Talking Collaboration: Conceptualizing Collaborative Research for Sustainable Development in Theory and Practice

Jennie Persson
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Abstract: Cross-collaborations and interdisciplinarity have become buzzwords in academia as it has been identified and argued, that going beyond traditional academic boundaries is essential for providing solutions to complex, societal problems. Currently, most of the scholarly literature on collaboration focusses on sub-issues, such as arguments for and against the crossing of fields and disciplines, while there is a lack of practical case studies exemplifying its effect. The objective of this research was therefore to explore the arguments underlying initiatives to start an introductory collaborative program for young academics, identify these programs’ roles in the researchers’ collaboration capacity, and thus, to gain understanding of how collaborative programs can contribute in the process of equipping young researchers with valuable tools to tackle today’s and tomorrow’s complex challenges linked to United Nations 2030 Agenda for Sustainable Development and its seventeen Sustainable Development Goals. The research for this thesis was done in two steps: (1) to search for a conceptual framework on the topic of research collaboration, and (2) presenting a single-case study of one example of a collaborative research enhancing program by conducting qualitative interviews with key respondents. This thesis explicitly includes an assessment of current theories on the development of collaborative and interdisciplinary research teams and the relevance of these for enhancing scientific capacity of innovation, effectiveness and progress. It concludes that collaborative research is an ambiguous and fluid concept. Although concepts and theories around this phenomenon have been proposed, there is no coherent consensus on the concept in the scholarly literature. Furthermore, the case study presented in this thesis offers a unique insight into young researchers’ experiences of participating a collaborative research program. It is recognized that there is a consensus among the persons interviewed that participating in a collaborative research program has greatly contributed to the individual researcher’s professional development. It is further recognized that the lack of standardized indicators for collaborative outputs implicates on the possibility to argue for the proposed benefits of collaborative research in relation to the Sustainable Development Goals.

Keywords: Sustainable Development, Research and Development, Collaborative Research, Interdisciplinarity, Capacity Building

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Talking Collaboration: Conceptualizing Collaborative Research for Sustainable Development in Theory and Practice

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Summary: This thesis addresses the emerging field of interdisciplinary and collaborative research in the context of sustainable development. It has been identified and argued that going beyond traditional academic boundaries is often necessary for tackling complex problems like climate change and other contemporary development issues. Some of the various collaborative methods and theories of academic collaboration encountered in the literature will be investigated in this thesis. The objective of this research project has been to explore the arguments underlying initiatives to start an introductory collaborative program for young academics, to identify such programs' roles in the researchers' collaboration capacity and how collaboration can add value to the individual researcher and their capacity to deal with the multifaceted problems facing the world today, focussing on how the principle of collaboration translates and is implemented on the ground. In order to gain understanding of how collaborative programs can contribute in the process of equipping young researchers with valuable tools to tackle today's and tomorrow's complex challenges linked to the United Nations 2030 Agenda for Sustainable Development and its seventeen Sustainable Development Goals, this thesis aims to investigate collaboration in practice, guided by the hypotheses on increased knowledge production and innovation widely acclaimed for this concept. This was done in two steps: firstly, by reviewing relevant literature in the field in order to develop a conceptual framework on the topic of research collaboration; and secondly, by conducting a single-case study based on interviews with key respondents who have experience of involvement in a structured introductory collaborative program. The thesis explicitly includes an assessment of current theories on the development of collaborative and interdisciplinary research teams and the relevance of these for enhancing scientific capacity of innovation, effectiveness and progress. Collaborative research has proved to be an ambiguous and fluid concept. As demonstrated in the thesis, although concepts and theories around this phenomenon have been proposed there is no coherent consensus on the concept in the scholarly literature. The case study presented in this thesis offers a unique insight into young researchers' experiences of participating in such a program. Among the respondents interviewed, there was consensus that participating in a collaborative research program had greatly contributed to the individual researchers’ professional development. Furthermore, the collaborative aspect of the project constellation was thought to have created more innovative and holistic project outcomes. It was also shown that the program had provided the key respondents with opportunities to expand their network, get enhanced visibility, gain insights into and skills from different disciplinary fields, practice interdisciplinary methods, develop social skills needed to succeed in collaborative projects, gain experience in management of research projects and a more holistic view of research problems and the sustainability of a project. The collaboration was of a transnational, multidisciplinary, partly interdisciplinary, and, introductory sort – it presented the first opportunity for the researchers involved to take part in a collaborative research project for young academics. It is further recognized in this thesis that the lack of standardized indicators for collaborative outputs implicates on the possibility to arrive at easily applicable conclusions on the proposed relationship between collaborative research and reaching the Sustainable Development Goals.

Keywords: Sustainable Development, Research and Development, Collaborative Research, Interdisciplinarity, Capacity Building

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Preface

As part of my internship at the International Foundation for Science (IFS), I was asked to investigate, evaluate and - if possible - enhance the collaborative program addressed by the organization since 2012. I was going to look at, in specific, the challenges, learnings and prospects of the program by evaluating the former and on-going pilot programs, as well as review literature on the topic. The research questions formulated in this thesis emerge from that process and have been narrowed down and appointed together with my supervisors Lars Rudebeck at Uppsala University and Nighisty Ghezae at IFS. The aim here was to provide a locked down view of what collaboration actually has come to contribute with in the program and whether or not collaborative programs add intrinsic values to the research progress and, if so, in what ways.

Having been interested in this field since before it was only natural that my thesis in sustainable development would treat such a topic. It is long said that in order to reach the Sustainable Development Goals and the 2030 Agenda set by the United Nations in 2015, collaboration is necessary, and this in multiple ways not excluding intersectoral collaborations in Academia. It goes without saying that this thesis would not have been possible, if it had not been for the layout of my master’s program at Uppsala University, through which I have personally been pressed and shoved into many of these interdisciplinary team constellations. This has of course affected me and contributed to my interest for the interactions amongst scientists of different disciplines.

Many of these experiences with collaborative research have come to shape the final product which now lies in your hand, my Master thesis in Sustainable Development. I hope that this thesis will contribute to further discussion about collaborative programs, their relevance or irrelevance for academic research and the 2030 Agenda for Sustainable Development.

Peace out,

Jennie
<table>
<thead>
<tr>
<th>Acronyms</th>
<th>Description</th>
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<tbody>
<tr>
<td>CRAG</td>
<td>Collaborative Research Approach Grant</td>
</tr>
<tr>
<td>DAC</td>
<td>Development Assistance Committee</td>
</tr>
<tr>
<td>DFG</td>
<td>Deutsche Forschungsgemeinschaft</td>
</tr>
<tr>
<td>EBA</td>
<td>Expertgruppen für Biståndsanalys</td>
</tr>
<tr>
<td>GAR</td>
<td>General Assembly Resolution</td>
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<tr>
<td>ICSU</td>
<td>International Council for Science</td>
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<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
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<tr>
<td>IFS</td>
<td>International Foundation for Science</td>
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<tr>
<td>IGO</td>
<td>Intergovernmental Organization</td>
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<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
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<tr>
<td>MDG</td>
<td>Millennium Development Goal</td>
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<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
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<td>NUS</td>
<td>Neglected and Underutilized Species</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<tr>
<td>ODA</td>
<td>Official Development Assistance</td>
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<tr>
<td>SciTS</td>
<td>Science of Team Science</td>
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<td>SDG</td>
<td>Sustainable Development Goal</td>
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<td>UN</td>
<td>United Nations</td>
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<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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<td>WCED</td>
<td>World Commission on Environment and Development</td>
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1. Introduction

Cross-collaborations and interdisciplinarity have become buzzwords in academia. Interdisciplinarity is a form of collaboration involving more integrated approaches to scientific activities. It can be practiced both within and between universities and other educational and research institutions. It has been identified and argued for, that going beyond traditional academic boundaries (such as disciplinary borders) is often necessary for tackling complex problems like climate change and other contemporary development issues including political ones (Klein 1996; 2004; Barry, Born & Weszkalnys 2008; Bridle, Vrieling, Cardillo, et al. 2013; Cheruvilil, Soranno, Weathers, et al. 2014; UNESCO 2015).

This thesis, however, is not primarily concerned with interdisciplinarity as such but more in general with collaboration between institutions of research and education located in different parts of the world. This may certainly involve interdisciplinarity but could of course also involve collaboration between geographically and institutionally separated representatives of one and the same academic discipline. Over the last half century, there has been a shift towards more integrated research initiatives in academia with the sponsoring of and setting up of multi- and interdisciplinary institutions, departments and research centers (Alpert 1969; Anzai, Kusama, Kodama, et al. 2012; Barry, Born & Weszkalnys 2008). Physical spaces like this, typically engage scientists in integrated seminars and symposiums, research camps, etc. (Anzai, Kusama, Kodama, et al. 2012). Adding to these cross-boundary meetings spaces allowing for physical meeting, is the online space. Since the millennium change there have for instance been multiple initiatives for exchanging information for research online in different forums. Examples of these include online forums such as ResearchGate®, LinkedIn®, and Unicollaboration®.

Over the coming decades, millions of people need to raise their living standards. This notion is declared, recognized and addressed by the United Nations 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs). Extensive work on all levels will be needed in order to achieve the SDGs. The “grow-now-clean-up-later” model that has been practiced since industrialization in the western world does no longer work, if we are to achieve the UN 2030 Agenda. That all nations will acquire a good standard of living for all people in a sustainable way is necessary in order not to drain the planet’s resources completely (UN 2015). This momentum in time has increased the pressure and expectation of technological innovations and scientific discoveries.

There has been an expressed demand for increased interdisciplinary science, one of the reasons for this, according to Lélé and Norgaard (2005) is to make more objective advice in the context of social issues as sustainable development. Coherently, there is a substantial need to enhance the resilience of many countries in order to better withstand the challenges of the coming decades. However, while the majority of the world’s population live in low- and middle-income countries, most science is produced or initiated in high-income countries (UNESCO 2015). This raises the issue of inequality with regards to the influence over and financing of education and research. There is a substantial gap between low-, middle- and high-income countries educational systems and a significant majority of all scientific articles originate from high-income countries (UNESCO 2015). In times of increasing complexity of global issues and even more fast pacing development, it becomes ever more important to include everyone and accumulate common knowledge.

In addition to the global issue, local research capacity is important in order to identify unaddressed needs and to develop simple and affordable solutions sensitive to the local context. The lack of such solutions substantially obstructs the innovation and problem-solving capacities in less developed economics. This is further recognized in SDG 9, which highlights the need to “support domestic technology development, research and innovation in developing countries” (UN GAR 70/1 p. 20, section 9.b). If there is an overall need for more research (UNESCO 2015), research in low- and lower-middle-income countries is even more needed.

Collaboration is not only a buzz-word, it also has a wide range of substantial meanings and subthemes.
Although increased collaboration is widely agreed to be necessary (UNESCO 2015, UN 2015, Schellnhuber 1999; Pohl, van Kerkhoff, Hadorn, et al. 2008; Cheruvilil, Soranno, Weathers, et al. 2014), and invested in (Klein 1996; Anzai, Kusuma, Kodama, et al. 2012), to meet societal needs and knowledge demands, it is not clear what kinds of collaboration will be most needed, and how they can be best designed to fit each purpose while at the same time increase our capacity to handle the complex issues addressed by the SDGs.

