other commitments on the part of the farmers, or could indicate that there were fewer extreme weather events to report.



Graph 3 Cross-referencing cassava with biotic and abiotic factors from 3.2011–11.2013. Analysis: J. Schläpfer 2015



Graph 4 Farmers' posts indicating drought, positive mentions of rain, or flooding from 3.2011–11.2013. Analysis: J. Schläpfer 2015

If we extract the data on rain, flooding and drought, we can see that there are four instances where a positive mention of rain is followed quickly by concern with flooding and then sometimes almost immediately afterwards by drought again. This tells an agronomist that the soil is not retaining enough moisture (too sandy), and that the water storage capacity – either of the soil or in aquifers – is not adequate for the crops the farmers want to cultivate.

The farmers' posts could also be used to indicate the start of rain, but there may be some imprecision due to the posts not always being sent on the day they were written, or the farmer who had the phone did not post on the day the rains started.

Year	Mention of rain starts	Mention of rain ends	
2011	19.03 (long rains)	23.05	23 posts
2011	13.11 (short rains)		1 post
2012	11.04 (long rains)		1 post
2013	08.01 (??)		1 post
2014		End date data set 17.02	

Table 6 Dates of posts with positive mentions of rain 2011-2014. Analysis: J. Schläpfer

The start of the short rainy season in 2011, 2012 and 2014 was documented, and one can see that the long rains started late in 2012, while it was unclear what kinds of rains the ones reported in January 2013 were. If the farmers had more precise instructions, and perhaps reminders, this could be a useful method of gathering localized rainfall data over a long period of time, and could possibly help them see a pattern. Likewise, such information can inform climate modelers, as local weather data and such kinds of information in countries like Tanzania are rare to non-existent. In our case, the nearest weather station – and one of a very few in the entire country – is at the airport in Dar es Salaam, some 75 km south of Bagamoyo.

Can a mobile phone project contribute to the processes of agricultural field trials such as participatory breeding of cassava?

It was not possible to answer this question with the data collected, as there was too little information on breeding trials. We did not discuss this with the farmers as a tag or a subject for their documentation at the beginning of the project. This would be an interesting study in itself as part of the cassava participatory breeding project. However, the opportunities seem obvious. As with weather pattern, pests and diseases, this tool could also help to document and build an evidence base regarding any breeding program. Data collection and data storage is notoriously problematic in countries like Tanzania as proper and sustained access to computing facilities and machines is rare and unreliable and more often than not quickly outdated. This methodology offers multiple opportunities when combined with proper data

base management and internet storage. IT support is becoming more sophisticated in Tanzania and the future potentials are huge.

4.4 Results from the urban farmers case study, Ubungo, Dar es Salaam

In Chapter 3 I described the background context of urban agriculture in Dar es Salaam (3.2.1 Context: Urban and peri-urban farming) and outlined the field visit (3.4.3.3 field visits: Urban agriculture, Dar es Salaam).

The urban farmers case study is a good example of a project not working in the way one had hoped or imagined. The group of farmers we met were bound by geography, as they worked on neighbouring plots, but according to the agricultural officer, apart from ordering fertilizer together, they did not have any collective or cooperative activities and were even competing to a certain extent.

The project aims were similar to those with the farmers in Chambezi, but from the initial workshop, when the farmers listed issues that were affecting them, climate change did not feature at all. As mentioned in the field visit notes, we did not do a Rich Picture workshop with them, as in contrast to her boss (Flora Ishmail, who helped facilitate in Chambezi), Agnes Nymora, a horticulturalist from the Botany Department at the University of Dar es Salaam, was clearly not comfortable with this activity. It was a lesson learnt that all partners have to be fully on board with the transdisciplinary methodology in practice as well as in theory.

The farmers were trained to use the phones with the same procedures as at Chambezi, and a list of tags was made from their list of issues. The crop list can be ascertained from the tag list. We can see that all the crops in this instance are fast-growing and harvested within 60 days. Even the pumpkin is harvested for the leaves and not allowed to mature to fruit. There is no agro-forestry or intercropping; the farmers said they rotate with cowpeas (as a nitrogen fixer), but the only input was chicken manure. They do not compost either household food scraps or plant waste. Stalks from the okra, for example, are just laid down next to the path or heaped on wasteland at the edge of the gardens (interview with agricultural officer, 6.2011).

The tags were: amaranth, Chinese cabbage, cowpea, cucumber, eggplant, mustard, okra, pepper, pumpkin, sweet potato leaves, solanum, water, water pump, well, market, seeds, land, insect fertilizer.

Over the next eight months, from March to October 2011, images were posted, some with sound recording. We believe that most of the posts were done by one person, Andrew. The other group posted two to three images, and then the phone disappeared. Andrew's group reported that the phone was faulty and that is why they stopped posting. At the visit in October we took the phone back and closed the project; the other phone was lost.

Figure 41 View of the urban agriculture plot visited in Ubungo, Dar es Salaam. Photo: J. Schläpfer, Ubungo, Dar es Salaam, Tanzania 2011

Figure 42 The farmers compiled a list of concerns and issues. Photo: J. Schläpfer, Ubungo, Dar es Salaam, Tanzania 2011

Figure 43 Dr Agnes Nymora compiles the list of the farmers' issues. Photo: J. Schläpfer, Ubungo, Dar es Salaam, Tanzania 2011

The main issues of the urban farmers were as follows: They needed access to clean water: there had been a well but it went salty, and their water supply was polluted with industrial and household waste. They also spent about five hours each day carrying water from the river. They had compiled a list of pumps that they thought we could buy. They had a poor supply of fertilizer – chicken manure was hauled on a bicycle trailer from several kilometres away. They needed better access to markets – their produce only fetched low prices, as they were not allowed to sell legally at the markets, because their water supply was not clean.

Figure 44 Water supply for urban agriculture plot. Photo: J. Schläpfer, Ubungo, Dar es Salaam, Tanzania 2011

Figure 45 Homemade watering cans. Photo: J. Schläpfer, Ubungo, Dar es Salaam, Tanzania 2011

Figure 46 Washing greens to sell at the market. Photo: J. Schläpfer, Ubungo, Dar es Salaam, Tanzania 2011

Illegal sand miners were increasingly an issue. The district agricultural officer reported to us that there had recently been a standoff between the sand miners and the police, who were trying to protect the vegetable plots. The police had apparently backed down.

Figure 47 Destruction of an urban agriculture plot by illegal sand miners. People's livelihoods are instantly destroyed. Dar es Salaam, Photo: District Agricultural Office, Ubungo 2011

Land tenure was a very important issue, as their plot was on the water-board property, but they had no tenure. After the field visit we had a meeting with Sustainable Cities International. This organisation was helping to set up the Tanzanian Food Garden Network, which was pressing for tenancy rights for urban farmers. As a result of this meeting, we wrote the grant application to the Swiss Development Corporation (see Appendix).

Results: posts from Ubungo. Positioning posts results in transdisciplinary framework

In the eight months of the Ubungo project (4 March 2011 to 27 October 2011), the farmers posted 647 times. The vast majority of the posts were close shots of green leafy vegetables such as pumpkin, sweet potato, amaranth, Chinese cabbage and okra. The images were tagged correctly most of the time: in a sample set of 50 there was a correct tagging rate of 85%. The farmers did not really start to interview each other as they did in Chambezi, which they probably would have found more interesting. This had, in fact, been suggested, and they had the same instructions as the Chambezi group. One commented to us that it was boring just taking pictures of vegetables. The Ubungo farmers may have been concerned about security, both personal and for their crops. There were very few pictures of people, wider shots of the plots or anything that might identify where they were – apart, of course, from the geo-tagging of the images, which rather gave them away. The reasons for their fears are well founded: Dar has a high community crime rate[24] and the farmers plots are vulnerable to thieves, illegal sand miners, and the ever-present threat that comes from not having land tenancy. All of these issues (apart from the sand miners) were characterized already in a paper from 1992 by Mlozi, Lupanga, and Mvena, in *Urban Agriculture as a Survival Strategy in Tanzania*, who note that urban agriculture is precarious in terms of 'lack of supply factors, theft of produce, by-laws restricting urban agriculture, crop pests and diseases, physical destruction of crops, and contamination of crops' (Mlozi, Lupanga, and Mvena 1992, p. 293).

I have categorized all the posts from the Ubungo farmers as falling within systems knowledge, focusing on infrastructure (e.g. water supply) and availability of inputs (e.g. fertilizer).

One comment said that in June they have water but in November, January and February they have a water shortage. In any case at all times of year the water is polluted with city runoff, and rubbish lines the waterway.

[24] According to Outwater et al. 2015 'Tanzania has consistently shown in recent decades to have a high overall crime rate. Although its homicide rate is moderate, Dar es Salaam has an unusually high amount of community violence; more than half of all homicides were due to lynching and vigilantism. Most of these Homicides were a reaction to petty theft of purses, cell phones, and domestic meat animals http://www.ajol.info/index.php/thrb/article/view/104128 (accessed 5.12.15).

Figure 48 Map of all tagged posts in Ubungo, Dar es Salaam. The urban agriculture plot is just behind the Ministry of Water and the university Water Research Institute. Screen shot sautiyawakulima.net 6.6.2011

Figure 49 View of the Ubungo plot. Screen shot sautiyawakulima.net

Message sent by megafone on Tuesday 5 of July of 2011 at 22:51:47

Comments:

Comment sent by megafone on Wednesday 31 of August of 2011 at 07:21:24
A well which does not contain water anymore, it is dry.

Figure 50 This well was used by the farmers, but overused by the surrounding houses, which did not have sufficient sanitation. Screen shot sautiyawakulima.net

Message sent by megafone on Tuesday 26 of July of 2011 at 20:59:29

Comments:

Comment sent by megafone on Wednesday 31 of August of 2011 at 08:25:22
This is a machine that is being used to pump water for watering plants.

Figure 51 The farmers use a petrol driven pump, but said the fuel is expensive. Screen shot sautiyawakulima.net

Figure 52 Water sourcing is the main issue. Screen shot sautiyawakulima.net

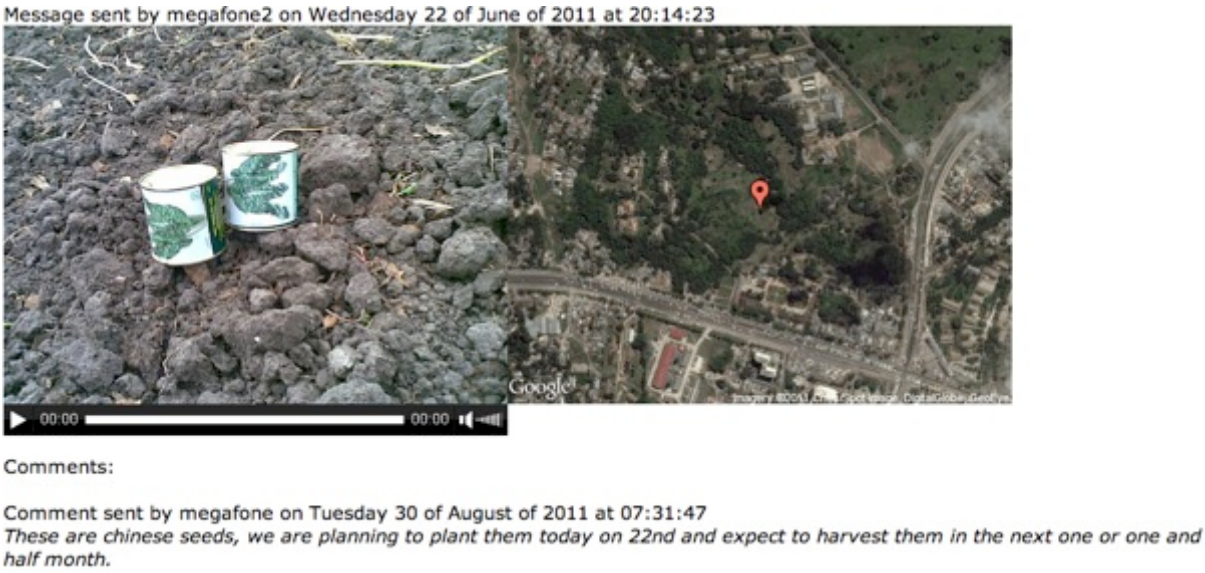


Figure 53 Image of seed cans for Chinese cabbage. Screen shot sautiyawakulima.net

Figure 54 Few of the comments were positive or about crop success, although the vegetable appeared to be healthy. Screen shot sautiyawakulima.net

Evaluation of the posts from Ubungo

Lessons learned.

It is clear from the literature that urban agriculture is not a new issue in Dar es Salaam. In 1992 Mlozi et al. reported that the number of urban poor in Tanzania had recently increased rapidly as a result of the collapse of the industrial sector, which had attracted migration from the rural areas in search of employment opportunities. Consequently, in the late 1980s the ranks of the unemployed and underemployed grew in Dar es Salaam. Coupled with high inflation at the time, this precipitated an increase in urban agriculture as a strategy for coping with unemployment or low incomes. The paper recommended that urban agriculture be surveyed and then projects undertaken by the government to improve conditions for poor urban farmers, such as setting aside land for them. The researchers further advocated that groups of farmers form cooperatives in order to benefit from agricultural credit and secure land rights. Some thirteen years later, in research for Habitat International, Wilbard Kombe reported that urbanisation in poverty is the key factor catalysing changes in land use, increased rural–urban immigration, and the overall transformation of land use in the peri-urban areas (Kombe 2005). The ever-increasing population of Dar es Salaam constantly puts pressure on the land and water resources available for production, while at the same time increasing demand for vegetables (Dongus and Drechsel 2010).

As the situation with urban agriculture has been going on for at least twenty-odd years in Dar es Salaam, it became clear this was a community that needs a much greater level of engagement than we were able to deliver. Their needs were (are) so complex and manifold that a low-level intervention of a community archive project such as *Sauti ya Wakulima* was not going to scratch the surface. Apart from one person, the farmers could not afford the luxury of taking time to visually document their lives. They perhaps also needed more effort on the part of the project team to engage them and help them see the value of the project. There was a laptop provided to view the images and this was based in the District Agricultural Office. The officer reported that two of the men had come once to view the website. Unlike Chambezi, the farmers in Ubungo do not meet regularly with the agricultural outreach officer; she goes around and talks to them separately, and they do not have any evident sense of community. However, we saw a potential for advocacy and community creation, which is why we wrote the grant application to Sustainable Cities International. The Ubungo farmers would have been a suitable group for the Tanzanian Food Garden Network to engage with.

One must be careful of generalizing, but this could be one of the cases that Green (2000) mentions, where the poor are not automatically bonded because they are poor and in the same occupation.

What learning effects did the artists and scientists report?

In the paper *Sauti ya Wakulima – a Collaborative Knowledge Base* (see Appendix for full paper) the authors Tisselli, Schläpfer and Hilbeck argue that the creative freedom afforded to the participants encouraged and motivated participation. The results from this study can be compared with other participatory data-gathering projects and ICT4D projects. The contention would be that researcher-driven questionnaires give a limited picture of the lives of smallholder farmers in comparison with ongoing self-documentation and farmer-led interviews with other farmers. The original research question was to identify the communication needs of farmers relating to climate change and their adaptation to rapid change. By including artists on the team and artistic methods such as Rich Pictures and smartphones, we allowed the farmers creative freedom to document as they chose. We contend that this creative freedom motivated the farmers to participate and to continue to post prolifically. Thus we did not experience the lack of participant motivation frequently cited by similar projects (Miscione 2011, North South Center ICT4D 10.11.2011).

Our findings concur with those of Abay, who states

> Farmers are highly motivated when they can take the lead in documenting their problems and their solutions. They appreciate their roles in making decisions about what to document. Farmers often choose different foci in their documentation than the FLD facilitation team would have done (Abay 2009, p. 25).

Lessons for science and agricultural research

Even in the first exploratory year of this project we gained impressive insights into the daily life and livelihoods of the farmers on the ground – and this, most of time, without being there. While the *Sauti ya Wakulima* method will not replace the personal time of researchers in the field, it can demonstrably, during the time between missions to the field, supply real-time, continuous information – provided one enjoys the full collaboration and trust of the community. This methodology thus holds enormous promise for researchers, both in the global South and in the remote countries of the North, whose projects are based on the identified needs of farmers and seek to make a tangible contribution to the farming community. Real-time postings can inform both the conception and design of research projects that are tailored to local conditions and needs.

This is one the main demands of IAASTD (2009), which called for a paradigm shift in the conception and design of research projects for development, when it became clear that many such projects designed in the North lacked proper information and understanding of real-life conditions in the recipient country. Hence the literature is full of well-meant projects that simply died after the researchers left because of inadequate appropriation. Local needs and the conditions and limitations of adoption had not been sufficiently understood or addressed.

The results discussed in this chapter will be further discussed in the Conclusion to the thesis in relation to some of the broader themes introduced by the literature, which are also relevant to the second case study, the *Climate Hope Garden*. This work, which will be presented and discussed in the next chapter, also concerns questions of collaboration in art-science, lay knowledge with regard to climate change, and how the transdisciplinary knowledge produced by art-science collaborations can be characterized. Again this will be related to the transdisciplinary framework of Pohl and Hadorn.

Chapter 5: Climate Hope Garden

5.0 Art Context: Climate Hope Garden 2011/2012

In this chapter I will examine an installation I staged in collaboration with ecologists and climate scientists at the Swiss Federal Institute of Technology Zürich, (ETHZ) between 2011 and 2012. This consisted of a garden grown in climate-controlled chambers, based on the climatic conditions proposed by IPCC climate scenarios. The project was executed twice, in summer 2011 (which I will call CHG1) and spring 2012 (CHG2), the first time to coincide with the publication of a new downscaling for Switzerland of the IPCC global climate models by ETHZ and Meteoschweiz (CH-2011) in September 2011, and the second as part of a large public outreach event at the ETH Zürich on food and climate change, Treffpunkt Science City*: Welternährung* (Feeding the World), in March 2012. In a third installation, the monoprints produced as part of the installation were exhibited at the event *Ecological Novelty; the World in 30 Years,* held at the Institute for Integrative Biology, ETH Zürich on November 16, 2011.

The project aimed to demonstrate IPCC climate models on a temporal and spatial scale to which people (the general Swiss public) could relate. This was achieved by investigating the nature of a future Swiss garden based on downscaled climate scenarios from the IPCC, using plants that currently grow well in Switzerland. It was hoped that the installation would contribute to the public dialogue on mitigating CO_2 emissions. Further goals were to question notions of evidence in science and art by constructing a site-specific work using the technologies and claiming the legitimization of science. Finally, the intention was to analyse the collaborative aspects of this artwork. How and to what extent were scientists involved, how could this particular art-science collaboration be described, and where was it positioned in relation to similar collaborations?

5.1 Thematic context: Climate scenarios and public response

Environmental and climatic changes already affect people's lives, but not always on a temporal and spatial scale with which they can identify. It can certainly be argued that received climate models are based on a Durkheimian concept of time, which organizes the

data into a time structure that is precise, but too distant for the immediate timescales on which most people base their decisions (Hulme et al. 2009). The project described in the present chapter aimed to create an opportunity for social learning and to relate concepts of climate change to a human scale and a local level.

Public responses to climate change science were introduced in Section 0.3, where notions of space, scale and time were touched upon. In their paper *Human geographies of climate change: Landscape, temporality, and lay knowledges,* Catherine Brace and Hilary Geoghegan (2010) state that climate change 'can be observed in relation to landscape but also felt, sensed, apprehended emotionally as part of the fabric of everyday life in which acceptance, denial, resignation and action co-exist as personal and social responses to the local manifestations of a global problem' (Brace and Geoghegan 2010 p. 1). They argue that climate change could (and should) be researched as a relational phenomenon, understood on a local level. But this local level has to contain a concept of futurity.

They go on to say that such a concept is 'fundamentally conjoined with climate change', and that this conjunction has yet to be fully examined. To fill this gap they take up Fish's argument that notions of the future guide public policy, and that science, governance and communication of climate change create a 'didactic futurology' which 'is designed to foster a sense of obligation and investment in versions of the world that, in the final assessment, may or may not come to pass' (Fish, 2009 p. 3 in Brace and Geoghegan 2010). The crux of the dislocation between public knowledge and public action lies here: in the argument that the scenarios *may or may not come to pass*. What the IPCC is trying to communicate is that one or other scenario will transpire, based on an established chain of past, and a plausible chain of future events. The question is: Which version will transpire and when? It could be argued that even this level of uncertainty dampens a commitment to the future.

The theme has been taken up by Richard Matthew in *Space, time and scales of human security in climate change* (2013), where he investigates universal versus particular narratives. Matthew refers to Michael Walzer's text on the sources and dynamics of moral arguments: *Thick and Thin: Moral Argument at Home and Abroad* (1994). Here Walzer writes that 'in moral discourse "thinness" (i.e. universality) and intensity go together, whereas with "thickness" comes qualification, compromise, complexity and disagreement' (Walzer 1994, p. 6 in Matthew 2013 p. 93). In this scheme a *thin*, but intense, universal story such as genocide or torture can make an impact on a particular community even if they are not directly affected by it. An example of a *thick* (complex, controversial), or particular, story might be the suspected human health effects caused by a local factory which is the only employer in a small community (although this may not be the perfect example, as it is also a universal story).

Matthew argues that the dominant climate change narrative attempts to impose a *thick* universal story on humankind, and that this is the narrative form least likely to succeed (Matthew 2013, p. 94). This has come about because, while the fact of anthropogenic driven climate change is certain, there are uncertainties and planetary variability to the extent of its specific effects, due to unpredictable feedback responses from natural and human systems. This is partly because complex ecosystems display non-linear behaviour, creating uncertainty in exactly how they will behave. So although the climate change story should be universal and intense, prompting moral outrage and action, it is thick and contested, and not finding moral entry points into local dialogue.

The universal narrative is also problematic because of its timescale, both past and future. Climate change has been generated by the behaviour of everyone on the planet over many generations (Matthew 2013). As an aside it could be argued that not everyone is equally culpable, but nevertheless the issue is that no particular community feels motivated to transform unless all others do so as well. As Matthew says, this is the classic problem of cooperation under anarchy. He cites Ken Oye (1986), who considers three variables to be the key to societal cooperation: the number of actors, the likelihood of future interaction, and the payoff structure. From this we can surmise that the grounds for cooperation on climate change are weak. The next section will look a little more closely at the topic of lay knowledge of climate change.

Lay knowledge and climate change

There is a line of thought beginning to gather critical mass that we must recognise the limits of what science can do for climate change politics. From art critics (Bunting 2010) to climate scientists (Hulme 2007) to geographers (Miles, Brace and Geoghegan), there is accord that what we lack is not scientific knowledge but ethical consensus:

> The question is not whether there is a scientific consensus for concern, but simply whether there is an ethical consensus for action and, even more importantly, whether people behave and choose by such ethics. There lies the real weakness of science (Hulme 2007 p 244).