Most of the scholarly literature on collaboration is focused on sub-issues, such as arguments for and against the crossing of fields and disciplines. Very few contributions deal with the broad concept of academic ‘collaboration’ as such. Some of the various collaborative methods and theories of academic collaboration encountered in the literature will be further investigated in this thesis. Gaziulusoy, Ryan, McGrail, et al. (2016) acknowledge a large scientific body of challenges and opportunities of transdisciplinary research. However, they also identify a research gap in regard to practical case studies. Even literature available on this issue in relation to sustainable development and scientists in low-income countries is very scarce (see for example collaboration research in social science and humanities: Szenberg & Ramrattan 2017, McCarty & Deegan 2012). While there are many studies on cross-sectorial collaborations to increase innovation (see: Sarkis, Brust & Cordeiro 2010, pp. 1-16; Pohl, Rist, Zimmermann, et al. 2010; Anzai, Kusuma, Kodama, et al 2012; vom Brocke & Lippe 2013; Lippe & vom Brocke 2016), there are few case studies exemplifying transdisciplinary collaborations in academia. Furthermore, there is a lack of knowledge about how to manage these sorts of projects in the most effective ways (see: Anzai, Kusuma, Kodama et al. 2012). Yet, the benefits of working together in teams are widely acclaimed (UNESCO 2015, UN 2015; McLeish & Strang 2016).

1.1. Aims and Objectives

This thesis aims thus to contribute to conceptualizing the notion of research collaboration as practiced mainly in low and lower-middle income countries striving to become more scientifically prominent. The thesis aims to investigate collaboration in practice, guided i.a. by hypotheses on increased knowledge production and innovation widely acclaimed to this concept. This will be done in two steps: firstly, by reviewing relevant literature in the field, presenting the background motivations and justifications of the collaborative research approach; and secondly by conducting a single-case study based on interviews with key respondents who have experience of involvement in a structured introductory collaborative program. These findings will be connected to the current debate on collaborative research and sustainable development. The overall aim is to contribute to the conceptualization of capacity building through collaborative research and to clarify the arguments underlying it.

As will be further explained in Chapter 2, the thesis is inspired by a pilot project on collaborative research carried out by the NGO International Foundation for Science (IFS) in Stockholm. This research will contribute to the evaluation of the IFS approach by conducting a case study of the far-progressed participating researchers in the pilot project. The objective of this research will be to explore the arguments underlying initiatives to start an introductory collaborative program for young academics, identify these programs’ roles in the researchers’ collaboration capacity, how collaboration is adding value to the individual researcher and her or his capacity to deal with multifaceted problems facing the world today, and thus, to understand how the principle of collaboration translates and is implemented on the ground. And thus, to gain understanding of how collaborative programs can contribute in the process of equipping young researchers with valuable tools to tackle today’s and tomorrow's complex challenges linked to UN 2030 Agenda and the SDGs.

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1 Low and lower-middle income countries is defined as by the World Bank’s income group classification system of countries. The classification system is based on the World Bank Atlas method after GNI per capita (see: World Bank 2018).
The focus for the analysis is thus, to identify what specific role ‘collaboration’ has in relation to creating new synergies and innovative approaches to complex issues, and what collaborating as a young scientist will contribute to the overall capacity building of the individual and the countries scientific contribution, as well as the quality of the research conducted in each case. Finally, capacity building as a type of international development cooperation, with focus on the collaborative programs’ validity and importance, will be discussed. As will be seen, issues considered in the study will include the conceptual meaning of “collaboration” in scientific research; interdisciplinarity; effectiveness and innovation capacity; and challenges faced by scientists in these respects.

1.2. Research Questions

The aspiration is to provide elements of answers to the following questions:

1. What is the conceptual meaning of “collaboration” in scientific research as revealed in relevant literature and documentation of collaborative projects?

2. What can introductory collaborative programs bring to young researchers in low and lower-middle income countries?

3. How does the investigated case translate into the concept of collaboration in terms of types of collaboration and chances for continued collaborative efforts?

1.3. Outline

In Chapter 1. Introduction, the reader is introduced to the subject matter of the thesis and given a primary background to the general topic. The research questions and overall aim of the thesis are furthermore presented. In the following Chapter 2. Background: Supporting Collaborative Research, the topic of research is more thoroughly laid out and the background to the aim and research questions presented above is given, with a focus on the background to the case study. Chapter 3. Methods deals with the methods used for the research, in particular the case study. Here, the thesis delimitations and limitations are discussed, as well as the ethics considered in conducting the investigation. In Chapter 4. Conceptual Framework, an attempt is made to conceptualize ‘collaborative research’ on the basis of relevant literature and documentation. Thus, theories and concepts used for the analysis to follow are presented in detail. In Chapter 5. Learning from the Experience, the empirical findings of the case study are presented. In Chapter 6. Concluding Discussion, the case study results are discussed and analysed in relation to the content of Chapter 4. Conceptual Framework, i.e. the theories and concepts found relevant in order to highlight important findings. Furthermore, concluding remarks are made based on the discussion.

2. Background: Supporting Collaborative Research

Exchange of information and working together are of course no novelties within science. In fact, the emerging trends of integrated scientific approaches may even be a transition towards a former order. The enlightenment started with the disassociation of the natural sciences from philosophy (Hadorn, Biber-Klemm, Grossenbacher-Mansuy, et al. 2008, p. 20), and ever since the list of scientific disciplines has grown immense. Increasing collaboration among and across disciplines has been a phenomenon of the 20th century development of science (Pohl, van Kerkhoff, Hadorn, et al. 2008). According to Pohl, van Kerkhoff, Hadorn, et al. (2008, p. 413), this development is influenced by the three following cognitive objectives: (1) the ideal of a unity of all sciences and other disciplines, (2) solving problems in basic
research by innovation, and (3) responding to the knowledge demands of the knowledge society.

Over the last decades, the funding community has begun to recognize the important aspect of building strong institutions through so-called capacity building. The types of financial resources offered by these programs vary. However there has been a mix of private funding by companies and state funded aid. A couple of such initiatives are presented by ICSU who wants to Lead Integrated Research for Agenda 2030 in Africa with its collaborative program for early-career scientists with less than ten years of working experience post-PhD (ICSU 2018). Another example of investments in collaborative research is the German Collaborative Research Centre Programme. Its aim is "(...) to provide young scientists and academics with early opportunities to independently carry out research." by integrating early career researchers into an academic network, ensuring appropriate equipment and administrative structures (DFG 2018). A third example is an initiative by a Swedish based research council and funding agency, the International Foundation for Science (IFS), the Collaborative Research Approach Grant (CRAG), which aims to introduce collaborative research to young scientists in low- and lower-middle income countries. A project within this program will serve as a case to be studied in this thesis.

2.1. Case Study Background: IFS Collaborative Research Approach Grant

2.1.1. IFS Organizational History and Strategy

IFS was founded in 1972 and is registered as a non-governmental organization (NGO) with its base and secretariat in Stockholm, Sweden. IFS’ vision is “to enable early-career scientists in the developing world to contribute to a global research community that is reducing poverty and supporting sustainable development.” (IFS 2015). IFS has shown strong motivation to increase young researchers’ capacity to work together to ultimately make them more successful scientists. IFS’ standpoint is that science can be an important driver of economic and human development and that there are several areas in need of urgent improvement, referring to the UN SDGs (IFS 2017a).

The program serving as a case for this thesis has been ongoing since 2012 (first starting research groups in late 2013). IFS have since 2012 initiated three pilots of their CRAG program with the intention to launch a permanent program supporting collaboration among early-carrier scientists in low and lower-middle income countries. The former IFS Director Dr. Graham Haylor, lays out in a paper why IFS is introducing a collaborative research approach. It is acknowledged in this paper that there is an increased need for collaborative skills among the target group, which is “young researchers in developing countries” (Haylor 2012). The IFS CRAG is one of three approaches presented (see: Fig. 1) in IFS’s strategy for 2011-2020 titled “Working together” (IFS 2017b). The CRAG adds to IFS’s work in a way that IFS hopes will contribute to levelling the playing field and lift the quality and quantity of science conducted in low and lower-middle income countries. Although IFS had been working with collaborative research projects since before, it is also pointed out that this new approach to research will contribute to deliver on the SDGs (IFS 2017a). The main ambition of the CRAG is to provide an opportunity to early-career scientists in IFS’s target counties to start working across cultures and disciplines, with all assumed benefits of doing so (Haylor 2012, see: Chapter 4.1.3.).

The term CRAG for IFS Collaborative Research Grant (IFS 2015; 2016; 2017a; 2017b; Haylor 2012; 2015; Haylor, Porter, Ghezeae, et al. 2016) is used explicitly in this thesis for its simplicity and is not the formal designation for the program at IFS.
Fig. 1. International Foundation for Science strategic approaches presented in their strategy for 2011-2020 (IFS 2017b).

When developing the concept of the program and making it a part of the organizations strategy (see: IFS 2017b), it was decided to launch a set of pilot programs in order to test the program and grant model. Up until 2018, three pilot programs have started, all being region- and theme-oriented. The collaborative program at IFS has the aim to meet the following objective within the organization’s strategy (IFS 2017b): ‘Participation in collaborative research networks increased, including links to the international research community: interdisciplinary collaborative research that tackles development issues; collaborative research links between scientists in the developed and the developing world built.’

Prior to the launch, there was a range of in-house investigations on the applicability of this type of research funding and its effect (see: Haylor 2012). Among these are the compilation of proposed benefits of research collaboration (after Katz & Martin 1997). With the CRAG, IFS hopes to bring forward the benefits of collaboration proposed by Katz & Martin (1997):

- Sharing of knowledge, expertise and techniques
- Tacit knowledge transfer
- Learning the social and management skills needed to work as a part of a team
- Source of creativity
- Intellectual companionship/expanded networking
- Greater scientific visibility
- Pooling equipment

2.1.2. Development of the Collaborative Research Approach Grant Program

After preparatory measures, knowledge accumulation within the field and expressed interest from eligible scientists, IFS could launch the first pilot-project (Haylor, Porter, Ghezae, et al. 2016). The first pilot of the IFS CRAG was launched in 2012, awarding ten teams with individual grants based on their team applications. There were 38 participating researches. The eligible countries for this pilot project were South Africa, Tanzania, Uganda, Nigeria and Ghana. The focussed research topic was neglected and underutilized species (IFS 2016). Pilot 2 started in 2014, awarding thirteen teams individual grants in the eligible countries Benin, Côte d’Ivoire, South Africa, Tanzania, Uganda, Nigeria, Burkina Faso and Ghana. In total, 48 researches participated in pilot 2. The selected research topic was biodiversity (IFS 2016). As a part of pilot 2, IFS conducted a workshop focused around collaborative research in practice in Ouidah, Benin (See: IFS n.d.). Pilot 3 was decided to be the last one before launching the program in IFS yearly research grant calls. The concept was tested again in 2016 in a new region, focussing on nine countries in Asia; Vietnam, Thailand, Philippines, Timor-Leste, Cambodia, Myanmar, Laos, Malaysia and Indonesia. The selected focus area was climate change adaptation and mitigation in Southeast Asia. In total, 12 teams consisting of a total of 43 individual researchers were granted.
IFS CRAG pilot 1 serves as the primary case for this thesis. Eligible aspirants for the program were invited to a social networking platform, PODIO to meet and match with other researchers of similar research interests (Haylor 2015). Through the PODIO platform, they were asked to form teams of three to five scientists and submit a research proposal on the pre-decided topic of neglected and underutilized species (NUS). The following definition of NUS is presented by Padulosi, Thompson & Rudebjer (2013, p. 9):

“The NUS concept applies to useful plant species which are marginalized, if not entirely ignored, by researchers, breeders and policy makers. They are non-commodity crops and belongs to a large biodiverse group of thousands of domesticated or wild species. They may be locally adapted minor crops as well as non-timber forest species.”

Out of 40 teams formed and 25 research proposals in PODIO, of which 17 were excepted (Haylor 2015). The members of the 17 teams were all invited to a three-day capacity building workshop in Ghana (Haylor 2015). From there, 10 teams were selected for funding and continuation in the program after passing through a process of multi-step reviewing (Haylor 2015).

2.1.3. Previous Evaluations of the Collaborative Research Approach Grant Program

Up to this point, there have been three larger evaluations (five surveys in total) made in the collaborative program. These have enabled continuous modifications to the approach. The first evaluation was a survey sent out to the 38 participating researchers in the first pilot of the IFS CRAG at the end of 2014 with the objective to collect the participants experience of the program so far (Haylor, Porter, Ghezae, et al. 2016). The second evaluation was made on the participants of IFS CRAG pilots 1 and 2 and conducted as a survey finalized in August, 2017 (Orlendo 2018). The third evaluation in February 2018, was of IFS CRAG pilot 3 and based on individual mid-term reports from the participating researchers (Persson 2018).

The first survey investigated whether the proposed benefits of Haylor (2012) adopted by Katz & Martin (2007) had been met. The results of this survey (in Haylor, Porter, Ghezae, et al. 2016) is shown in fig. 2, where it demonstrated that most of the incentives have been met to a large extent. And thus, that the participants to a somewhat large extent confirm some of the proposed challenges. Furthermore, the second and third evaluations focused on the challenges, communication pathways and general progress insights of the team’s research process and progress.

Collaboration within this program has mainly occurred through ICTs with occasional physical meetings and workshops. The usage of ICTs’ here specifically reported in pilot 1 and 2 to be through: e-mail, phone (unspecified), WhatsApp®, Skype®, Facebook® and IFS internal platform for meeting and discussion on collaborative research (Orlendo 2018). And, reported in pilot 3 to be mainly through e-mail, Facebook® and Facebook Messenger®, Skype® and phone (unspecified) (Persson 2018).

Main challenges in IFS CRAG pilot 1 and 2 included; late project start due to delays in funding and/or equipment; individual researchers delays affecting the teams time schedule; unexpected weather conditions; issues of ownership of data and/or credit of work; challenges in reaching consensus within the team of methodology and analytical frameworks; inability to meet set, common, goals; various technical issues that were of consequence of insufficient planning and/or knowledge; permissions to collect data; and, inflation affecting the budget (Orlendo 2018). These challenges were observed to re-occur in pilot 3, where half of the teams had reported on issues of funding matters, planning and time delays caused by or extra delayed due to weather conditions, and technical issues due to insufficient planning or background knowledge. One third of the teams had suffered from issues with permission for their research activities, and one fourth from faulty or insufficient quality on eligible equipment for
the research (Persson 2018). It was concluded that although these three pilots have been set in different regions (Pilot 1 and Pilot 2 in African countries and Pilot 3 in Asian), young scientists face similar challenges in these countries.

In terms of collaboration and individual researcher input in pilot 1 and 2, 96 percent of the participants taking part in the 2017 survey of pilot 1 and 2 reported on a four-pointed scale that their team leader had matched the team members inputs fairly well or better (Orlando 2018). Similar to this, 91 percent had answered that team members shared responsibility for the work fairly well or better on a four-graded scale (Orlando 2018). The participants in pilot 3 reported that in general they were very happy with the collaborative design of the research project (Persson 2018). Specifically, they reported in free words on the benefits of; being able to share knowledge; gaining new perspectives; meeting up and discussing methods and approaches; and, being of general assistance to each other in times of trouble. Some of the challenges of collaborative research identified was; difficulty to converge due to individual schedules and other obligations; difficulty in entering deep discussions over internet; and, that communication is time-consuming.

![Fig. 2. Score card of perceived costs and benefits of the IFS CRAG in 2014, results as shown and figure extracted from Haylor, Porter, Ghezae, et al. (2016).](image-url)
Based on the findings these two evaluations (Orlando 2018; Persson 2018), a set of action points were made for the further development of the programs:

- Capacity building: general
- Better communication from the funding agency about terms and conditions
- Sharing experiences among teams that are currently or previously participating in the program
- Equipping and bettering skills on project management/planning, team leadership, procurement and financial management
- Improve the reporting system
- Continuous support to upscale the researchers research finding and potential generated technologies

3. Methods

In this chapter, the methods for achieving the results and answering the research questions will be laid out. The chapter will be mainly focussed on the methods of empirical gathering of data that underpins the case study, however also present on the methods for gathering information for the literature review underlying the conceptual framework that will be used for the further analysis and ultimately for answering the research questions.

3.1. Research Approach, Strategy and Design

This thesis seeks to understand the benefits of and the intrinsic role of collaborative aspects in academic research teams in relation to the sustainable development agenda. To better understand this, the method of conducting this research was exploratory. In answering the research questions, the following strategy was developed to highlight multiple angles of the topic and to better understand the issue: (1) to develop a conceptual framework on the topic of research collaboration, and (2) to present a single-case study of one example of a collaborative research enhancing program. The first part was about reviewing literature within the fields of collaborative research as well as sustainable development. The literature review provided a base (Tranfield, Denyer & Smart 2003) for the further analysis of the second, and most results-influential part; qualitative interviews with key respondents. The interviews were held with key respondent participating in the IFS CRAG, the focus was on a few, but comprehensive interviews with researchers with collaboration experience within the field of the theme chosen.

3.1.1. Ethical Considerations

Ethics in regard to the interviews was taken into account. The interviewees were informed when invited to participate in the study on how their personal data would be treated in the context of writing and publishing the thesis. In the development of the interview process ethical standards were considered according to Allmark, Boote & Chambers et al. (2009). In the interview invitation (see Appendix B), there was an ending clause treating the topic entitled "Treatment of personal information", informing candidates accepting to be a part of the study on how their personal information and interviews would be treated. The standards used for this procedure were extracted from Finnish Social Science Data Archive (FSD 2018).

3.2. Literature Review

A key factor, providing the corner stones for the conceptualization of collaborative research in this
context was the literature review. This was a basic survey, sorting out key thoughts and arguments in relevant literature and documentation on the two main topics of interest: collaborative research and sustainable development. This was done in order to create a theoretical and conceptual foundation for the case study, to provide a basis for the analysis and in order to be able to concretize and put the results in contrast to other studies and theories on the topic. The review was essential for gaining a deeper understanding of the topic and imbedding the results of the study in a larger context for analysis and for drawing conclusions.

The review was done on a wide range of literature consisting of reports and documents from IGOs, NGOs and authorities as well as scholarly literature in the form of peer-reviewed articles and published books. The literature review was done using the libraries of Uppsala University Library and the Swedish University of Agricultural Sciences as well as Google, Google Scholar and IFS’s publications database. Search words used include: transdisciplinary research in sustainability science, practice, principles, and challenges; interdisciplinary research; collaborative research for sustainable development; collaborative research case study; etc. The topics (theories and concepts) were chosen due to their relevance for the aims and objectives of this study. Thus, the framework was shaped by concepts to understand the issue.

3.3. Case Study

A case study was chosen as a method to bring a valid example of collaborative research in practice into the analysis of the topic. Furthermore, the case study was at the core of answering the research questions and providing a case for the gap of concrete examples of collaborative research in practice. By focusing on one case, it was possible to limit the number of outside factors and other disturbing side-tracks leading to difficulties in answering the research questions. The methodology for the case study was based on Yin (2003), Stake (1995), Johansson (2007), Flyvbjerg (2006) and Thomas (2011).

A plan for data collection was made in the form of an interview guide (see: Appendix A). As Stake (1995, p. 51) pointed out, there has to be a thorough plan of how to collect the data in detail, as there is always a risk of delays. Stake (1995, p. 51) listed the following steps as essential in all data-gathering plans: definition of case, list of research questions, identification of helpers, data sources, allocation of time, expenses, intended reporting. However, in addition to the essential steps for the research, there should also be allowed time for more informal events that are part of the process as well. These include, interacting with the case actors, and being generally open to taking in new ideas and impressions on the topic of research (Stake 1995, p. 51).

The case was carefully considered. The case selected was so due to its significance to the ongoing debate on advantages and disadvantages of global scientific collaboration in the context of sustainable development (see: UN 2015). Based on the premises that the persons to be interviewed had taken part in the IFS CRAG Pilot 1 and had showed some sort of collaborative result. More precisely, that they had finally reported on their project, partly reported, or published a common article. This group was chosen as a focus group because of their long experience of being a part of the IFS collaborative grant program.

3.3.1. Interviews

For the conceptualization of collaborative research and concretization of collaboration occurring among young researchers in collaboration-promoting programs, interviews were held with a few, engaged participants. They were chosen to be key respondents and a relevant group of researchers because of their responsiveness to the invitation to participate in this study, and because of their experience of collaboration programs in academia. The selection was therefore made from individuals of teams who had produced some sort of collaborative research outcome. Furthermore, they were all chosen from the same program and pilot group in order to limit the factors not dealing with the collaborative research as
such. Limiting the selection to individuals who had achieved an outcome was in order to learn about the process of reaching this specific output, thus, their progress through the collaboration.

The intended focus group was approached by e-mail. They were sent an invitation to participate in an interview for the purpose of this study, the invitation further contained information about the interview procedure (see: Appendix B). The purpose of the interview was to understand how collaborative program participants perceive the program and how the collaborative aspect of their research has affected the processes and outcomes. Furthermore, the purpose was to understand how collaboration is occurring within the program and what enables the collaboration to continue as a process.

After response from the selected participants on the email invitation, an initial set of questions was sent out to the respondents on the researchers’ academic backgrounds, previous knowledge or experiences of working in teams and ways of working together (see: Appendix C). Together with the collection of the respondent’s answers on the initial survey, a time and form for the in-dept interview was set. The interview in depth was on the process of collaboration with the IFS CRAG and ultimately the perceived outcomes of working together (see: Appendix D). The interview was offered in multiple ways for the convenience of the interviewees. The interview was designed with six thematic areas divided into a number of pre-structured questions (see: Appendix D). These were individualized for each participant based on their background and previous answers. This was done based on Stake’s (1995) method on how to conduct qualitative interview. Stake (1995, p. 65) argue that the interviewee is seldom asked to fill out the same survey-based questions, the respondent is instead expected to contribute individual and original thoughts and ideas on the topic, not being found in a standardized survey questionnaire (Stake 1995, p. 65). A guiding set of questions was developed in accordance with and as a practical transformation of the research questions. The questions were carefully looked over several times based on parameters taken from Stake (1995, p. 65), Yu & Cooper (1983) and Bhattacharjee (2012). Table 1 shows the interview method used for each respondent. The interview process gave as result empirical data further processed into transcripts (text files). The data was further processed and interpreted with the result presented in Chapter 5.

<table>
<thead>
<tr>
<th>Key respondent</th>
<th>Interview method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Skype</td>
</tr>
<tr>
<td>2</td>
<td>WhatsApp, Email</td>
</tr>
<tr>
<td>3</td>
<td>Email</td>
</tr>
<tr>
<td>4</td>
<td>Skype</td>
</tr>
<tr>
<td>5</td>
<td>Skype</td>
</tr>
<tr>
<td>6</td>
<td>Skype</td>
</tr>
</tbody>
</table>

**3.4. Research Delimitations**

This focus of this thesis is on inter-academic collaboration among scientists, not touching cross-collaborations with other sectors of society. This was chosen as a delimitation because of the interest of conceptualizing scientist-scientist collaboration and synergy effects. Furthermore, ICT is assumed as a basic tool enabling collaboration in the 21st century, however will not be further discussed as a premise.