I would argue that this is not a weakness of science, nor is it due to our view of science per se, but rather a recognition of the fact that it is not within the remit or competence of science to make policy or to change behaviour: only politics and culture can do that. Hulme made this point about eight years ago. Today the question is rather: Given the scientific and ethical consensus, why are we not acting? Is the current issue one of representation? In a special issue of *Political Geography* on climate change and political geography, Dalby (2016) points

to the contentiousness of the representation of climate change in the political process and in culture. How climate is represented obviously has implications for how it is understood by various publics, and Dalby contends that CO_2-reducing behaviour is contingent upon this understanding, or lack thereof. There are a number of issues here that need to be addressed. The first is: What is it that laypeople[25] do not understand about climate change? Secondly: Is lack of action on CO_2 reduction due purely to this lack of understanding, or are there other factors/barriers to change? In the following section I will address these questions and examine some suggestions for solutions, including what art might contribute in this context.

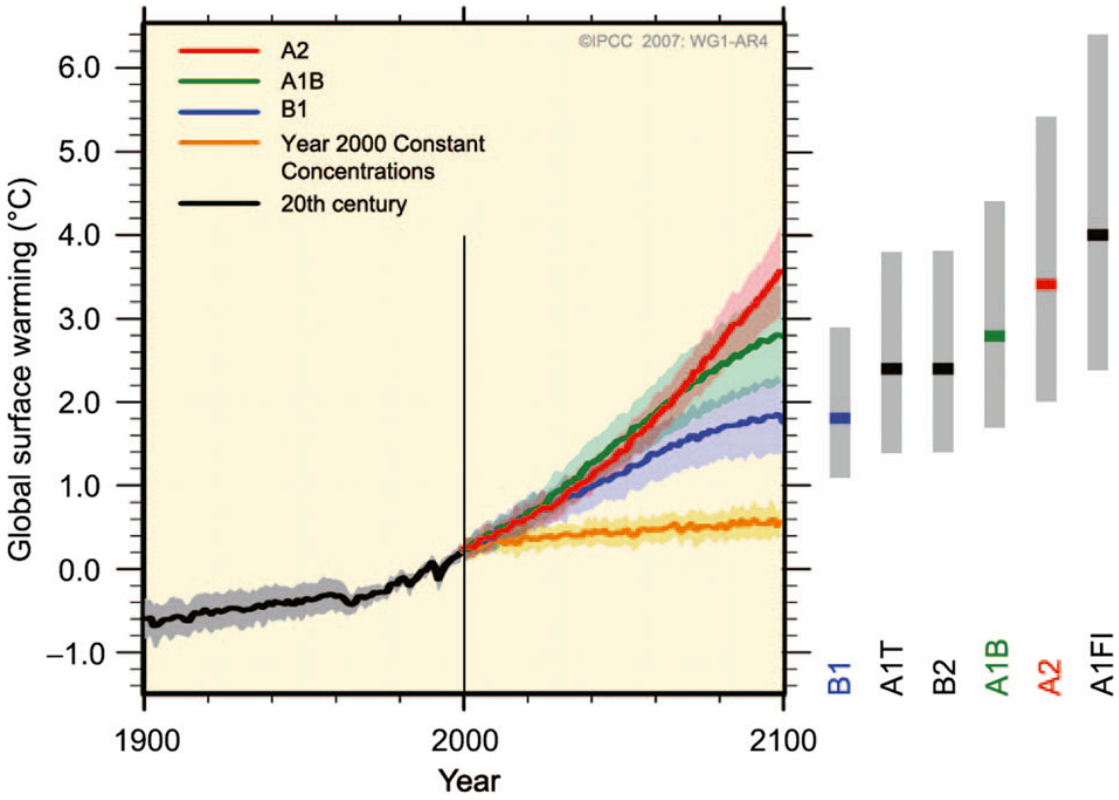
What do laypeople fail to understand about climate change?

There have been a number of studies of laypersons' knowledge or misconceptions about climate change levels; the general picture appears to be similar in the UK, the USA and Switzerland (Bord et al. 1998; Dunlap 1998; Leiserowitz 2007; Reynolds et al. 2010). The studies in question indicate confusion of the hole in the ozone layer with climate change, and a lack of understanding of ocean thermal warming. Even highly educated adults have a limited comprehension of CO_2 stock and flows, and net removal (Moxnes and Saysel 2009). In an attempt to create a standardized way of measuring climate knowledge, researchers from the ETH Institute for Environmental Decisions have created a knowledge scale consisting of various subscales measuring different areas of knowledge: namely physical knowledge about CO_2 and the greenhouse effect, knowledge about climate change and its causes, knowledge about the expected consequences of climate change, and action-related knowledge (Tobler et al. 2012). They found that the Swiss public shared the misconceptions found in the studies mentioned above, but were more knowledgeable about CO_2 than sample publics in other countries. However, this may have to do with the Swiss sample, which had a higher than average educational level. A highly relevant study for the *Climate Hope Garden* was published this summer (2015). It examines understanding of an IPCC graph, and was undertaken by the Institute for Atmospheric and Climate Science at the ETH. The study focuses specifically on a highly educated cohort; this is justified, as the graph in question appears in the Summary for Policymakers (SPM) in the Fourth Assessment Report, and the sample is analogous to the target audience of the SPM.

The IPCC graph displays two types of uncertainty: socio-economic scenarios, and response uncertainty due to imperfect knowledge and models. The graph is shown below with the

25 There are several terms such as 'the public', 'publics', 'laypersons', 'lay experts', which could be used here when referring to everyone who is not a climate science expert. I shall use the term 'laypeople/persons'.

caption 'Multi-model averages and assessed ranges for surface warming', as it appears in the SPM (IPCC AR4 2013).



Multi-model averages and assessed ranges for surface warming. Solid lines are multi-model global averages of surface warming (relative to 1980–1999) for the scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. Shading denotes the ±1 standard deviation range of individual model annual averages. The orange line is for the experiment where concentrations were held constant at year 2000 values. The grey bars at the right indicate the best estimate (solid line within each bar) and the likely range assessed for the six SRES marker scenarios. The assessment of the best estimate and likely ranges in the grey bars includes the AOGCMs in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints.[26]

Graph 5 Graph from IPCC AR4 used by McMahon et al. in their graph comprehension study. Source (including caption): IPCC AR4 WG1 Figure SPM.5

Rosmarie McMahon et al. conducted interviews with forty politicians, communication experts and academics, and three climate scientists. The subjects were tested for graph salience, scientific literacy, content knowledge and graph schema. The results showed that the lay respondents were unable to identify the two different types of uncertainty in the IPCC graph without a substantial amount of assistance. Instead they saw a great deal of uncertainty but

[26] The A2 scenario is business as usual and the A1B is with some emissions controls and the B1 with the strongest emissions controls.

falsely attributed it to the climate models and ignored the scenario uncertainties. This is crucial information to policymakers and communicators of climate change, as this graph is widely shown in the media and, according to Schneider, is an essential tool in climate discourse (Schneider 2012, in McMahon et al. 2015). Indeed a failure to distinguish between these two types of uncertainty may well lead to a 'misjudgement about the overall magnitude of the uncertainties, thus resulting in an overestimate of the response uncertainties, and an underestimation of socio-economic choices' (McMahon et al. 2015). In other words the study found that only climate scientists understood that the uncertainties in the scenario (grey areas in bars on the right) were due to the unpredictability of humans and not due to scientific uncertainty in the models. It was concluded that the graph does not fulfil its 'heuristic function' as a decision-making tool (Schneider 2012, p. 189 in McMahon et al. 2015). This perceived uncertainty could be a contributory factor to stasis in policy and behavioural change.

This leads to the second question to be addressed in this section: Is it the lack of understanding that contributes to lack of action on CO_2 reduction, or are there other factors/barriers to change? Irene Lorenzoni et al. examined the *Barriers perceived to engaging with climate change among the UK public and their policy implications* (Lorenzoni et al. 2007) and found that barriers could be classified as occurring at both social and individual levels. They define engagement as an individual state, made up of three elements: cognitive, affective and behavioural. From a survey of studies they found a disparity between public awareness – which was quite high – and behavioural response. So even if people were able to identify differences between natural and anthropogenic influences on the climate (*cognitive*), 52% of people believe that climate change will have 'little' or 'no effect' on them personally (BBC 2004, in Lorenzoni et al. 2007). Believing (*affective*) that the effects will not be seen for decades and are therefore remote from them creates a 'value-action' gap. This combined with 'widespread and ingrained social barriers' prevents individual voluntary action (*behavioural*). People also claimed that they were not acting, as the government had not imposed, for example, energy restrictions on society as a whole, and individual action was therefore futile. One of the factors contributing to collective or social barriers is media reporting of climate change. A quantitative analysis of the UK tabloid press found that 'combined influences of contrarianism and the utilization of the journalistic norm of balance jointly contribute to informationally biased coverage of anthropogenic climate change' (Boykoff and Mansfield 2008, p. 7). The authors concluded that while tabloid opinion does not inform policy dialogue, it might significantly contribute to the resistance of its working class readership to mitigation and adaptation plans.

So what will inform better dialogue and affective behavioural change? Climate scientists and communication projects such as the Yale Project on Climate Change Communication are advising policymakers to turn to psychology for insights. In a paper they just published with psychologists they advocate five best practice insights:

> (a) emphasize climate change as a present, local, and personal risk; (b) facilitate more affective and experiential engagement; (c) leverage relevant social group norms; (d) frame policy solutions in terms of what can be gained from immediate action; and (e) appeal to intrinsically valued long-term environmental goals and outcomes (van der Linden et al. 2015 p. 758).

As the human brain privileges experience over analysis, climate change has to be communicated as local and personal. While climatic issues are often presented in analytical formats, this assumes that laypeople process uncertain information in a logical and analytical manner. Yet psychologists have shown that the human brain uses two different processing systems. The first is intuitive, experiential, affective (emotional), and fast. The second is deliberative, analytical, rational and slow. We constantly make judgements using these systems in parallel, but when they diverge, the first system dominates. In other words, how we feel about something has a stronger influence on how we respond. The resultant policy recommendation is to translate information about climate change risks into 'relatable and concrete personal experiences' (van der Linden et al. 2015, p. 759).

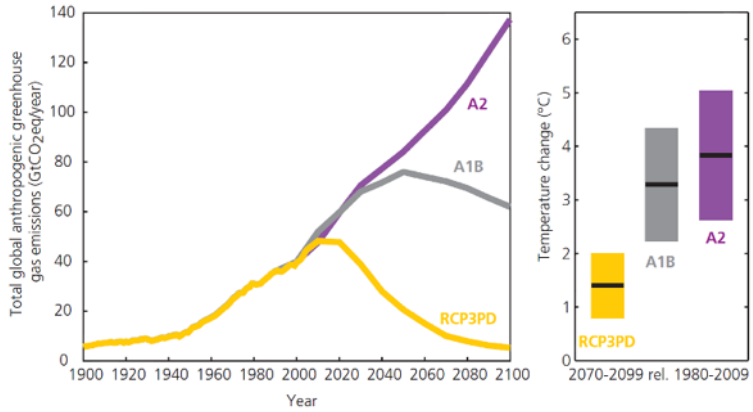
I would argue that art is uniquely positioned to provide such experiences. This has been described as 'the "work" art can do with respect to socio-ecological transformations (Hawkins et al. 2015, p. 331). These authors examine a collective knitting project in Scotland, Bird Yarns, a flock of knitted Arctic terns, which 'land' in various locations in Scotland, provoking dialogue about the disturbance in migration patterns due to climate change. The project has created an international network of knitters sharing patterns, wool and finished birds: 'Bird Yarns offered knitters—and, in part, the local community—the chance to register a different imaginary of earthly and atmospheric collectivities than one focused on scientific fact' (Hawkins et al. 2015, p. 336). The artwork offers not only a different imaginative experience but also 'localizes and materializes climate change', bringing epic narratives to a situation closer to home (ibid). The question arises, then: What other kinds of narrative might catalyse an affective response?