The concept of sustainability is limited here to the definitions presented in Chapter 4.3. *Sustainable Development*, and thus, this thesis presents no assessment of the ‘sustainability’ of the CRAG at IFS as such. This is an important delimitation imposed as the term ‘sustainable’ in this thesis is related to the sustainable development agenda with its definitions and not the term sustainability as often used within international development cooperation program assessments (for reference see: EBA 2017). Thus, the IFS CRAG was chosen as a case for this study in order to further assess the collaborative aspect rather than the economic and development implications of such a program.
The selected group of key respondents did not represent the total number of participants in IFS CRAG pilot 1. As pointed out, the selection was based on the single criterion of having reported progress to IFS since the pilot program started in 2013. This implied leaving out the individuals who had not produced any sort of outcome. This is an important delimitation as it influences the results and conclusions of this research in two ways: (1) no discussion can be made on what hindered successful collaboration from occurring and what main constraints hindered this; and (2) there cannot be drawn any conclusions of the collaboration that has occurred in the whole pilot 1 group of researchers.

3.5. Research Limitations

This thesis has some limitations. Firstly, what is presented in Chapter 5 cannot be statistically generalized beyond the six key respondents. This is due to the fact that there was no random selection of individuals and other statistical parameters set aside in this research design during the process. Initially, a larger selection of individuals was aimed for. The number of individuals contacted and invited to participate was 29. The initial intention was to carry out a survey with less detailed interview questions. However, due to the low response rate from the invitation, a change of method was made resulting in a more in-depth conceptualization of collaboration calling for qualitative interviews with participants assumed to be engaged in the program design and its further development. On these premises and given the fact that the finally selected key respondents had chosen to be part of a collaborative research pilot program, it can be assumed that the participants had a positive attitude towards collaboration, affecting their answers and the conclusions that can be drawn from these.

In terms of interviewing and collection of empirical data, there may have been information lost in the interview process for various reasons. For example, the method of choosing participants was presented to the key respondents. This was done in order to facilitate their answering. It may however have complicated the analysis of the results and their validity (see: table 1). For example, conducting the interview via email did not allow for follow-up questions to the same extent as interviews via Skype®. Furthermore, the variance of presenting the interview questions when doing so via Skype® may have affected the results as no interview stayed rigid in its form and questions (see guiding interview questions and themes in Appendix D). During the interview process, there were issues with the internet connectivity. This may have affected the overall outcome, as constant cuts of conversation may be stressful, disorienting or irritating.

Furthermore, there may be limitations to the interpretation of the results based on the design of the interview questions. As for example, listing the proposed benefits of collaboration in the way done in the interview question may have led the respondents to emphasize those benefits in their answers as being the most addressed ones in their projects. Issues like this may have affected the outcome and results of this research. There may also have been information lost by only interviewing the key respondents, as there are another twenty-three researchers not included in the interviews. The point of the design used in this study was however not to gather as much information as possible, but to get and use the information with the highest possible quality.

Other important aspects to be considered are transparency and reliability. Firstly, this research is conducted in collaboration with IFS and under IFS name, and the selected group are IFS grantees. This may have affected the results and the answers having to do with the evaluation of the program and experience. Furthermore, it is important to raise the issue of transparency of the interviewer and the analysis conducted on the empirical material, as well as the transcription process and reinterpretation of the results presented in this thesis. This is important, as interpretation of data when conducting an interview will not be viewed in the same way by different researchers (Stake 1995, p. 64). It is of course important to be aware of such limitations, which are difficult to avoid.
4. Conceptual Framework

4.1. Academic Collaboration

Collaboration in academia can be defined in many ways. For example, a common way of identifying collaboration in Academia is found in Traoré & Landry (1997) as in general “a project taking place between a university researcher and another partner”. These partners can then in Traoré & Landry’s (1997) definition, be either (1) another university researcher, (2) a company representative, or (3) an organization representative. In the first case, this would be in the constellation of two scientists working together. In the second case, this would be as in the case of university-industry collaborations. And, in the third case, this would be in the case of university collaboration with provincial and federal government agencies, local governments or other organized interest groups (Traoré & Landry 1997).

In this thesis, collaboration will be looked at out of an integrated perspective of collaboration among scientists (see: Chapter 3.4. Research Delimitations). The phenomenon studied will then fall under Traoré & Landry’s (1997) first category of collaborations in academia: (1) a project taking place between a university researcher and another university researcher. What follows in this chapter is an overview of the concepts of academic collaboration, including describing and presenting terms used for the continued analysis of the concept in Chapter 6. Concluding Discussion.

4.1.1. Academic Disciplines

Academia is generally divided into subgroups based on the scientific classification of disciplines. The following is a dictionary definition of discipline in the academic sense: ‘‘A branch of knowledge, typically one studied in higher education.’’ (Oxford English Dictionary, 2018). Seen in general, most researchers seem to have a hard time agreeing upon to define what a discipline really is (Krishnan 2009, p.7; Becher & Trowler 2001, p. 41; Wallerstein 2004, pp. 22-25) and, in turn, to describe and delimit the different disciplines suggested by different scientists (Wallerstein 2004, pp. 22-25).

This division is generally seen in two or three super-disciplines. As argued by Wallenstein (2004, pp. 22-25), these are usually ‘‘natural sciences’’ and ‘‘humanities’’, with the third one discussed being ‘‘social sciences’’. Furthermore, the super-disciplines are later divided into specific disciplines that follow a more enclosed character. However, Wallenstein (2004, pp. 22-25) points out that the specific disciplines vary with the moment in time, the person who is composing the list, as well as with country and language.

The compartmentalization of scientific knowledge is according to Campbell (1969), as summarized by Hoffmann-Riem, Bieber-Klemm, Grossenbacher-Mansuy, et al. (2008, pp. 3-17), created by two main factors: institutional structures and incentives in academia that result in an ‘ethnocentrism of disciplines’. According to Krishnan (2009), ‘‘(…) academic discipline can be seen as a form of specific and rigorous scientific training.’’. Thus, form practitioners who have been ‘disciplined by their discipline’, as ‘disciplining’ also means policing certain behaviors or ways of thinking (Krishnan 2009). Furthermore, Krishnan (2009) argues that individuals who have deviated from their ‘discipline’ can in this way be brought back in line or excluded, keeping the discipline intact.

4.1.2. An Emerging Change in the Academic Structure

Academic disciplines are under constant change and reformation as they are regenerated, compiled, dispersed or renewed in different ways. Krishnan (2009, pp. 48-51) further developed a theory for survival strategies for disciplines, consisting of three possible actions of development: (1) turning inward and strengthening boundaries; (2) forming strategic alliances with stronger disciplines; and, (3)
reconstituting the discipline in a newer and larger field of study.

Recently, there has been argumentation that the academic structure is under a fundamental reformation, leaving the traditional disciplinary knowledge-production (Frodeman 2011). Furthermore, in alignment with the development of new research centers for integrated research, attempts have been made to classify methods of research collaboration across disciplines into various categories and sub-categories. Rossini & Porter (1979) specify three head categories: (1) multidisciplinary research; (2) interdisciplinary research; and, (3) transdisciplinary research. The latter represents the highest level of integration, where there is a ‘‘(…) presence of a single overarching theoretical framework which serves to integrate the various components.’’

A similar division of types of integrated research centers into three categories has been proposed by Alpert (1989): (1) the cross-disciplinary centers, ‘‘in which researchers with problems in one discipline seek new methodologies, solutions or problems from another discipline’’; (2) the multidisciplinary centers ‘‘in which individual scholars from different disciplines share common facilities, a common research approach or a common environment, but each works on problems posed by his own discipline’’; and, (3) the interdisciplinary centers ‘‘where the problem determines the selection of personnel involved in a given project.’’

Other ambitions of such definitions can be seen in for example Pohl & Hadorn (2008, pp. 427-432), and Cooke & Hilton (2015, p. 23). This increased interest in, and aims for conceptualization of, the academic collaboration phenomenon has culminated into a new scientific discipline; the field of science of team science (SciTS). The aim of the SciTS discipline is to entirely focus on how to in the most efficient way conduct, manage, and support team-based research (Stokols, Hall, Brandie, et al. 2008; Baker 2015).

4.1.3. Proposed Benefits of Collaboration Among Disciplines

Approaching research with integration of and work on the borders of disciplines is currently a praised phenomenon on the academic and political agenda. It is even claimed that interdisciplinarity, or increased integration of disciplines, would imply creating completely new forms of knowledge providing solutions to contemporary and increasingly complex societal problems (Birnbaum 1977; Alpert 1969; Klein 1996; 2004; Barry, Born & Wieszkalns 2008; Hadorn, Biber-Klemm, Grossenbacher-Mansuy, et al. 2008 pp. 19-39; Bridle, Vrielings, Cardillo, et al. 2013; Cheruvellil, Soranno, Weathers, et al. 2014). Hadorn, Biber-Klemm, Grossenbacher-Mansuy, et al. (2008, pp. 19-39) further argue that interdisciplinarity can be used as a ‘‘(…) tool to make the research more democratic and problem oriented’’. These claims of benefits are widely spoken out now more than ever when the world is becoming increasing globalized and knowledge-oriented. Krohn (2008, p. 382) nuances this contribution of crossing fields with the example:

‘‘There is no environmental concern without seeing nature in its cultural dimensions; there is no solution to any problem without integrating human actors in its definition.’’

In more concrete manners, the benefit of collaboration is a diffuse topic of discussion, as will be further explained in Chapter 4.2.2. Evaluating Collaborative Research Initiatives, due to the lack of standardized concepts and indicators addressing this issue. Attempts to measure and argue for the benefits are therefore complicated, however, there have been attempt in various forms. As for example, Bridle, Vrielings, Cardillo, et al. (2013) argue that interdisciplinary encounters, as for example in regular conferences and other meetings, provide researchers with an opportunity to build a research network, being exposed to new perspectives and ideas and gaining practical experience of cross-disciplinary collaboration.

Furthermore, in preparation of the CRAG at IFS, the organization presented its initial estimates of costs and benefits that could be expected from supporting young researchers in collaborative research. IFS’
costs and benefit analysis of collaborative research (Haylor 2012) is presented in table 2 and 3 below (for table 3, see: Chapter 4.1.4.).

**Table 2. Benefits of collaborative research projects proposed by IFS at the beginning of the initial collaborative research projects (adopted from: Haylor 2012; Katz & Martin 1997).**

<table>
<thead>
<tr>
<th>Proposed benefit</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing of knowledge, skills and techniques</td>
<td>If two or more researchers collaborate, there is a greater probability that between them they will possess the necessary range of techniques.</td>
</tr>
<tr>
<td>Tacit knowledge transfer</td>
<td>Speeding up the knowledge transfer from idea to academic contribution</td>
</tr>
<tr>
<td>Learning the social and management skills needed to work as a part of a team</td>
<td>Providing a chance to practice collaborative settings and gain practical skills on how to work in a team by training.</td>
</tr>
<tr>
<td>Source of creativity</td>
<td>The idea that collaboration is more than the sum of the parts, thus, holistic in its nature and that cross-fertilization among researchers will generate new ideas.</td>
</tr>
<tr>
<td>Intellectual companionship/expanded networking</td>
<td>Collaboration can provide the researcher a wider network of contacts in the scientific community.</td>
</tr>
<tr>
<td>Greater scientific visibility</td>
<td>Adding to the possibility of becoming more visible at conferences, seminars and by co-published articles.</td>
</tr>
<tr>
<td>Pooling equipment</td>
<td>The possibility of sharing expensive scientific instrumentation and concentrating resources.</td>
</tr>
</tbody>
</table>

Haylor (2012) and Katz & Martin (1997) proposed that increased collaboration among scientists would contribute to seven main benefits for the individual researcher, including: (1) sharing of knowledge, skills and techniques; (2) tacit knowledge transfer; (3) learning the social and management skills needed to work as a part of a team; (4), source of creativity; (5) intellectual companionship/expanded networking; (6) greater scientific visibility; and, (7) pooling equipment.

**4.1.4. Criticizing the Collaborative Agenda**

Simultaneously, there is a worry expressed by a small group of scientists on the design and usage of integrated and collaborative efforts in science. They argue there is an overall threat from collaboration if done incorrectly. Collaborating may then instead work against and block flows of creativity and innovation due to, for example, the phenomenon of groupthink (Wray 2014). This phenomenon was conceptualized by Janis (1971). The groupthink theory suggests that groups tend to aspire for alignment and thus, radically reject and suppress critical evaluation of alternatives in favor of the consensus of the group. However, the groupthink theory has been critiqued by Aldag & Fuller (1993) for its ultimate assumption of leading to negative outcomes. Aldag & Fuller (1993) proposed instead that the variables of the groupthink theory can be used for general group-problem solving, further elaborating the theory for concrete applications.

Wray (2014) further investigated the application of the theory of groupthink in relation to collaborative research teams in his article *Collaborative research, deliberation, and innovation* where he questions the praise of collaboration in some aspects of the scientific, empirical process. He argues that, whenever alternative solutions or proposals are the goal, groupthink is a genuine threat, rather than an asset. According to Wray (2014), individuals instead work best alone in those moments. Instead he supports team work in instances where ready proposals are to be evaluated and the course of action decided. In these instances, groupthink is not a threat, and team work and group interaction can be an asset, allowing various proposals to be examined and reviewed from different angles.

Some of the concrete challenges of collaborative research identified by IFS are shown in table 3 below. These are mainly based on the typology of cost and benefits of research collaboration elaborated by Katz & Martin (1997), here as presented in Haylor (2012).
Table 3. Costs of collaborative research projects proposed by IFS at the initial collaborative research projects beginning (adopted by: Haylor 2012; Katz & Martin 1997).

<table>
<thead>
<tr>
<th>Proposed Cost</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding collaborative partners</td>
<td>Finding the appropriate collaborators may be time and cost assuming.</td>
</tr>
<tr>
<td>Financial</td>
<td>Collaborating may be resource costly in both time and financial for travels and work-time.</td>
</tr>
<tr>
<td>Time</td>
<td>Collaboration may come with additional time requests for meetings, planning and common research activities.</td>
</tr>
<tr>
<td>Increased administration</td>
<td>Managing research and funds may become more administratively heavy and a bureaucratic affair.</td>
</tr>
<tr>
<td>Reconciling different financial systems, management cultures and mechanisms</td>
<td>Researchers from different institutions may have different management systems for e.g. funds and ethics, disrupting and challenging the research process and of a cross-institutional research team.</td>
</tr>
</tbody>
</table>

Haylor (2012) and Katz & Martin (1997) proposed that increased collaboration among scientists would pose the following challenges for the individual researcher: (1) finding a collaborative partner; (2) financial; (3) time; (4), increased administrating; and, (5) reconciling different financial systems, management cultures and mechanisms.

4.2. Organizing Collaborative Research

There are various ways and examples of structuring collaborative research projects. Here, however, the focus is on collaboration among scientists in groups larger than two individuals working together. What follows in this section is an overview of concepts and theories on the topic of managing such integrated research projects, and in addition, what is known about how to best measure and evaluate these types of collaborative efforts.

4.2.1. Managing and Designing Collaborative Research Projects

Managing research is a complex challenge, where the focus should be both on the agreed outcome of the project and on allowing for flexibility, variety and unexpected findings during the research process and progress. This is especially considerable when it comes to a creative process within a research team producing a collective research outcome. Vom Brocke & Lippe (2013, p. 109) argue: “In order to manage research projects successfully, project management must find a balance between the flexibility and freedom required for creativity and the strict techniques needed to manage the related risks.”

Vom Brocke & Lippe (2013) and Lippe & vom Brocke (2016) investigated the management process of collaborative research projects in various ways. Lippe & vom Brocke (2016) identify four important concepts to use for this purpose: (1) management target; (2) management demand; (3) level of consensus building; and, (4) predictability and structure of the work. Thus, different collaborative research projects will require different management styles in different phases of the project and based on the design of the project and its individual members. Furthermore, in order to enhance creative processes, vom Brocke & Lippe (2013) identified three creative tasks involved in such projects, including: (1) research tasks in which original thinking is performed to solve a research question; (2) the knowledge generation process, idea generation, and idea implementation; and, (3) technical management tasks that aim at the vision generation, sensemaking, and creative leadership required from the technical project manager, where the management in order enhance these would be extra crucial for the projects outcome in terms of creativity and innovation.

Management of research in general may be complex, however, adding to this is the complexity of having a social dimension to the research process when acting in a group. Rossini & Porter (1979) argue that
"Because interdisciplinary research is team research entailing social interaction among the research team in order that the disciplinary perspectives may interact, the process of actually achieving integration involves both social and cognitive elements.” What they are referring to is that there is an ever more complex notion of how to integrate research because of the many social factors involved in collaborations. Conducting collaborative research therefore requires a high level of consensus building (Lippe & vom Brocke 2016) and thus, the level of management efforts may vary a lot based on such premises. Furthermore, Birnbaum (1977) evaluated management forms of interdisciplinary structured projects and found that projects managed by a structured organization are more successful. The components for managing these types of project include: establishing clear roles, organizing the work and defining communication channels (Birnbaum 1977, p. 283). Birnbaum also emphasizes the importance of a production-oriented group leader.

It is argued by Lélé & Norgaard (2005) that a better understanding of the barriers in-between disciplines would help to better design interdisciplinary teaching programs. Capacity building and training are needed to apply gained knowledge in new projects and fields, hence, building for the future. It is therefore essential that knowledge can be transferred between projects (Adler, Hadorn, Breu, et al. 2018). Currently, there is a gap in the literature with regard to this kind of knowledge transfer, which has to be filled in order to propose recommendations on the management of transdisciplinary projects (Alder, Hadorn, Breu, et al 2018). Furthermore, if to talk about capacity enhancement and cross-disciplinary collaborations in science, the topic of values and knowledge is inevitably relevant. Two philosophers having investigated this are Kuhn (1962; 1977) and Ernan (1982, pp. 3-28). Both argue that the notion of value is essential for science (Ernan 1982; Kuhn 1977). This becomes increasingly important in collaboration as there is a risk of individual researchers entering the collaboration having completely different sets of values that will inevitably affect the research outcome. Furthermore, it is important to acknowledge individual assumptions, human decisions and separate linguistic frameworks and languages (Ernan 1982, pp. 3-28), as will be underlying the choice of theory.

Depending on the nature of the collaborative research and the characteristics of the participating researchers, the steps leading to successful integration can expectedly differ. Lélé & Norgaard (2005) investigated the proposed barriers to interdisciplinary research and constituted a list of four key challenges in working together across disciplines: (1) values; (2) models and theory; (3) difference in epistemology; and, (4) the way society interacts with and influences the research. This notion affects the choice of questions posed, theoretical positions, variables and ultimately, the style of research, and, this in itself poses a risk that scientists from different disciplines will ‘‘talk past each other’’ (Lélé & Norgaard 2005). Furthermore, researchers may study the same phenomena, but use different models and theory as their first-hand choice and it may not be easy to prove the superiority of one over the other (Lélé & Norgaard 2005). There may also be a difference in what the participating researchers regard as adequate proof of knowledge, meaning that they have different epistemological views when entering the collaborative project (Lélé & Norgaard 2005; Kuhn 1962; 1977; Ernan 1982). In working together and overcoming such barriers, Lélé & Norgaard (2005) suggest five key characteristics in interdisciplinary practitioners that have proven successful for the outcome. These include:

- Self-reflection
- Identify and agree on shared concerns to motivate efforts
- Respect and to learn from ‘‘the other’’
- Work with alternative and new models (taxonomy)
- Allow for plurality and incompleteness

Furthermore, according to Lélé & Norgaard (2005), some disciplines are easier to bring together than others. Lélé & Norgaard (2005) argue that the barriers of working together in interdisciplinary research are the least among different natural scientific disciplines. The barriers become larger in between natural and social sciences (Lélé & Norgaard 2005; Strang 2007).

More recently, the importance of interpersonal skills when conducting collaborative research has been
further acknowledged and investigated by Cherevelil, Sorrano, Weathers, et al. (2014). They argue for increased attention towards the interpersonal skills of team members including social sensitivity and emotional engagement, as well as increased attention to the team faction in terms of communicative pathways and patterns. Key features identified that aggravate a collaborative research project were identified by Cooke & Hilton (2015, pp. 5-7): (1), high diversity of membership; (2) deep knowledge integration; (3) large size of group; (4) goal misalignment with other teams; (5) permeable boundaries and changing project goals; (6) geographic dispersion; and, (7) high task interdependence, all of which raising the demand for greater coordination, management and communication efforts in a team.

How to further design collaborative research is consequently situational. Pohl, van Kerkhoff, Hadorn et al. (2008, p. 413) argue: ‘’The most promising kind of integrative approach depends on the specific questions to be answered - for instance, the ways different research approaches can be merged or innovative methods and concepts developed.’’. Olsen & Pedersen’s (2008, p. 14) theory developed for young academics entering research collaboration projects claims that the research carried out by a team should be problem-oriented, i.e. focusing on a research problem rather than a subject-matter. This would be more flexible and adjusting along the way as the group widens its perspective on the identified problem, hence adding to the need for flexibility (vom Brocke & Lippe 2013), and thus, rather than becoming a project of collecting information, carrying out a collective analysis and put forward a solution to a problem (Olsen & Pedersen 2008, p. 14).

However, there are few concrete examples of collaborative research designs in the academic literature. The collaborative team model used for the IFS collaborative program was developed from Rossini & Porter (1979) and Becx & van Hofwegan (2006, in IFS 2016). Rossini & Porter (1979) conceived and identified four frameworks useful for research integration among scientists based on twenty-four technology assessments (which consumed two to six person-years of effort, and typically involved three to six major participants in a team). These four frameworks are: Common Group Learning (as modified by IFS to team model 1 and demonstrated in Fig. 3: Common Group Learning); Integration by the Project Leader (as modified by IFS to team model 2 and demonstrated in Fig. 4: Integration of Research by Leader); Negotiation Among Experts (as modified by IFS to team model 3 and demonstrated in Fig. 5: Common Research Component; and, Formal Modeling (as modified by IFS to team model 4 and demonstrated in Fig. 6: Modelling). The models are shown in full description in Appendix E. The various team constellation models (fig. 3-6) represent different forms of integrated research approaches developed by IFS based on Rossini & Porter (1979) and Becx & van Hofwegan (2006 in IFS 2016). These models would allow for different research strategies and levels of integration among team-members and their common knowledge production addressed as ‘research outputs’.

Fig. 3. Team model 1: Common Group Learning (Model developed by IFS, source: IFS 2016).

Fig. 4. Team model 2: Integration of Research by Leader (Model developed by IFS, source: IFS 2016).
4.2.2. Evaluating Collaborative Research Initiatives

It has been recognized that evaluation methods of the effectiveness of interdisciplinary and collaborative research initiatives are scarce (Porter, Roessner, Cohen, et al. 2006; Porter, Cohen, Roessner et al. 2007; Anzai, Kusuma, Kodama, et al. 2012; Goring, Weathers, Dodds, et al. 2014; Gaziulusoy, Ryan, McGrail, et al. 2015; McLeish & Strang 2016). As the primary scholarly discussion has stated on this issue, there seems to be a lack of consensus on both methodology and proposed indicators that may be suitable in order to follow up and measure integrated research efforts. This is something hoped to be addressed by for example the new, prominent field of SciTS. Previously, there have been some attempts to define and measure the level of interdisciplinarity in research articles (see: Porter, Roessner, Cohen, et al. 2006; Porter, Cohen, Roessner et al. 2007). Furthermore, concrete efforts to pinpoint indicators of research integration have been made by Anzai, Kusuma, Kodama, et al. (2012).