5.2 Project procedures: Climate Hope Garden 2085 – an embodied scenario

Climate models tell us what the future could bring in terms of global climatic changes. We hear about the likelihood of extreme weather events and global average temperature changes of 1.7 to 6°C, but what does this mean for the citizens of Switzerland? For many people it is very hard to imagine what a global few degrees' difference will make to their local weather. Yet a tangible understanding of this may be a key to encouraging ecological stewardship and energy-saving behaviour. According to a report by Meteoschweiz and ETHZ:

> Towards the end of the 21st century, Swiss climate will be strongly affected by the future course of global greenhouse gas emissions. Even if global temperature change is stabilized below 2°C relative to pre-industrial levels through strong mitigation efforts, models project further warming for Switzerland of 1.4°C (CH-2011).

This is about the same increase in warmth as that already undergone by the Swiss climate since pre-industrial times; without strong emission controls, the warming will be two to three times as large. In this 2011 study, global climate predictions were downscaled for three areas of Switzerland, three time periods in the future, and three different emission scenarios. The RCP3PD scenario (which requires cutting global greenhouse gas emissions by at least 50% by 2050 relative to 1990) could be termed a "best case scenario"; the A2 scenario means "business as usual" for emissions; the third scenario A1B was an emissions scenario with some mitigation (see Graph 6):



Graph 6 Emission scenarios from CH-2011 Image: ETHZ/Meteoschweiz

The three pathways of past and future anthropogenic greenhouse gas emissions, along with projected annual mean warming for Switzerland for the 30-year average, centred at 2085 (aggregated from four seasons and three representative regions). These pathways are based on assumptions about global demographic and societal development, energy demand,

technological and economic trends, and corresponding decisions and choices that our world is taking now and may take in the future (CH-2011).

In this context, the aim of the *Climate Hope Garden* project was to grow two horticultural plots under controlled climatic conditions based on two of the downscaled scenarios: A2 and RCP3PD (business as usual and best case) for the period up to 2085.

5.2.1 Collaborators

The project was based on scientific and technical advice from ETH scientists. Prof. Peter Edwards, Head of the Institute for Integrative Biology, gave permission for the project to be undertaken in his section of the greenhouse. Without this sanction to use this very expensive space, and his tacit collaboration, the project would not have been possible.

The most extensive input was provided by Prof. Andreas Fischlin from the Institute of Integrative Biology at ETHZ. Fischlin is an earth systems ecologist and one of the lead authors of the 2007 IPCC Report on Climate Change (and co-recipient of the Nobel Peace Prize). Deeply involved in climate change politics, he has been one of the lead negotiators for Switzerland at the last several COP meetings, including COP21 in Paris. He is also a passionate communicator about climate change and is interested in collaborating with artists in order to better engage the public and help them understand the facts as presented in the IPCC reports. He was a reviewer of the CH-2011. Dr Andreas Fischer from Meteoschweiz, one of the lead authors of this report, provided me with the figures before the publication date and explained the assumptions of the emissions scenarios. The list of suitable crops to grow was compiled with assistance from Dr Angelika Hilbeck, who also recommended the sample size. Dr Jake Alexander, an ecologist examining the effect of climate change on alpine plants, gave advice on simulating different climate scenarios in a greenhouse. Procedures for sowing seeds and transplant seedlings according to standard experimental practice came courtesy of Dr Miluse Trtikova, who also provided maize plants that were surplus to her own experiments.

The mode of collaboration with most of these scientists was collegial advice, as if I were undertaking a scientific experiment as a master's or doctoral student in ecology. They understood the project as a transdisciplinary experiment and gave advice and assistance as they would to any colleague, chatting informally or meeting in the greenhouses.

Andreas Fischlin was as generous with his time as he could be and discussed the parameters and possible variables of the climate chambers. He gave me references and connected me to the authors of the new report. The project was not primarily of scientific interest to him, as he said, “It has been done”, but he was interested in public reaction to the embodiment of the climate models.

Andreas Fischer met with me twice to discuss the results of his report. I suggested that his group could become more involved in the project, as it was attempting to engage with the public, and this might result in a wider reception then a statistical downscaling report would normally receive. However, the group declined to collaborate other than providing me with the report ahead of the publication date. The mode of collaboration of the scientists on the whole was to support and facilitate the idea but not to engage further or co-design the experiment. This is what Born and Barry would term a *subordinate-service mode* of collaboration, with science being in the service of art (Barry et al. 2008).

5.2.2 Participants: modes of collaboration and participation of other actors

In the first installation, *Climate Hope Garden 1* (CHG1), the participants were an invited audience and people could sign up on an online calendar for a tour over a three-week period. Groups of six to eight persons (totalling around fifty participants) participated in a 30-minute tour and talk with the author. In the second installation (CHG2), participants were from Treffpunkt Science City, a bi-annual science communication event, and tours were run every 15 minutes over a two-day period. After the tour the participants were asked to fill out a one page written survey about their experience. Two students assisted with the survey.

Here the co-actors were the organizers of Treffpunkt Science City, who saw the potential for the *Climate Hope Garden* to engage their audience in dialogue about food production in Switzerland under climate change.

Further actors were the television and radio journalists who interviewed me and reported the project on Swiss national television and radio. The TV program was the *Tageschau*, which used *Climate Hope Garden* footage together with the interview in their coverage of the release of the CH-2011 report. A science journalist did the radio interview, but it was broadcast on the culture programme *DRS2 Kultur*.

5.2.3 Technical procedures

1. From working with Hilbeck and Trtikova, researching the biosafety of genetically modified maize, I knew about the climate chamber facility and that several parameters could be precisely controlled.
2. I obtained information on downscaling of climate models for Switzerland (CH-2011), read a draft of the paper, reviewed global climate models, discussed the project with climate scientists (Fischlin and Fischer), read an EU study about public climate change knowledge, and gathered information from the Yale Project on Climate Change Communication.
3. On the basis of this information, it was planned that one compartment should be set to the temperature of the A2 scenario and the other to RCP3PD. Best and worst case scenarios were taken to ensure maximum effect. Variables were based on practical capabilities of the facility in terms of temperature, humidity and precipitation that would most closely simulate the scenario. Summer daylight hours and intensity were created in the March installation. It was not possible for technical and financial reasons to have increased levels of CO_2 as a variable. The modelling for precipitation in the CH-2011 report showed the greatest variation, ranging from 5-30% less rainfall in summer. The value of 30% less rainfall was chosen, as the system would not have been accurate enough to record smaller differences.
4. Seeds were obtained from seed storage in IBZ or bought from a garden supplier. They were sown in multi-cell seed trays with organic seed compost and covered with fine gravel. They were germinated at 22°C and re-potted into 1L pots at 4-6 weeks in organic peat-free compost. The soil was covered with gravel to suppress blackfly. The plants were then moved to the two climate chamber greenhouses for the six-week stress treatment.
5. Crops were chosen according to whether they currently grow well in Switzerland, because this moves the scale from the present to the future. It was also important to choose plants that are iconic for Switzerland such as feed grasses and fodder for cows (which provide milk for cheese and chocolate), sunflowers, wheat and maize. Emmer, an old variety of wheat, was also grown, as it used to be widely grown in Switzerland and (like all the crops) has already adapted to climate change. There is a large population of allotment holders in Switzerland; in order to engage them, horticultural as well as agricultural plants were used. The list of plants was:

- feed grass - *Festuca pratensis*
- feed grass - *Festuca rubris*
- emmer - *Triticum dicoccum*
- wheat - *Triticum aestivum L.*
- lucerne – a forage crop *Medicago sativa*
- maize - *Zea mays*

- Swiss chard - *Beta vulgaris*
- sunflower - *Helianthus annuus*
- cucumber - *Cucumis sativus*

6. Plot 1 (RCP3PD) – the best-case scenario – was set at 21°C and 45% humidity. Each variety was cultivated in a sample size of six. These were divided and half the plants received 30% less water than the other set.

Plot 2 (A2) – worst case of no emission controls – was set at 24.9°C and 30% humidity. Each variety was cultivated in a sample size of six. These were divided and half the plants received 30% less water than the other set.

7. The plants were cared for daily. A video recorder was set up to record a time-lapse of the growth.

8. A personal artistic reading was taken daily, by holding light-sensitive cyanotype paper up to the growing plants, thus creating an image record of the changes in the plants. Each print took 3 minutes to make. This created a personal connection between the author and the plants, and was also a measure of light, as cyanotype paper darkens in sunlight.

9. The audience tour involved experiencing both chambers with only brief input from the author. This was followed by a short talk and discussion of issues raised by the garden.

10. After the CHG2 tour, visitors were asked to fill out a short questionnaire

Figure 55 Young plants being positioned in the climate chamber. Photo: J. Schläpfer ETHZ June 2011

Figure 56 The experimental setup with cooling system. Photo: J. Schläpfer ETHZ 2011

Figure 57 In the 'best case scenario' the festuca on the left with 30% less water is showing signs of stress. Photo: J. Schläpfer ETHZ 2011

Figure 58 Cyanotype image in progress. Photo: J. Schläpfer ETHZ 2011

Figure 59 Cyanotype of corn tufts 15x21 cm 2011, Image: J. Schläpfer

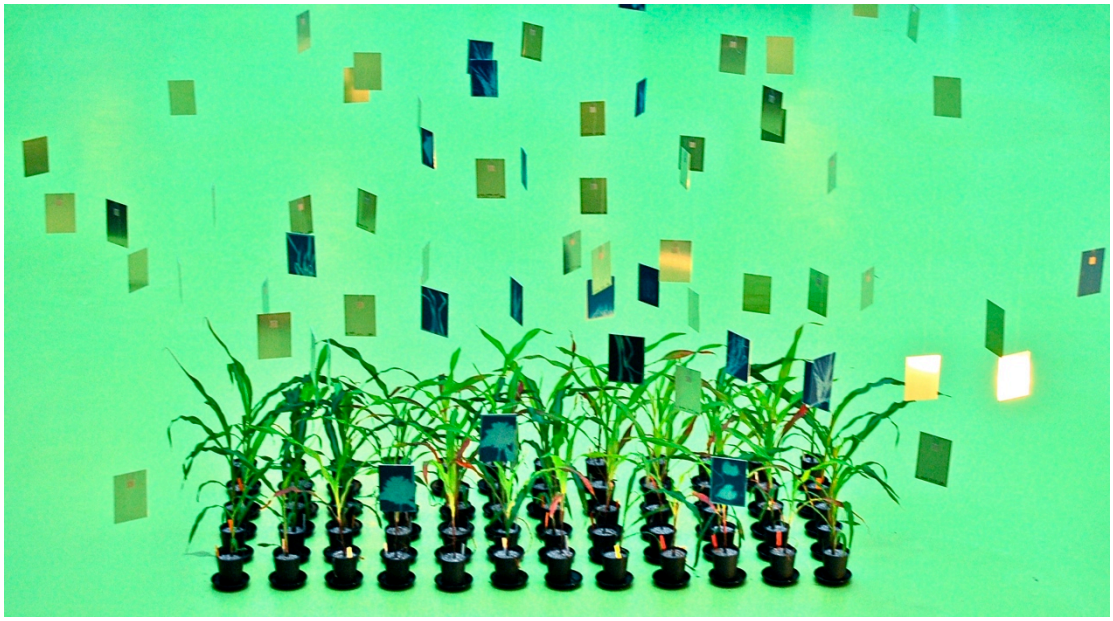


Figure 60 Installation of cyanotype images and corn plants 3x1.5x3.5 m ETHZ, 11.2011 Photo: J. Schläpfer

5.3 Collaboration and new knowledge

I became aware of the research design framework of Pohl and Hadorn during the process of the *Climate Hope Garden*, at which point I positioned possible research questions into the framework of target, systems and transformational knowledge. However, it was too late to design the visitor questionnaires with this framework in mind. The questions were thus:

Systems knowledge – *Will new climate scenarios downscaled for Switzerland be easier for the public to understand and relate to than global scenarios? Can this art-science installation enable a relational understanding of climate scenarios?*

Target knowledge – *Will a better (relational) understanding of climate scenarios contribute to a lowering of consumption in Switzerland?*

Transformation knowledge – *To what extent can an art installation done within the institutions of science contribute to a cultural shift in how climate change is communicated?*

These are, however, huge questions requiring an extended research effort. The question of the long-term affective behavioural responses from science communication events has been widely addressed (Allen 2004, Brown et al. 2009, Ockwell et al. 2009, O'Connor et al. 1999, O'Neill 2009, Falk and Dierking 2000). The consensus is that it is extremely difficult to

assess the long-term learning (cognitive responses) from such events and even more difficult to attribute behavioural responses to any learning that occurred.

I would argue that only the systems knowledge question – *Can this art-science installation enable a relational understanding of climate scenarios?* – is sufficiently manageable to be addressed at this juncture. This question could be partially answered with data from the questionnaires and from conversations with participants. Physically being in the installation encouraged visitors to make judgements about the work from their own knowledge base, in the mode for example of Carey's *ritual communication model*, where all participants bring their knowledge in a ritual-like sharing (Carey 1975).

5.4 Results

The observable results indicated that an increase of nearly 4° average temperature change and a possible 30% less precipitation will have dramatic effects on ecology and food production in Switzerland from 2050 onwards. The plants went through their growth cycles faster in warmer temperatures. The 30% loss of water affected health and growth of plants and visible biomass. The worst affected were animal feed-grass and emmer. In the plot where the temperature was 1.5°C warmer than the current summer average the plants grew well, but growth was reduced by lack of water.

That the garden was visibly in a scientific context validated it for the participants. While plant growth was not measured as it would have been in a scientific study (e.g. by biomass), the technical facilities made the experiment as realistic as possible. An important element in conversation with participants was that all scenarios are imperfect, and while the IPCC models are based on real data, there are uncertainties (due to feedback) as to how complex ecosystems will react. This led to discussions of the limitations of the installation as a model: e.g. the fact that CO_2 was not a variable, that severe weather events were not modelled, and that it was difficult to simulate rainfall, as in essence the experiment plots were gardens, not fields or woodland, and if we have the means we water gardens during drought.

Participants

A total of around 50 people visited CHG1 and stayed for an average of 30 minutes. The temperature difference between the chambers was the most visceral experience, as one could walk directly from best-case into worst-case scenario. The physical difference in what the

scenarios would mean was made clear to the participants. These changes will become more noticeable in their lifetime and will likely be a direct experience of most of those born post 2000, rather than just their children or grandchildren. This moved subjective knowledge from third person to first person reality, by positioning the changes in a landscape and a temporality with which viewers could identify.

Around 150 people visited CHG2, staying between 15 and 20 minutes, and 50 of those persons completed post-visit questionnaires based on visitor survey methods from museum studies (Allen 2004).

Results from surveys

The post-visit surveys were modest in scope, but they did show that 78% of the visitors said the installation gave them a feeling about what climate change would be like in the future; 63% made a clear statement in the survey relating the scenarios to themselves or the future of Switzerland. This is pertinent to the systems knowledge question: *Can this art-science installation enable a relational understanding of climate scenarios?*

Participant comments included admissions that the respondent had not previously considered *'how the plants I grow in my garden will be affected'* and the statement *'Until now I didn't understand the difference between climate and weather.'*

They also showed anxiety about the future: *'I have concern and insecurity about future climate developments'*; or *'It helps me see 2085 as a time worth thinking about and planning for. Makes me realize how things could change. Emotions: both fearful and hopeful'* (visitor surveys 2012).

The installations provided a visceral space to physically experience and engage in dialogue about climate change in relation to horticultural plants in Switzerland, and became a site of reflexive learning within the system of science. Evidence from surveys and participant feedback showed that they could relate to the timescale represented. The timescale was presented to participants as part of a time continuum, as discussions emphasized that we already had a climate that was 1.7°C warmer than the pre-industrial average. We also looked at a graph of the downscaled scenario, which represented this continuum flowing from the past to the future.

Media

On the day of publication of the CH-2011 report there was a three-minute news report on the *Tageschau* (see DVD for clip). This is the main evening news in Switzerland, watched by over a million viewers. The *Climate Hope Garden* was shown as a science experiment and I contributed a sound bite. I explained several times that this was an artwork, not a science experiment, but this concept appeared to be outside the frame of reference of the journalist. The rest of the broadcast comprised interviews with the report lead authors. According to an editor of the news show, the item on the climate report would have been given less than a minute's airtime without the garden to show. Thus if media time were a measure of success then the installation tripled airtime that would have been given to a rather dry report, and thereby reached over a million viewers. The following day there was a five-minute radio report on the national radio culture program, including an interview with Dr. Andreas Fischlin and me. The media coverage validated the work for scientists at the institute, for whom media coverage is an important aspiration.

Monotype prints: The CHG1 resulted also in 35 monotype prints mounted on aluminium done with cyanotype (shadow images formed by UV light on photosensitive paper). Anna Atkins first used cyanotypes for botanical studies of algae in 1843 (*Photographs of British Algae: Cyanotype Impressions*). These formally aesthetic images provide traces of plants past and future, those already gone and those to come. Incidentally, this type of print is where we get the term 'blueprint', which has come to mean a basic design. In this context the term plays on the uncertainty of designing our future.

In CHG2 the plants were more stressed then in the first installation and withered quickly. The monotypes of each plant were therefore placed in the pot with the plant, the image replacing the dying plant and becoming the more visible element in the course of the installation.

Figure 61 CHG 2 with cyanotypes in plant pots. Photo: J. Schläpfer ETHZ 2012

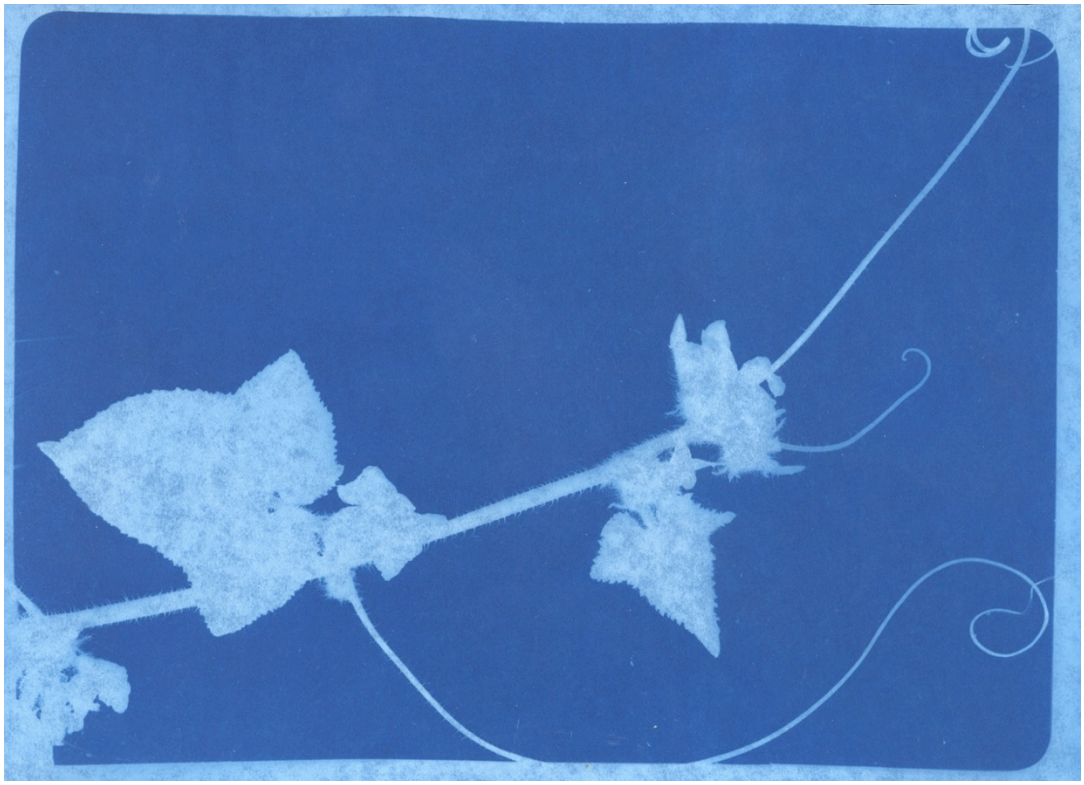


Figure 62 Cyanotype of cucumber plant 15x21cm. Image: J. Schläpfer 2011

5.5 Reflections

The garden installation was an extremely effective way of showing the difference in plant growth between the two scenarios, and of comparing back to back the likely average summer temperatures we would have with strong emission controls and with no emission controls. One could also see that plants that currently grow well south of the Alps, such as cucumber, would benefit from the increased warmth, but only if there was sufficient water. I discussed with visitors the increased occurrence of severe weather events, already a theme in Switzerland, where at least one hailstorm per summer causes crop losses. An increased number of plant installations would have shown better results, as the differences would have become more apparent. Next time I think it would be more valuable to make a comparison of crop plants grown in stress conditions and in the field. This might make comparisons with current Swiss conditions easier, and also show that perhaps while future crop yields will be affected, the real climate losers will be the (more vulnerable) forests and alpine flowers.

The first installation (CHG1) was not accessible to the general public, as I did not yet have permission to open the research greenhouse, so viewing was by appointment only, confining it to an elite audience. The news on TV and radio brought it to around a million people, which could be seen as a measure of success; however, these audiences did not experience the installation physically. An immersive experience was crucial to the functioning of the artwork. The second installation was part of an open day attended by around 150 people, who had mostly come for the science content, so it did reach an audience other than art circles. If we regard it as an art installation, the validation of having it in a science space definitely gave it a weight and attracted media coverage that it would not have had, had it been in a gallery. The future will be to explore a venue in truly public space.[27]

No evidence was gathered to indicate that participation in the Climate Hope Garden might result in affective behavioural responses that might lead to CO_2 reduction. However, it can be evidenced that the systems knowledge question could be answered, as the majority of visitors did relate climate scenarios to their own lives, either personally or spatially.

This project was what Born and Barry (2013) might categorise as science in the service of art, as collaboration was mostly limited to factual input from the scientists who enabled the artwork. I would have liked to have had a project team to co-design the experiment; however, the scientists I worked with did not believe that the installation could answer any relevant (scientific) questions. As there was no budget, all time contributions were voluntary and it

27 Climate Hope Garden 3 will take place in summer 2016 in the Old Botanical Garden in Zürich, a public park in the center of the city.

was hard to find time to discuss questions with scientists. However as I was working as a lab assistant in Hilbeck's lab and therefore immersed in the working culture of the institute, the scientists interacted with me as if I were a researcher and gave advice and input as they would to any other colleague.

So there was indeed a sense in which I was appropriating the methods and infrastructure of science to create an artwork, and the institution of the ETHZ certainly lent validity to the project. If I had been commissioned by the authors of the CH-2011 report to create an artwork to engage the public with their results, it could be argued that this art was being instrumentalised by science. Yet this was not the case, as the report's authors only gave technical input; nor did they show any gratification for the media coverage.

As an artist and science communicator I saw the need for a different kind of understanding of climate scenarios, a need which I believed could be met by creating an embodied experience. If art was in any sense instrumentalised, then it was by my dual role as both artist and science communicator – using art to communicate science.