Anzai, Kusuma, Kodama, et al. attempted to identify key performance indicators (KPI) for interdisciplinary research by studying two interdisciplinary academic institutional research projects in the form of an action research study. They specifically looked at the teams’ working processes and productivity levels in these projects. As an indicator for overall interdisciplinarity, they coupled the breadth of the research network and the range of participating research fields (disciplines). This was done by looking at KPI (1) Interdisciplinary indicators, and (2) a Publication Productivity Indicator. KPI (1) with the interdisciplinary indicators included: extensity of research field interdisciplinary index; extensity of research network; number of joint papers; number of affiliated organizations and regions (per paper and in total). In addition, KPI (2) equalled number of research papers in total.

Furthermore, McLeish & Strang (2016) specifically looked at five areas for validation and evaluation of interdisciplinary research, including: publishing, research grants, careers, interdisciplinary research centers, and institutions. A conclusion was drawn that single-discipline peer review processes are poorly fitted to evaluate interdisciplinary research, however, if there is an acknowledgement as a premise for
the evaluation that the project is of interdisciplinary character, the more traditional single-discipline evaluations may be equally good as a method. Moreover, Gaziulusoy, Ryan, McGrail, et al. (2015) argue that transdisciplinary research projects should be evaluated based on their overall impact, rather than traditional academic performance indicators, such as number of published articles proposed by McLeish & Strang (2016).

4.3. Sustainable Development

Ever since the Report of the World Commission on Environment and Development: Our Common Future also known as the Brundtland Report was published in 1987, the agenda of the world’s development has been set to become Sustainable. In the Brundtland Report the notion of Sustainable Development was first presented as a strategy (or survival mechanism) for the human future and defined in words still used today. After over a century of hard industrialization, this report impressed upon the world that resources are finite, that the environment is taking damage and that we have to work together in order to meet ‘‘humanities’ goals and aspirations’’ (WCED 1987). The nick-name of the report refers to the chairperson of the authoring organ, Gro Harlem Brundtland, simultaneously also holding the role as Prime Minister of Norway (1986-89).

In the Brundtland Report (WCED 1987, Chapter 2: IV. Conclusion), sustainable development was defined as:

‘‘(...) development that meets the needs of the present without compromising the ability of future generations to meet their own needs.’’

It was also stated that all goals for economic and social development in all countries must be defined in terms of their sustainability, regardless of world ranking and political governance system (WCED 1987). It was further recognised that implementation, interpretation and course of action would vary, but that all development policies should follow the same basic concept and broad strategic framework for sustainable development implied in the concept (WCED 1987).

It would be another twenty-eight years, before this broad, strategic framework and definition of concepts would be presented by the UN and accepted and ratified by its member states. On September 25th, 2015 at the United Nations Sustainable Development Summit, member nations joined together to the UN 2030 Agenda for Sustainable Development and its 17 SDGs (see: UN GAR 70/1 2015). The agenda with its 17 goals is the consensus looked for in the Brundtland Report published in 1987. The overall aim behind the SDGs was to end poverty, protect the planet and ensure prosperity for all (UN 2015). The ratified agreement by the member nations entered in force on January 1st, 2016. The 17 goals covered a wide range of areas in both social, economic and environmental aspects of development and was further concretized into 169 targets.

- Goal 1. End poverty in all its forms everywhere
- Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Goal 3. Ensure healthy lives and promote well-being for all at all ages
- Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Goal 5. Achieve gender equality and empower all women and girls
- Goal 6. Ensure availability and sustainable management of water and sanitation for all
- Goal 7 Ensure access to affordable, reliable, sustainable and modern energy for all
- Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- Goal 10. Reduce inequality within and among countries
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12. Ensure sustainable consumption and production patterns
Goal 13. Take urgent action to combat climate change and its impacts
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

As applied as a concept in this thesis, sustainable development is one of the contemporary key arguments underlying the promotions of increased collaboration and partnership, as it substantially drives the global and national policy agenda. The SDGs are closed with goal 17, entitled Partnerships for the Goals, and thus, with this new framework, all member states are obligated to make national arrangements and strategies that will follow the ratified agreement. SDG number 17 is particularly interesting in the context of this thesis, as it states that the ‘(…) interlinkages and integrated nature of the Sustainable Development Goals are of crucial importance in ensuring that the purpose of the new Agenda is realized’. Thus, the goals have been made to not stand alone, whereas collaboration and integration of work is needed in order to reach not one, but all of the goals (UN GAR 70/1 2015, p. 6, section 17).

Various frameworks have been underlying and supporting the global development agenda over the past decades. Preceding the SDGs were for example the Millennium Development Goals (MDGs), a development strategic plan that was focussed on the less developed economies at the time of their ratification by the United Nations in 2002. It has been further recognized that the ‘development’ of the world has led to difficulties in defining the term international development cooperation, development assistance, aid, etc., (Alonso & Glennie 2015) as the world’s economic and political map has been reshaped. The ratification of the SDGs and 2030 Agenda acknowledges the challenges and ‘development’ need of all nations, not any specific countries in any classification level of development.

Currently, the definition of international development cooperation is that it should aim at: (1) supporting and complementing efforts of developing countries to guarantee the provision of universal social basic standards to their citizens, as a means for people to exercise their basic human rights; (2) promoting the convergence of the developing (in particular the poorest) countries to higher levels of income and wellbeing correcting extreme international inequalities; and/or, (3) supporting efforts of developing countries to participate actively in the provision if international public goods (Severino & Ray 2009; Ocampo 2015 in Alonso & Glennie 2015), and can be funded from both official or private institutions and organization. International development cooperation transfers and funds have previously been determined and regulated by DAC of the OECD which refers to it as Official Development Assistance (ODA) (Tarp 2006). As previously stated, the entry of the SDGs substantially changed the way of viewing aid and development, including concepts like “developing country”. In SDG 17.6, it is instead stated that there is a need to enhance international cooperation. Furthermore, and in specific, it stated the need to increase collaboration North-South, South-South and triangular regional on access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms (UN GAR 70/1 2015, p. 26, section 17.6). Continuously, SDG 17.9 emphasizes on the enhancement of international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the Sustainable Development Goals (UN GAR 70/1 2015, p. 27, section 17.9).

The SDGs are specific in promoting a more integrated approach to science (UN GAR 70/1 2015, p. 5, section 15). This idea of an integrated approach to science and scientific capacity building in low and lower-middle income countries is further aligned with SDG 9: build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (UN GAR 70/1 2015, pp. 20-21,
SDG 9, with many of its sub-goals, or targets, address topics that require collaborative efforts. Such as: 9.1, “to develop quality, reliable, sustainable and resilient infrastructure, and support economic development and human well-being, with a focus on affordable and equitable access”; and, 9.4, “by 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes”. Thus, the SDGs may be viewed out of the perspective of a driving force for collective action on increased investments in innovation and collaboration among countries to achieve these goals and targets.

5. Learning from the Experience

In this chapter, the empirical findings of the interviews conducted with key respondents of the IFS CRAG are presented. The content is a combined value- and opinion-based set of personal experiences and practical information offered by the respondents on the experience of participating in an introductory collaborative promoting research program.

The six key respondents conducted research in a collaborative way in the field and topic of neglected and underutilized species (for reference, see: Chapter 2.1.2.). The key respondents represented five out of ten teams participating in IFS CRAG Pilot 1 and five out of seven teams asked to contribute to the study. They represented all five countries in the region that were eligible for the program in Pilot 1, namely Uganda, Tanzania, Nigeria, Ghana and South Africa. Furthermore, they all currently work in the role of researcher or lecturer at a university and have natural science or applied science backgrounds; however, their team-composition was of multiple disciplines, varying from three to five researchers of various backgrounds, including in some of the teams one or more social scientist(s). Further characteristics of the key respondents are shown in Table 4.

Table 4. Characteristics of the key respondents of the IFS CRAG.

<table>
<thead>
<tr>
<th>Research topic</th>
<th>Neglected and underutilized species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Countries</td>
<td>Uganda, Tanzania, Nigeria, Ghana and South Africa</td>
</tr>
<tr>
<td>Highest reached academic level at project start</td>
<td>4 MSc and 2 PhD</td>
</tr>
<tr>
<td>Highest reached academic level at time of study</td>
<td>2 MSc and 4 PhD</td>
</tr>
<tr>
<td>Disciplinary belonging</td>
<td>6 out of 6 natural sciences</td>
</tr>
<tr>
<td>Team leader role</td>
<td>2 out of 6</td>
</tr>
<tr>
<td>Gender</td>
<td>1 female, 5 males</td>
</tr>
</tbody>
</table>

At the time of this study, five of the six key respondents reported that they had finalized their project. One team had finalized the IFS granted project part, however, kept on working within the same project and team to conclude on their long-term project (respondent 5).

5.1. Motivation to Participate

All of the respondents reported that they had no or little earlier experience of collaborative research projects. When asked about their motivation for applying to the IFS CRAG, the reasons for doing so
varied. Four said they had been interested in working in the collaborative way, while two had a more strategic funding-seeking-oriented reason for joining the program. Respondent 1 expressed that, having already been interested in this type of project, it had been hard to find suitable collaborative partner(s). One factor enabling this contact was being introduced to the platform PODIO by IFS (see: Chapter 2.1.2.). Respondent 1 had for a long time observed an issue and been eager to work on it, however, it was judged to be of such a complex nature that it required collaboration in order to become an effective project. Consequently, this later became the research topic of this team. The same was found for respondent 5, who also had an idea of a project brought into the group. This respondent wanted to test the idea together with others having recognized that in order to find a solution to the problem, a variation of different competencies in the team would be required. In another case, one researcher reported to have applied both for an IFS individual grant and for the collaborative grant (respondent 2). When asked by IFS to choose between the two, this respondent decided to go for the CRAG out of two main reasons: firstly, not to disappoint the teammates after having developed a common proposal; and secondly, because of previous experience of collaborative settings, this was seen as a good opportunity to expand on a collaborative network (respondent 2). The same type of curiosity was found in respondent 3, who applied out of curiosity for cross-African collaborations and in order to gain the skills of how to manage collaborative projects.

5.2. Collaborative Models

When entering the program, the teams were asked to choose a collaborative team model (see: Appendix E) developed by IFS based on Rossini & Porter (1979) and Becx & van Hofwegen (2006 in IFS 2016), or to develop their own model for the research (IFS 2016). The model chosen would guide the process of reaching the common research output (see Appendix E). Out of the key respondents, one reported to have used collaborative team model number one, two reported to have used collaborative team model number two, and three reported to have used collaborative team model number three (see: table 5). None reported to have used collaborative team model number four. However, it was noted that there was a non-coherent reporting in one of the teams, as two key respondents participated in the same team and reported to have used different collaborative models in their projects.