Nor was this work what Nowotony et al. would describe as Mode 2 knowledge production (Nowotony et al. 2001). It did not seek to create new scientific knowledge; rather, by situating scientific knowledge in a physical context, it sought to provide an alternative understanding of what future scenarios mean. It may be more accurate to use Born and Barry's concept of 'public experiment' to describe the *Climate Hope Garden*. They use the example of an artwork called *Pigeon Blog* by Beatriz da Costa to illustrate their concept of public experiment. This art-science project used homing pigeons to monitor air pollution in inner-city areas. It was not a purely citizen's science exercise, nor did it present results to the public, but it contributed 'to the generation of something new within scientific practice itself, challenging the boundaries of disciplinary authority' (Born and Barry 2013, p. 263).

Referring back to Chapter 1 section 1.4, where I describe Born and Barry's writing on Cassin's discussion of the Greek rhetorical forms of *apodeixis* and *epideixis* (where they argue that *apodeixis* equates with public understanding and *epideixis* with public experiment), I would argue that as a public experiment the *Climate Hope Garden* uses an installation as object in a performative way, to engage a public in dialogue through the rhetoric of *epideixis*. In the sense that *apodeixis* is a kind of proof-demonstration confirming the object or finished truth, '*epideixis* forges relations between the new knowledge, things, locations and persons that did not previously exist' (Born and Barry 2013, p. 265). In order to further differentiate between science communication and public experiment we can use Cassin's distinction between 'the presentation of pre-existing proofs' and 'managing evidence by contriving new types of obviousness' (Cassin 2005, p. 864 in Born and Barry 2013, p. 265). In this sense the

Climate Hope Garden 'manages evidence' by forging new relations between time-scales, climate, place and human activity. Potentially at least, such new relations may become the basis for communities to create their own narratives about climate change – narratives that are both universal and particular and use complexity not to stifle, but to galvanise action.

The *Climate Hope Garden* will be further discussed in the Conclusion.

Conclusions – Defining the new art-science knowledge produced by collaborative art-science research

6.0 Introduction to chapter

In this Ph.D. research I have engaged in practice-based research and situated this research in an artistic and transdisciplinary research context.

Concern in scholarly circles about the role of inter-/transdisciplinarity in addressing "wicked" problems such as global environmental change is still as pertinent now as when I began this research, in what seems like a previous geological era[28]. In an opinion piece for *Nature Climate Change,* 'Changing the Intellectual Climate' a large authorship of eminent environmental social science and humanities scholars argue that despite the frequent calls for cross-disciplinary research – which would be both more integrated and more useful – many environmental scientists have a 'limited conception of social sciences and virtually ignore the humanities' (Castree et al. 2014). In their paper these authors make the case for an expanded conception of intellectual engagement to include the social sciences and humanities. More recently, a special edition of *Nature*, *Interdisciplinarity* (September 2015), has included articles on "How to Catalyse Collaboration" and "The Metrics of Interdisciplinary Publishing". In a comment entitled "Global Funders to Focus on Interdisciplinarity", Rick Rylance, the Chief Executive of the Arts and Humanities Research Council UK, noted the dearth of data on which funders could base judgements about the merits of interdisciplinary research, and announced the publication of a Global Research Council in-depth report on interdisciplinarity in 2016. This comment, as well as the special edition, sparked a lively response from transdisciplinary scholars, who asserted the need for prolonged thinking about transdisciplinary research and how it could be assessed:

> Interdisciplinarity should be assessed in light of its purpose in addressing societal problems. Criteria applicable to assess relevance ask whether the framing of the research problem adequately represents the complexity of the societal issue, acknowledges diverse perceptions of stakeholders, and enables the development of

[28]Officially we are still in the Holocene, but I have not included discussions about the Anthropocene, for – although widespread in academic circles – they have little bearing on Tanzanian farmers or the general Swiss public. Crutzen, P. J. (2006). *The "anthropocene"* (pp. 13-18). Springer Berlin Heidelberg.

> effective means to solve the problem (Adler, Hadorn and Küffer, 2015 online comment to Rylance)[29]

That the discourse on interdisciplinarity, and the importance of including widely disparate disciplines, has reached *Nature* and *Nature Climate Change* indicates that the issue is far from resolved. It is, in fact, still not sufficiently represented in mainstream journals. If the humanities are still being sidelined in this debate, this is even more the case with the creative arts, which underlines the relevance of examining current art-science research.

6.1 Research questions

In this concluding chapter I shall return to the research questions formulated in the Introduction, in order to structure discussion of the case studies in the light of the literature reviewed earlier in the thesis. The final section of the conclusion will propose areas for future research.

The main research questions were thus:

1. How does the application of this transdisciplinary framework enable the discussion of the knowledge produced by art-science?
2. In what ways do the modes and logics of collaboration impact the research practice?
3. How and in what ways can art-science collaborations engage with lay knowledge on climate change?
4. How can creative participatory methods facilitate social learning and or participant data gathering?

Having identified the following key facets of the transdisciplinary framework, this section will take up each of these in turn and explore them in relation to the projects *Sauti ya Wakulima* and the *Climate Hope Garden*. The key facets of the framework are: a) Designing research questions with the type of knowledge in mind; b) Structuring the results according to the type of knowledge produced; and c) The importance of including lay knowledge in the research process.

[29] www.nature.com/news/grant-giving-global-funders-to-focus-on-interdisciplinarity-1.18344 (accessed 21.11.15).

6.1.1 Research question 1: How does the application of this transdisciplinary framework enable discussion of the knowledge produced by art-science?

I have found the transdisciplinary framework proposed by Pohl and Hadorn a useful tool to structure thinking about the type of knowledge produced by art-science research. The categories of knowledge in their transdisciplinary framework proved broad enough to encompass the many types of knowledge, including local and embodied knowledge, that I encountered during the development of the two projects discussed in this thesis. However, I did not use the framework as it has often been used, to integrate various types of knowledge in research that is goal-oriented towards problem-solving or creating policy recommendations. This is because it was not appropriate for my projects' goals. Osborne critiques the established transdisciplinary discourse on goal-oriented problem-solving as being 'positivist and organizational', and indicative of an 'instrumental, technocratic humanism amenable to technological solutions' (Osborne 2015).

This critique of Pohl and Hadorn's view of transdisciplinarity provokes the question of whether their framework is suitable for application to art-science research, which aims beyond instrumentalism and towards new ways of thinking about both art and science. For, as Barry asserts, it is by resisting the logic of instrumentalism and accountability that art-science can come into its own as a field – although it must be added that resisting the logic of accountability may be inimical to the acquisition of funding for art-science research projects. Be that as it may, research questions must be carefully considered so as not to limit them to disciplinary norms or values of usefulness. It was for this reason that I revised the phrasing of the transformation knowledge question relating to *Sauti ya Wakulima* from *Is this transdisciplinary data useful to natural scientists*? to *Can this type of data gathering inform the natural sciences?* The revised formulation provides a more open-ended question, the focus now being on what the natural sciences might learn, rather than what farmers' data can prove. Nevertheless, part of the chosen data evaluation method was a filtering system looking for correctness of tags and text/image correlation.

6.1.1.1 The transdisciplinary framework as applied to Sauti ya Wakulima

The transdisciplinary framework enabled a sorting of data into the types of knowledge defined by the framework: *systems*, *target* and *transformation* knowledge. From the results in Chapter 4 it can be evidenced that farmers' posts contributed to all three knowledge types, with more contributions to systems and target than to transformation knowledge.

Systems knowledge questions were, for example: *How are Tanzanian farmers adapting to possible changes in climate? How do they share information about farming practices?* Adaptation and flexibility of practices was frequently evidenced, as was the sharing of good practice. 'Interview' and 'knowledge' are still the most frequently used tags, as shown by the tag cloud on the web platform. Praising good practice by interviewing colleagues is a common theme of posts, making information culturally accessible to other farmers.

Target knowledge questions included: *In what ways can a participatory mobile phone project strengthen the community?* Evidence for this knowledge comes from interviews with the group of farmers rather than from the posts themselves. The interviews report deeper interactions about best farming practices between members of the group, as well as strengthening of their collective business activities.

The transformation knowledge question was: *Can this type of data gathering inform the natural sciences?* This has been partially answered, inasmuch as I have demonstrated the potential of participatory data gathering. But the answer also depends on how one interprets the phrase '*inform the natural sciences'*. The Tanzanian farmers could contribute systems and target knowledge, but not necessarily repeatable experimental data. Natural scientists have traditionally needed data that is accurate and scalable, bringing us to the conventional dichotomy of idiographic versus normative knowledge production. But what if we could move away from the 'objectifying consciousness' (Kester 2011, Gablik 1995) of science towards 'a way of collaborative thinking and theory formation that depends on long-term continuous interactions' (Küffer 2012 p. 132)? The generation of knowledge in 'long-term continuous interactions' is a process to which *Sauti ya Wakulima*, for example, could arguably contribute. After all, the farmers have been posting images and voice recordings continually from January 2011 until the present, beyond the end of the 'official project' and funding. The participation of stakeholders and the inclusion of lay knowledge are crucial to Pohl and Hadorn's definition of transdisciplinary research, constituting the third key facet of their framework. This was applied in *Sauti ya Wakulima* as the central mode of the project. Rather than including evidence from farmers in a multi-layered project, the evidence was, and

is, the voice of the farmers themselves, as they are the ones who speak. The role of the other researchers was that of facilitation, of an 'enabling voice' (Tisselli 2015).

6.1.1.2 The transdisciplinary framework as applied to Climate Hope Garden

With regard to the *Climate Hope Garden* the research framework of transdisciplinary questions that I encountered during work on this project (see Chapter 5.3), helped structure my thinking about how – and what type of – knowledge is produced by this mode of art-science collaboration. The questions were as follows:

- Systems knowledge: *Will new climate scenarios downscaled for Switzerland be easier for the public to understand and relate to than global scenarios? How can this art-science installation enable a relational understanding of climate scenarios?*
- Target knowledge: *Will a better (relational) understanding of climate scenarios contribute to a lowering of consumption in Switzerland?*
- Transformation knowledge: *To what extent can an art installation undertaken within the institutions of science contribute to a cultural shift in how climate change is communicated?*

These are all really interesting and still pertinent questions, but (as observed in Chapter 5) they are also complex and only partially answerable for the last iteration of the *Climate Hope Garden*. The systems knowledge question about relational understanding links to the third research question: *How and in what ways can art-science collaborations engage with lay knowledge on climate change and enable a relational approach?* The two projects relate to these questions in different ways. *Climate Hope Garden* included an examination of lay knowledge in the conception and execution of the work and addressed uncertainty and physical experience. *Sauti ya Wakulima* was/is actually constructed by lay knowledge via a participatory process. (This discussion continues as part of Research Question 3, below.)

6.1.2 Research question 2: In what ways do the modes and logics of collaboration impact the research practice?

As collaboration becomes an increasingly valued part of how we tackle complex world problems, it is progressively important for us to critically reflect on these practices and examine both the definition of collaborator and the logics and modes of collaboration with research partners. In this section I will reflect on the logics for undertaking this art-science research and the modes of collaboration evidenced in the two projects, including the mode of participation of the farmers. In doing so, I will examine the ways in which these are relevant to the research outcome.

The way collaboration is organized in transdisciplinary or interdisciplinary research can be described as the mode – i.e. the type of collaboration defines the mode. Referring back to the modes of transdisciplinary research discussed in the introduction, it is safe to state that *Sauti ya Wakulima* was transdisciplinary as defined by Hadorn, as this project went beyond integrating knowledge from different disciplines to integrating perspectives of social groups outside of academia (Hadorn 2011).

The ground feels a little shakier, however, when I attempt to decide which of Barry's three modes of interdisciplinarity could best describe the project.[30] Arguably there are elements of at least two modes in this multifaceted project. For instance, the subordinate-service mode is the one in which the service discipline makes up for a lack in the master discipline – or, here, in which 'the social sciences enable the natural sciences to engage with social factors by adopting their natural science problem framing'. In the case of *Sauti ya Wakulima* there is a sense in which we, as artists, adopted the natural scientists' framing of the problem. In the first round of grant applications at least, the stated aims were 'to communicate climate change' and 'mutual learning for climate change adaptation'. The very concept that the global south should adapt to climate change makes the undertaking sound value free, which of course it is not. It also omits the cultural and historical context of the causes of climate change in Tanzania. Yet in *Sauti ya Wakulima* there were also elements of the second mode, the agonistic antagonistic mode, where the interdisciplinarity 'springs from a self-conscious dialogue with, criticism of, or opposition to, the intellectual, ethical or political limits of established disciplines' (Barry et al. 2008, p. 29). The decision of the agro-ecologist Angelika Hilbeck to engage in cross-disciplinary practice with artists was based on dissatisfaction with the ability of her discipline to engage in truly transdisciplinary research. Eugenio Tiselli, my

[30] The *integrative synthesis mode* - work is judged by the criteria of the antecedent disciplines; the *subordinate service mode* - the service discipline compensates for a lack in the master discipline; the *agonistic antagonistic mode* - opposition to, the intellectual, ethical or political limits of established disciplines' (Barry et al. 2008 p. 29).

artist colleague, was concerned with the ability of science to hear the voice of the research subjects; and my own slightly antagonistic concern was with the nature of transdisciplinary art-science practice itself, and the question whether it could really deliver more than the sum of its disciplinary parts.

In the *Climate Hope Garden*, the subordinate-service mode was reversed and science was in the service of art. Science lent its infrastructure, expertise and legitimacy to art without participating in the research questions or using the results.

6.1.2.1 Logics of collaborative art-science: under what logic was this project undertaken?

I would argue that *Sauti ya Wakulima* was undertaken partly employing the logic of accountability (Barry et al. 2010), and that this was justified by the need for socially robust science, exemplified in the calls for climate change research to involve local, indigenous, and non-scientific knowledge. The grant applications written by the research team stated that:

> A particular challenge is the communication of micro and macro scales of climate science. To create socially robust knowledge useful for communities, local knowledge has to be combined with scientific expertise (Project proposal for co-financing request from the KFH, Scott et al. 2011, see Appendix).

The logic of ontology (or what might more properly be termed 'meta-science')[31] argues that if artists and scientists collaborate they will be able to create 'a new understanding of the nature of art and science'. This must be of primary concern in any project concerned with mapping out the new knowledge created by art-science research. The present thesis can at most exemplify this logic; it is beyond its scope to make a claim about changing the nature of science and art in general, however tempting that might be.

The logics and modes of engagement discussed by Barry et al. (2010) are similar to the concept of 'ontological priors' (i.e. real, as opposed to notional preconditions) proposed by Reilly (2011) in the context of a framework for open development in Information and

[31] I would argue that it is necessary to mitigate the very loose use of the term 'ontology' in this context. To speak of 'ontology' in contrast to 'epistemology' brings out the distinction between the orders of knowing and being, our knowledge of the world and the world we know (although that world is only available to us in and through the act of knowing and the sign systems in which it expresses itself). But to speak of 'a new understanding of the nature of art and science' as 'ontological' is to confuse the two orders. After all, art and science are ways of knowing the world; they are not primarily the world we know; they are methods, not the object of methods. To make them the objects of method is to enter the realm of meta-science, which is actually what we are doing here.

Communication Technologies for Development (ICT4D). She argues that research should focus on enhancing cognitive justice rather than productivity or empowerment. In ICT4D research, ontological priors are often either the assumption that development should enable the Global South to be inserted into the information society, or conversely that development should empower local actors to resist the globalizing forces of the information society. Open development, Reilly contends, should start from the assumption that development aims to ensure cognitive justice, so that the protagonists of development can determine their own ways in the world (Reilly 2011, p. 49).

These arguments encourage reflection on the 'ontological priors' of the present research framework. The projects were motivated by discourses of empowerment, and my artist colleague Tisselli was additionally motivated by the concept of technology appropriation. Our epistemological commitments had both positivist and interpretivist tendencies, as evidenced by the various research proposals and articles. The urban agriculture (UA) proposal for Dar es Salaam, for example was much more solution-oriented then the original project in Bagamoyo. The UA project proposal included the aims 'To facilitate the legitimization of UA as a secure land use in Dar es Salaam and ultimately contribute to increasing economic, social and environmental benefits from UA through documentation and quantification of the contribution of urban and peri-urban informal food production to total food security of the greater Dar region' (Concept note to SDC 2011, in Appendix). In Bagamoyo, the project aims were 'To establish an open and participative research process in which local farmers use smart phones and a web platform to document their environment and the effects of climate change, and thus create a collaborative knowledge base that is useful for the farmers, extension workers and researchers' (Schläpfer et al. 2013). We were genuinely open to what the farmers wanted to do with the project. Although I certainly have personal political tendencies (or 'ontological priors') which would drive me to 'empower local actors to resist the globalizing forces of the information society', as a team we were pragmatic and open to the farmers if they chose to use the project to join the information society. On starting the project, I was not fully aware of the outreach of concepts of open development or cognitive justice, but perhaps due to our competencies as artists – or simply our curiosity and naivety – our participation enabled the farmers to fully engage in the project.

6.1.2.2 Participants as collaborators

Participation is often defined in contradistinction to collaboration, but (as mentioned in Chapter 2 in the context of web-based cooperation) the terms are often mixed. Questions arise about the community archive produced by *Sauti ya Wakulima* and the nature of the collaboration between the farmers as participants and the researchers as collaborators with each other and with the farmers. This is an interesting question in itself, which merits investigating for its intrinsic value; but it seems important, in addressing the larger thesis aim of *'how to define new knowledge produced by collaborative art-science research*, that the collaborative role of the farmers should be closely examined. The criteria for defining the mode or level of participation of the farmers, as presented in Chapter 2 above, are taken from Hyde et al. (2012, p 60-62). These are intention, self-governance, control of the mechanism, and network topology, as well as questions of accessibility, equality and scale.

The first is the question of intention: The answer to this – given that willed agency is required – is that the participants definitely intended to contribute and to do so actively. The farmers also shared the goal of contributing to the database of posts. They identified with the project aims as members of a group. Within the concentric circle of farmers from Bagamoyo region they were associated with the field-trials research coordinated from the Chambezi Research Station and they defined themselves as the *climate change reporting group*. Individual identity also sometimes comes into play when they say, for instance, in connection with the posts, "This is Mr Issa in Bamu village". The farmers enjoyed intellectual property rights for their images and farming practices, but drew no material benefit from the outputs. The farmers have no copyright in the posts, but the application has a creative commons licence. Knowledge transfer clearly took place among the participants and with other parties, inasmuch as the researchers evaluated the posts.

Questions of (self) governance also arise. The answer to the question 'Were the structures and rules of engagement accessible and could they be contested and renegotiated?' is 'Yes' to both parts. The rules were unwritten; they were discussed with the farmers but not formally negotiated. Yet at every meeting there was feedback, and space was given to negotiate the content and steer the direction, and the project progressed and expanded at the request of the farmers, who wanted to link up with other communities.

A related question is whether the participants were interested in having control of the mechanism. Here the answer is 'I don't know'. The mechanism was coordinated by the author of the software application, Tisselli, who, despite multiple attempts, found that there is not enough know-how (or willingness) for the software behind the server or the application to be

administered in Tanzania.[32] The system is not automatic, but only minimal human intervention is required for maintenance. Nevertheless, it would seem crucial for Tanzanians to have complete control over both programming and the server, otherwise their data is being kept in Europe and is dependent on goodwill and trust, as there is no written contract about ownership of intellectual property. It also means that the project is dependent upon the European researchers, who may at some point not wish to be bound to the project.

Questions of accessibility and equality: the participants were an invited group selected by the agricultural outreach officer and the researcher from the University of Dar es Salaam. The group was selected to be gender balanced with five men and five women, which is equal but not necessarily representative, as most farming work in Tanzania is undertaken by women. It is a weakness of the *Sauti ya Wakulima* project that gender issues are not fully addressed beyond the basic gender balance of participants. The phones rotate every two weeks, so everyone has the same amount of time, and the agricultural officer coordinates this rotation. Yet it is apparent that more voice contributions are from men than women. There is no user identification mechanism, so it is not possible to identify individual users other than by their own voice. More research such as individual interviews would be required to assess gender or time issues constraining or enabling participation.

What is the network topology? In this project individuals are connected to each other in that they all contribute one way to a platform and there is no network connection between the contributions apart from the tag cloud, which changes as posts and tags are added. Other connections between participants occur because of their social group and their collective commercial activities. So they network physically rather than digitally. More recently there has been an expansion of the project to Zanzibar, expanding the digital network at the initiation of the farmers who wanted to connect with similar groups (Tisselli 2015).

The scale of the project is that it is a small group of 10 farmers over a geographical area of 25km^2 that has been actively contributing for nearly five years. Each post takes between seconds to up to five minutes, depending on whether the speaker is interviewing someone. The scope of the shared goal is to document farming practices and adaptation to climate change. There is no goal for the number of posts or the scope or timescale of the collaboration, which is currently still open-ended.

We can see that, according to the digital collaboration criteria of Hyde et al., participation is high in terms of autonomy of content and motivation to participate; and intention, personal agency, group identity, knowledge sharing, and frequent posting over a long timespan are also

[32] Tiselli and Hilbeck tried numerous times to find local administrators and had meetings with local IT groups but they had little interest in such an agro-ecology/IT project with no business model attached to it.

given factors. Creative agency is present, as the farmers are free to post whatever they deem appropriate: there has never been any censorship, nor have posts been removed. Due to the technological structure of the project there is no network connection among participants; however, they have personal contact and weekly face-to-face connections. Yet the highest level of collaboration, that of self-governance, is not yet available to them.

6.1.3 Research Question 3: How and in what ways can art-science collaborations engage with lay knowledge on climate change?

In the *Climate Hope Garden*, lay knowledge was examined in terms of current narratives of climate change. The concept of universal versus particular narratives (Matthew 2013, Walzer 1994, and Dalby 2015, in press) pointed to the contentiousness of the representation of climate change in the political process and contemporary culture. I argued that this representation stemmed from a misunderstanding of climate science. It has been shown that the single most widely published IPCC graph was only fully understood by climate scientists. In a (albeit small) sample, politicians, academics and communications professionals failed to grasp the difference between model and scenario uncertainty. This type of confusion leads people to misjudge overall uncertainties and to underestimate the socio-economic choices available (McMahon et al. 2015). The *Climate Hope Garden* engaged with lay understandings of scenarios by enabling a visceral experience of a scenario in which CO_2 emissions are not curtailed, and a contrasting scenario of limited emissions. These were presented as social and economic choices, not as uncertainties inherent in a model. Two distinct issues are at stake here: *Do people understand the scenarios?* And: *Do people see themselves in the scenarios – do they relate to them in time and space?*

The main aim of the *Climate Hope Garden* was to enable a relational approach to climate scenarios. The results of the visitor surveys and conversations with visitors show that this was achieved. That is, laypeople were able to position themselves, and in some cases their gardens, *in relation* to the future. Visitors were able to bring their stories of what they grow in their garden and their memories of the weather during their childhood, and to relate this knowledge to the model of the future created in the controlled greenhouse. This fulfils Carey's ritual model of communication which, he states, enables participants in a communication event to bring their previous knowledge to the event and thus to create an

understanding based on commonality and an exchange of knowledge and experience (Carey 1992).