<table>
<thead>
<tr>
<th>Key respondent</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team model</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

When posed the question ‘Design and division of the work: did you follow through using this model?’ (see: Appendix D), the key respondents answered quite differently. For example, respondent 4, said that the model reported to have been used in their research project was chosen because it ‘(…) seemed most suitable for the work they had been executing’ and that they had worked on most aspects aligned with model number one as they had in the initial stage exchanged ideas and refined the exact program and project aims together for the final research proposal to IFS. Respondent 4 further explained, that there was a common input at this stage on how the groups’ common knowledge was formed, and further, the layout of the project responsibilities was decided. As the project progressed, the team was in close e-mail contact with updates and information on each other’s work. However, although the team was actively interacting, respondent 4 argued that it might not be pure group-based learning, as all had their own project at their respective institutions. During the projects progression, the interactions in the group decreased, as analyzed by respondent 4 to have to do with long distances and furthermore, group dynamics.

The groups of respondents 2 and 3 had chosen collaboration model number two with the argument that it would be most efficient for the team leaders to harmonize the otherwise discipline-, country- and institution-wise scattered groups in developing the project objectives. It would also present the opportunity to divide the work according to their respective expertise and consequently be responsible.
for one's own field but still deliver on the overall project outputs (respondent 3). Respondent 3 thought using this sort of model was essential to the whole project. Respondent 2 reported that the working constellation had been very good and that the work division had been well integrated by using this model.

Respondents 1, 5 and 6 reported that they had been following the collaborative team model number three. It was chosen because of the teams multidisciplinary and -nationality composition (respondent 1) as the model would allow individual research, while still influencing the common research outputs. The research proposal was developed from individual concept notes, later put together by the team leader before applying for the program (respondent 1). Respondent 5 reported to have a very individual process in the initial stage of the project. At the time of the interview, the team was still identifying itself as being in the individual phase, however expecting to follow through with the bigger project and become more integrated as a team as the project proceeds (respondent 5). In the team of respondent 6, all participating researchers had different areas of interest in doing the project but one common goal, which was why they had chosen to work according to collaboration model three. During the project, one of the participating members in the team did most work alone, while the others worked more closely together.

Respondent 4 and 6 emphasized that they were more focused on their research aims and objectives rather than following a strict model of how to collaborate.

5.3. Communication Pathways

A majority of the teams had been using e-mail as their main form of communication. In addition, Skype had been a common way to meet and discuss (respondent 4; 5) when appropriate. However, communication via Skype calls was difficult, due to irregularity in high speed internet connection. In such instances, e-mail conversations were most effective.

Respondent 1 expressed that sometimes it was difficult to assemble the group for a conversation, and that sometimes, dialogues were held with only parts of the team. There was similar reporting from respondent 2, 3 and 4 which all had moments when communication was lacking. According to respondent 1, the reason for such non-communication was thought to be lack of internet connection. Respondent 2 expressed that their collaboration had continued working well despite difficulty in communication, however when reflecting on why the communication was not working so well at all times, this was thought to be because being engaged in or busy with other assignments. In the teams of respondent 2 and 4, there was one team-member not being responsive or active in the dialogue according to the respondents. Respondent 5 did not report on any communication difficulties.

5.4. Overcoming Differences and Bridging for Consensus

Commonly, the key respondents reported collaboration or communication issues more or less frequently throughout their projects. Respondent 3 reported some communication difficulties in the beginning of the project, however these were reduced after the IFS workshop (for reference see: Chapter 2.1.2.). Respondent 1 reported some difficulties in following their chosen collaboration structure, mainly due to communication issues, where the team had tried to push for everybody to deliver on their individual part, however not been a hundred percent successful.

In some of the teams, there seems to have been one perceived less engaged team member (respondent 2; 4). In the case of respondent 2, one team member was perceived as having a low responsiveness and activity in the group’s dialogue. The issue was resolved as they got to understand this team member’s personality. Respondent 4 acknowledged the fact that this is a risk when entering collaboration with strangers, and furthermore, reflects upon that the size of the group might have been too big. For this team, the most critical phase of collaboration seems to have been in the introductory phase of the project,
which required dedicated collaboration to obtain the intended research material, however, where communication was stalled with one of the team members resulting in delays.

Working together with others on the same academic level was thought by respondent 6 to cause a lack of routine and experience on how to handle some issues that occurred along the way. Respondent 6 reflected that “while theoretically we all were able to look for the information being able to manage the project, we miss the knowledge of implementation and reaching the material and the actual cost for the activities.”. This led to budget issues that ultimately affected their research outcome and possibility to reach the research objectives with the funds available. Respondent 6 acknowledged that they in these moments needed additional help from senior faculty members outside of their team to manage issues of the budget spending. During the implementation phase, they had run short on funding and had first disagreed on how to proceed, following, the project outcome was affected.

Both respondent 4 and 5 observed that the attitude of the people who engage in these research constellations is highly important and a key factor for the outcome. Generally, coming across issues in collaboration, the teams found different strategies to solve their issues. Respondent 1 reported that they used the collaboration for pushing team members who were behind in their time plans. Respondent 2 found great help in having team members spread across different countries when running into sample analysis issues with a third party in another country. Respondent 6 argued that a key factor for continuing the collaboration and motivating each other was the agreed deadlines. Deadlines was also a good incentive for continuing the communication and keeping track of each other’s progress. Respondent 3’s team developed a well outlined work and communication plan which was thought to have enabled them communicate and collaborate smoothly. The moments when this team lost communication and engagement of team members, the reasons were discussed and recognized, as having other duties outside of the project.

There had been various ways of progressing towards the research outputs goals among the teams. As an example, respondent 1 reported that in the initial phase of the research it had been agreed that each member was to publish one paper from the common project, which they would all share as a co-authored publication. Up until the point of the interview, all members had not yet finalized their publications.

5.5. Reflections on Being in a Multi-Disciplinary International Research Team

There was a general consensus among the key respondents that being in a team consisting of multiple disciplines has been of value to their projects (respondent 1; 2; 3; 5; 6). The reasons given by respondent 1 correspond to theories of overlapping and bridging knowledge, referring to great value for natural scientists to exchange methods with social scientists. In the specific case of respondent 1, there was an exchange of practical knowledge on how to develop a questionnaire to reach higher quality in the data output which added new dimensions to the project and research outputs. The same was argued by respondent 2, who was able to transfer these newly gained areas of knowledge and skills to other projects:

“This program has opened up new networks outside my institution and even country, has enhanced my research output and broadened my scientific knowledge and skills. The networking has increased my visibility in the scientific world, improved the quality of my research and career in general. Invariably, I know it will contribute significantly to my research publications in due course as we publish our project results. This will enhance my profile and promotion in the University. Through this project I have also acquired some management (human and resources) skills. The equipment acquired is useful in training and development of next generation of students and scientists.”

Respondent 3 described the aspects of interdisciplinarity to have improved project implementation as
each component of the project was handled by a disciplinary expert. Respondent 5 also argued that being in an interdisciplinary team makes it possible to construct the whole value chain of research, gaining the perspective of how his or her own research is affecting other fields of science and vice versa. As a team, respondent 5 informed that many of the ideas important for their projects implementation and outcome came from different team members, thus seen to increase the possibility for innovation as it is a source of enhanced creativity.

Respondent 4 enjoyed taking up skills from other disciplines and thought that working across disciplines enabled a multi-angled approach on problems. In this case, respondent 4 said that the project had worked ‘‘fine’’ in relation to other experiences of multidisciplinary research. Respondent 4 pointed out that the main constraints with doing international collaborations in research are logistic, mainly shipping and transporting materials for the research, which is important to make an appropriate plan for and take into account in order to minimize risks associated with it. While seeing the backsides, respondents 3, 5 and 6 reported that the greatest benefit of this experience was gaining wider international collaboration possibilities, which resulted in a larger network and greater scientific visibility to conceptualize and test ideas.

Respondent 6 reported that it was a bit unclear in the end how much each participant had contributed to the final research output. This was mainly due to the barrier in understanding each other’s methods and approaches resulting in assessment of workload issues. Still, respondent 6 said that the work of all of the participants was of great value to the common goal. Respondent 6 highlights the importance of collaboration in helping each other conducting research more efficiently, sharing both workload and achievements. Respondent 6 said to have gained a deeper understanding of environmental issues and become better at assessing the sustainability of a project due to the multi-disciplinary team where sharing of knowledge lead to more holistically evolved research questions. Having all of the new angles of the research problems ultimately reflected more angles and aspects of society.

5.6. Benefitting from Collaboration

On meeting IFS’ objectives with the collaborative program, benefits of collaborative research in Haylor (2012) based on Katz & Martin (1997) (see: Chapter 4.1.3., table 3.) the key respondents were generally positive. The main benefit of collaborative research highlighted in the interviews was ‘‘sharing of knowledge, skills and techniques’’ by respondents 1, 4 and 5. Another benefit specially highlighted by respondent 3 was ‘‘learning the social and management skills needed to work as a part of a team’’, as follows:

‘‘As researchers we have been weak in conducting multi-sectoral or multi-disciplinary research due to lack of social and management skills but having acquired these skills we shall be in position to manage such projects’’.

Respondent 5 expressed that this constellation was a good exercise for collaboration, where the team had to discuss thoroughly how to incorporate each individual researcher’s point of view in the project design.

Generally, there was a consensus on having met a majority of the proposed benefits (seen by respondents 2, 3; 4, 5 and 6). However, one objective, ‘‘pooling equipment’’, was mentioned not to have been realized in the respective projects, only respondent 6 recognized its relevance for their project. The common perception that this proposed benefit had not been reached was argued by respondents 3 and 4 to be due to the constellation of the research being just that, international and interdisciplinary, where due to geographically separated research facilities or methodologically diverse approaches, sharing equipment was not a possibility or a resource to be counted on.
5.7. Gained Insights and Aftermath

Overall, the key respondents had no or little previous experience of collaborative research projects. However, they all expressed high enthusiasm towards further research collaborations, as respondent 1 stated:

‘You cannot work alone as a scientist.’

After or simultaneously with the IFS CRAG experience, all six key respondents either had the wish to or started other collaborative projects. Furthermore, continuous communication occurred in respondent 1 and 3’s teams and there was an interest among the team members in applying again for similar opportunities together. Respondents 3, 4 and 6 all pointed out that they wanted to continue to reap the benefits of their previous experience of working together in future projects.

There was a general consensus among the key respondents on the effectiveness of collaboration. However, respondent 4 argued that although collaboration is useful, and does enhance knowledge generation, it comes at a significant emotional and resource cost. Further, respondent 4 argue that collaboration takes more effort than individual work, because you need to coordinate with others which implies considering the value in each case. It was also clarified by respondent 4 that collaboration boils down to the individuals that actually do the collaboration, meaning that working together, is all about the incentive and engagement of the individuals, and that the collaboration must start there.

Generally, taking part in this program has led to new possibilities for the key respondents. Skills have been obtained to be transferred into new projects (respondent 1; 3; 4; 6). Furthermore, respondent 1 explained that the benefits of collaborating are not only individual, but transfers to the respective institutions and universities. Respondent 1 had for example been a supervisor for new collaborative research constellation after the experience with IFS. Another positive aspect of the collaboration seen was the potential for co-authorship of peer-reviewed articles and, thus, creation of a higher level of academic visibility (respondent 1; 3).

Throughout the interviews, a few selected unique insights of the collaborative process and the collective or individual outputs were obtained. These are as follows:

- Team members shared knowledge among each other during the project, however they struggled to share their knowledge outside of their group, with their respective fields (respondent 1).
- Post-project closing, respondent 4 reflected upon the conflict within the team and concluded that one skill obtained in doing this program was how to judge when it is good or not to join a research collaboration project.
- Respondent 5 expressed that as a young researcher you look for people who can help you develop in your field of interest. The design of the IFS program allowed for more interactions with new people, relying less on luck and offered enriching opportunities to speed up the process. Furthermore, it was an opportunity to meet other fellow researchers at the same level.
- The IFS program is ‘small enough to fail’ (respondent 4) meaning that it was a good opportunity for trial and error, trying out collaborative research without risking too much of your career and time.
- The team of respondent 6 would have needed enhanced support in framing research objectives and planning the budget in order to reach the project objectives. Furthermore, additional opportunities to meet in person as it would have enabled a closer collaboration, thus having created a better understanding of each individual team members research.
- As expressed by respondent 4, there is a risk in these type of funding opportunities that collaboration may not be the priority of the applicant. Thus, instead of collaborating, the priority may be living up to the funding requirements of a collaborative project due to the lack of funding opportunities in general.