A relational approach also includes *aisthēsis,* which correlates to knowledge that can be perceived or comprehended by the senses – i.e. by the body, through physical perception rather than just through cognition – before it is expressed in an argument or changed by writing (Derrida in Fliescher 2015). Thus the art of the *Climate Hope Garden* is to reflect the perceivable through perception and the experiential through experience (Mersch 2015). The scenarios are perceived by creating a physical experience, enabling a perceptual understanding according to Lyotard's argument that the power of art stems from 'a sudden heuristics' that makes use of inconsistencies within *aisthēsis*, creating its own evidence (Lyotard 1993). This can be applied to the *sudden heuristics* of the *Climate Hope Garden*, which physically and emotionally affects the visitor with its bluntness; for the heat, at first pleasant, becomes stifling, as one realizes that this would be the average summer temperature, and that some periods would be even hotter. The dried plants, crops that we eat, are clearly not producing as well as they ought to, provoking anxiety about food supplies.

Taking Lyotard's concept of *sudden heurestics*, it could be argued that the impact of the *Climate Hope Garden* is closer to philosophy than to art or science – a paradigmatic change in our way of thinking, or indeed something other than and beyond thought. This concept is relevant to the audience's creation of meaning in the *Climate Hope Garden*: meaning which is created through relating perception of the physical body to climate scenarios. To accept this argument is not, however, to situate the experiment in a realm beyond science or art. That its results are perhaps amenable to a philosophical rather than a strictly scientific or artistic critique merely indicates that the experiment does what it set out to do: to transgress the received boundaries of art and science.

The engagement of art-science with lay knowledge of climate change in *Sauti ya Wakulima* is manifest in the fact that *Sauti ya Wakulima* consists centrally of lay knowledge: it is the hands-on knowledge of Tanzanian farmers who in their daily lives encounter and cope with climate change as an ongoing phenomenon. Climate change in the scenarios investigated in this thesis has an immediate economic and existential impact of the sort not otherwise experienced by northern hemisphere scientists (or farmers, come to that).

The relational approach facilitated by the *Sauti ya Wakulima* project operates, I would suggest, at two levels. That the farmers among themselves achieved a higher level of mutual relatedness and a higher relational awareness to weather and climate change has been demonstrated above (see Chapters 3 and 4). Over and above this, however, is the relational

approach engendered by the project with respect to the scientists and artists involved, both in Switzerland and in Tanzania.

6.1.4 Research question 4: How can creative participatory methods facilitate social learning and/or participant data gathering?

In this thesis I have attempted to draw parallels between transdisciplinary research, participatory art, and socially concerned art. In the modernist era, both artists and scientists were taught not to be concerned with the applications or moral implications of their work. Yet just as the limitations of 'objective' science are now recognised, and there are many calls for 'socially robust science', so there is a wide artistic movement outside the gallery system and conventional art criticism that rejects 'the reductive and neutralising aspects of aesthetics and art-for-art's-sake' (Gablik 1995). Furthermore, just as transdisciplinary theory calls for an integrative mode of thinking which focuses on the relational nature of reality rather than discrete objective truths or realities, so art has moved away from a spectatorial epistemology 'from seeing to listening', which generates a very different epistēmē and ontology (Levin 1993). The role of art in facilitating social learning has been described as 'the "work" art can do with respect to socioecological transformations' (Hawkins et al. 2015, p. 331). After examining a collective knitting project in Scotland, the authors observed that the project offered participants a different imaginative experience from that of science: one that 'localizes and materializes climate change', bringing epic narratives to a situation closer to home (Hawkins et al. 2015, p. 336).

The methodology of *Sauti ya Wakulima* allows us to listen to the farmers. Their long-term engagement with being 'the climate change reporting group' has enabled them to consider climate change from their own individual and local perspective. Many of the posts were interviews with other farmers, showing their innovation and adaptation potential. It is this *showing* that parallels their knowledge to the reflexive knowledge of art, which Mersch describes as that which 'shows', and, unlike natural science theories, 'has no true or false dichotomies' (Mersch 2015, p. 46). The knowledge produced by the farmers in *Sauti ya Wakulima* is a *showing* which relates specifically to their situation, thereby creating a body of knowledge, an archive of first-person accounts.

Social learning has been evidenced by the analysis of the posts and by interviews with the farmers, who used the phones to post images of their animals and crops, harvests and

infrastructure, but above all to interview other people. In these interviews, their knowledge and creativity (for example the invention of a shelling machine or experimentation with intercropping) were revealed. The phones were also used to provide visual evidence of problems such as pests, plant diseases or the scarcity of water, and to advertise products or services. However, the main learning came not through learning from looking at individual posts on the web-platform, but rather from the discussions and interactions for which the mobile phones acted as catalysts. As evidenced by interviews the farmers made with each other, they learnt new farming practices such as terracing, pest control and intercropping. They also learnt that mobile phones can be used for more than telephoning and messaging, and they learnt that they, too, are players on the digital stage – that communications devices have further potentials to which even they as rural farmers have access.

Social learning may only be one reason why the project is still active five years on. It is a testament to the validity of it for the farmers' lives that they have found a way to keep it going without major financing from outside. The farmers take care of the data uploading, which is the most expensive item in the running costs. The server is still financed and run from Europe. The *Sauti ya Wakulima* concept and methodology has been taken up by *Brot für Alle*, a Swiss NGO that will be implementing it in the Philippines and Kenya.

In terms of social learning, it may be more accurate to use Born and Barry's concept of 'public experiment' to describe the *Climate Hope Garden*. They use the example of an artwork called *Pigeon Blog* by Beatriz da Costa to illustrate their concept of what a public experiment is. Beatriz da Costa used electronic sensors attached to homing pigeons to monitor air pollution in inner-city areas. It was not purely a citizen science exercise, nor did it present results to the public, but it contributed 'to the generation of something new within scientific practice itself, challenging the boundaries of disciplinary authority' (Born and Barry 2013, p. 263).

Referring back to Chapter 1 section 1.4, where I describe Born and Barry's writing on Cassin's discussion of the Greek rhetorical forms of *apodeixis* and *epideixis* (where they argue that *apodeixis* equates to public understanding and *epideixis* equates to public experiment), I would argue that as a public experiment the *Climate Hope Garden* uses an installation as object in a performative way, to engage a public in dialogue through the rhetoric of epideixis. In the sense that apodeixis is a kind of proof-demonstration confirming the object or finished truth, 'epideixis forges relations between the new knowledge, things, locations and persons that did not previously exist' (Born and Barry 2013, p. 265). In order to further differentiate between science communication and public experiment we can use Cassin's distinction between 'the presentation of pre-existing proofs' and 'managing evidence by contriving new types of obviousness' (Cassin 2005, p. 864 in Born and Barry 2013, p.

265). In this sense both *Sauti ya Wakulima* and the *Climate Hope Garden* 'manage evidence' by forging new relations between time-scales, climate, place and human activity.

6.2 Summary: Defining the new art-science knowledge produced

This thesis asks whether by applying a transdisciplinary research framework we could come closer to describing or defining the knowledge produced by the particular art-science research instanced in the case studies in question. It has been shown in 6.1.1–6.1.4 that the dual project presented in this thesis in many respects verifies Pohl and Hadorn's theoretical model, and its elucidation has been manifestly facilitated by that model. That the argument generated in these pages at times goes beyond the model simply demonstrates the relation of a research framework, however useful (and indeed necessary), to the research which it frames. This is a reciprocal relation, a mutual conditioning, not one of monolinear subalternity.[33]

Thus we return, in fact, to the problematic raised in the Introduction of my thesis, that transdisciplinarity is a different question from that of types of knowledge on the nomothetic-idiographic scale. Transdisciplinarity is a pragmatic question of definitions and inherited boundaries of disciplines. The knowledge categories of Pohl and Hadorn are on a different plane and are a secondary issue to that of 'placing' the type of knowledge generated on a science-arts (or nomothetic-idiographic) scale. Their categories do not differentiate between nomothetic and idiographic, but are concerned with which part of the problem-solving puzzle the methodology in question fits. This is perfectly valid for goal-oriented, problem-solving research, and it can even be argued that a philosophical description of the knowing process can be fitted to each of the categories of systems, target and transformation knowledge, just as Aristotle distinguished scientific knowledge from the various aspects of practical knowledge – the knowledge gained by demonstration was termed *epistême*, but this was of no use for day-to-day living, which required skills for action (*praxis*) and production (*poiêsis*), and prudence (*phronêsis*) for deliberation about things that called for choice (Aristotle 2003 in Hadorn et al. 2008). However, the philosophical distinctions exist on a different logical level from the transdisciplinary categories of knowledge.

The structure of the art-science knowing process is, I would suggest, fractal: each act or process of knowing reflects every other, but each at its own level: the larger structures reflect

[33] That is the subordination of one element to another

the smaller, the higher structures the lower, and so on. Thus each of the three distinctions of knowledge exists at a different level, or addresses a different problem. Yet each of them contains in its core the same recurring shape of the movement from understanding to encounter, from the *idios* (i.e. the particular instance) to the general principle abstracted from that instance, and back to the instance in all its particularity. This latter is what one could call the aesthetic as opposed to the scientific moment, the particular as opposed to the general.

In response to the implicit question of the thesis title, 'Defining new knowledge produced by collaborative art-science research', it can, therefore, be affirmed that the present research has generated new knowledge in three distinct but interrelated areas: firstly within the participating group of rural Tanzanian farmers (*Sauti ya Wakulima*) and urban Swiss public (*Climate Hope Garden*): enhanced awareness of climate change and its impact on agriculture/horticulture, and (especially in *Sauti*) enhanced community awareness. Secondly within the scientist-artist group: empirical knowledge and know-how about recording and developing the public understanding of climate science and its practical impacts through observation of selected/limited respondent groups. Thirdly within this thesis: reflective methodological knowledge about the research process, in particular the interplay of model–case study–verification–feedback in that process.

6.3 Propositions for further research

For the future version of the *Climate Hope Garden* in 2016 (which will be called *Klimagarten 2085*) many of the research questions mooted here are still relevant, and perhaps even more so as we have received funding from private foundations and the Swiss Department of the Environment (BAFU), and both are anxious to contribute to a cultural shift. If current thinking on psychological responses to climate change is correct (van der Linden et al. 2015), then the answer to the target knowledge question of whether a relational understanding of climate change will change energy consumption should be a qualified 'Yes'– qualified because many factors are at play. However, if as is generally maintained, 'the human brain privileges experience over analysis', then experiences such as the *Garden* may contribute to concrete and relatable personal experience. Further research would be required to assess the transfer of this experiential knowledge to behavioural adaptations such as energy conservation.

A new version of the IPCC graphic is being worked on by McMahon, and together with a lay focus group of Swiss citizens we are developing a graphic to explain the difference between a

climate model and scenario – this new graphic will be shown in the *Klimagarten 2085* in 2016.

Further research for *Sauti ya Wakulima* might be to scale up and expand the program so that other groups can network. This has happened to a certain extent, as Hilbeck and Tisselli have initiated another group in Zanzibar and Kenya and accompanied some members of the Chambezi group of farmers to Zanzibar to meet them, and farmers from Kenya travelled to Bagamoyo. What might be an interesting expansion of the database would be a kind of *how-to wiki* project similar to the *Howtopedia* (www.howtopedia.org), discussed in Chapter 2. On a very local level, farmers could post tips of what works for them on the sandy soils of the Chambezi region. This would have to be combined with community access to the internet, such as is available in community media centers in Kenya. The Tanzanian farmers have also suggested that their interviews with other farmers could be broadcast as part of a farming radio show such as those in Kenya. The situation with the Urban Farmers in many cities across the developing world would benefit from the sustained engagement that the *Sauti ya Wakulima* methodology could offer.

Given the present funding structures both for science and art, I therefore conclude that applying the transdisciplinary research framework when designing art-science research projects would be beneficial, as it gives structure and form to complex multi-level investigations. Such a framework can investigate what kind of new knowledge is produced and this will help others to further the ways that this knowledge can be generated.

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List of Appendices

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Appendix B

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