When asked about academic collaboration for sustainable development, the six respondents generally
gave highly positive and coherent answers. There were some ideas expressed linking innovation for sustainable development to collaborative research. As for example, respondent 1 and 4 would like to see continued support for their research teams in realizing their research outputs. They express that there is further interest, but few opportunities for collaborative research projects like this. The IFS CRAG is currently only up to three years of support. However, respondents 1, 3 and 4 argue that you need to take advantage of the fact that there has already been a research group established. Furthermore, the group has already yielded a great output of result but cannot, due to lack of funding, continue to implement their outputs. Because of this, according to respondent 1, the innovation process is cut and hindered, which poses the question from respondent 1 to IFS: "What is the follow-up from IFS on our output?".

On the same notion, respondent 5 argues that it is important to turn innovation into real-world solutions, and that this can be done through collaboration. Collaborating and caring for researchers’ ideas would then be important for sustainable development where collaboration can lower the need for resources, in both time and financial cost. Furthermore, respondent 3 expressed that collaborative research is needed to achieve the SDGs, because of these goals multi-disciplinary approaches. Ultimately, collaboration will leverage resources needed and shorten the time required to achieve the SDGs, therefore, academia should encourage collaborative research aligned to target SDGs through partnering and using their expertise to support other institutions rather than doing research in isolation (respondent 3). Respondent 5 argued along the same line, that collaboration enables each individual to use their core-skills and contribute their most qualified work, and that, ultimately, collaboration brings out the best ideas:

“If you have to do everything by yourself, any time you have a block in creativity it means that the solutions continue to lag behind and in other words the problems grow in size.”

And that, ultimately, innovation is created through collaboration (respondent 5). Further, respondent 6 emphasized that the most important part of collaboration is the gained ability to address problems more holistically, and argued that increased collaboration is needed, especially in academia.

6. Concluding Discussion

In this thesis, a conceptually grounded analysis was made on collaboration among young scientists in low and lower-income countries using empirical data obtained from key respondents participating in IFS CRAG Pilot 1. An analysis was conducted regarding to what extent the participating young researchers had absorbed and integrated the assumed benefits of participating in such a program promoting enhanced collaboration and to what extent there may be a need for increasing or decreasing the accelerating initiatives of investments into interdisciplinary research teams across the world in order to fulfill the 2030 Agenda and the SDGs. The thesis further explicitly included an assessment of current theories on the sustenance and development of collaborative and interdisciplinary research teams and the relevance of this for enhancing scientific capacity of increased innovation, effectiveness and progress. Conclusively, in answering the appointed research questions:

1. What is the conceptual meaning of “collaboration” in scientific research as revealed in relevant literature and documentation of collaborative projects?

Collaborative research has proven to be an ambiguous and fluid concept. As demonstrated in this thesis, although concepts and theories around this phenomenon have been proposed (see: Rossini & Porter 1979; Alpert 1989; Pohl & Hadorn 2008, pp. 427-432; Cooke & Hilton 2015, p. 23), there is no coherent consensus on this concept in the scholarly literature.

2. What can introductory collaborative programs bring to young researchers in low and lower middle-income countries?
The IFS CRAG case study now presented offers a unique insight into young researchers’ experiences of participating in such a program. In the case study, it was recognized that there is a consensus among the key respondents that participating in this collaborative research program greatly contributed to the individual researchers’ professional development. Furthermore, the collaborative aspect of the project constellation was thought by the respondents to have created more innovative and holistic project outcomes. However, the focus remains at the capacity building level, as the initiative poses an opportunity for early-career scientists to enter their first collaborative research project. In that regard, it was shown that the IFS CRAG provided the key respondents interviewed for this specific study with opportunities to expand on their network, get enhanced visibility, gain insights into and skills from different disciplinary fields, practice interdisciplinary methods, develop social skills needed to succeed in collaborative projects, gain experience in management of research projects and a more holistic view of research problems and the sustainability of a project. These findings correspond to overall literature reviewed on the proposed benefits of collaboration, as well as management approaches (see: Bridle, Vrieling, Cardillo, et al. 2013; Katz & Martin 1997; vom Brocke & Lippe 2013; Rossini & Porter 1979; Lélé & Norgaard 2005).

3. How does the investigated case translate into the concept of collaboration in terms of types of collaboration and chances for continued collaborative efforts?

The collaboration concretization of the IFS CRAG based on a literature reference to Rossini & Porter (1979) (see: Chapter 4.1.2.) was not inbound to any specific constellation of multi- or interdisciplinary research centres. Instead, the program was in its nature:

- transnational, involving scientists from many countries in each team,
- multidisciplinary, out of the context of involving multiple disciplines in each team,
- partly interdisciplinary, however not requested to be correspondingly integrated,
- and, introductory, presenting the first opportunity to take part in a collaborative research project to young academics.

Furthermore, continuous interest in collaborative research constellations was observed in all interviews, however, it was acknowledged that the international, interdisciplinary programs for research collaboration in the region were scarce and thus, due to lack of funding, in some cases collaborative efforts among the teams could not be maintained.

6.1. Implications

The collaborative model presented in this thesis is merely one of many possible collaborative project research designs. The research presented has contributed to filling the gap of practical case studies within integrated research pointed out by Gaziuslusoy, Ryan, McGrail, et al. (2016). Furthermore, building on the experience, some key findings from this case study can be used for further designing collaborative research programs aiming towards scientific capacity enhancement in low and lower-middle income countries.

The IFS CRAG has equipped the key respondents with useful skills of collaborative research acknowledged to create a better understanding of environmental and sustainability issues. However, based on the findings in the case study, extra support on project management will be needed, in specific regards: establishing and defining clear communication pathways and integration of the teams’ work, as also supported by Birnbaum (1977). Other issues worthy of reflection may be to further try to provide the collaborators with more personalized team-working skills of for example: self-reflection, knowledge of value indifferences, direct communication and openness (Lélé & Norgaard 2005; Kuhn 1962). It has been demonstrated that the key respondents acknowledge that they have been able to gain and transfer skills between research projects. However, the research gap was addressed by Adler, Hadorn, Breu, et
al. (2018) on the transfer of knowledge through researchers between scientific projects remains unknown.

In addition to the ambiguity around the topic and concept of collaboration, furthermore, wide acclaims have been made on the benefits of collaboration in relation to innovation, progress and for enabling a more holistic approach in tackling complex research issues both in this case study and in the scholarly literature (see: Barry, Born & Weszkalnys 2008; Krohn 2008; Hadorn, Biber-Klemm, Grossenbacher-Mansuy, et al. 2008; Klein 1996; 2004; Barry, Born & Weszkalnys 2008; Bridle, Vrieling, Cardillo, et al. 2013; Cheruvelil, Soranno, Weathers, et al. 2014). However, it has also been recognized that there are few methods and evaluation criteria for measuring collaborative research efficiency and outputs (Porter, Roessner, Cohen, et al. 2006; Porter, Cohen, Roessner et al. 2007; Anzai, Kusuma, Kodama, et al. 2012; Goring, Weathers, Dodds, et al. 2014; Gaziulusoy, Ryan, McGrail, et al. 2015; McLeish & Strang 2016). This has strong implications, as the arguments of the proposed benefits lack quantitative scientific support. This poses a problem in itself as it complicates the task of measuring and evaluating the effects of collaboration, and thus, furthermore, affects the willingness to invest in such initiatives.

Just because we say collaborate, does this mean that it is actually going to happen? And, if so, will it be of value as contradictorily argued by Wray (2014)? It is argued by Gaziulusoy, Ryan, McGrail, et al. (2015), that in order to better understand this issue, transdisciplinary research should be evaluated for its overall impact and that funding should be flexible towards the nature and design of such research projects. However, due to the complexity and individual design of each integrated research project, indicators and standardization may be difficult to obtain, regardless of efforts. Possibly, this is the greatest challenge for the emerging field of SciTS (Stokols, Hall, Brandie, et al. 2008).

Continuing on the problem of lacking scientifically based support for the proposed benefits of collaboration, this is a strong argument to make. It has multiple implications for the future. Thus, based on how collaboration is validated, regardless of whether its proposed benefits are confirmed or not, and thus, if initiatives enabling scientific collaboration and building capacity, this may determine whether or not these incentives are invested in. Thus, also, if what is claimed about collaborating in accordance with the SDGs is confirmed or not, this may determine if the goals will be met, and how ‘effective’ research can become. If collaboration is the key, then lack of methods of quantifying its effects becomes a big problem blocking potential investments.

I do not claim to have the answers to these questions, however, they become increasingly interesting and important as the world’s environmental issues escalate and the belief in technological prominence and innovation grows.

It is important too, at this point, to highlight the limitations on the conclusions possible to draw from the findings of the presented case study, as the interviewees are a selected group of individuals assumed to be engaged in and actively seeking for collaborative research opportunities. However, the findings are valid as such and provide a pool of interesting insights and experiences of the collaborative concept put into practice, opening up for continued investigations.

Additional research is needed to better understand and quantify tacit knowledge transfers (Katz & Martin 1997) and the creation of informal values in relation to collaborative research practice. Indicators for these transfers and values also need to be developed for appropriate evaluation methods for collaborative research programs. It would be useful to conduct more single case studies, such as the one presented in this thesis, to acknowledge and recognize the role of this type of programs and initiatives for the global development as such, and capacity enhancement in particular. Furthermore, to better quantifying and identifying the effects, exemplify varieties of research collaboration, and clarify the concept of collaboration, more action research projects on collaborative research, like the one presented by Anzai, Kusuma, Kodama, et al. (2012) should be conducted. In specific, larger and more quantifiable research studies of this sort would be appropriate to follow to study the collaborative processes in research in a more controlled manner, and to investigate its implications on a larger scale.
7. Acknowledgements

This thesis is a part of an evaluation of the IFS funding collaborative research approach and has been conducted with material support of IFS. Further in this section, I wanted to formally show my appreciation to all the people who have helped me throughout this process. What follows is a long list of people who have been essential for having produced this thesis. First of all, I would like to warmly thank my thesis supervisor, Prof. Emeritus Lars Rudebeck at CEMUS, Uppsala University for with great precision, warmheartedly and with patience having guided towards the completion of this thesis. Secondly, I would like to show my great appreciation to my in-house supervisor at IFS, director and Dr. Nighisty Ghezae for helping me in guiding the works scope and content and providing me with the material and resources necessary for this research. Thank you, Mr. Martin Westin at Swedish University for Agriculture Science and SWEDESD at Uppsala University for serving as my thesis evaluator and guiding my thoughts and providing me with critical comments and further guiding in academic research methods. Thank you, to all and every IFS staff member for throughout support in this thesis production, with a special thank you to Dr. Ingrid Leemans for with critical questions appointing my focus in methodology and helping in the formulation of the interview questions, and to Mr. Bahati Elvis Orlando for providing me with background information and reflections on the program in the initial phase of this research. Thank you to the individual researchers for sharing with me their experiences of the collaborative program which made it possible for me to carry out this research. Thank you Associate Prof. Malgorzata Blicharska and Ms. Amanda Johnson, heads of the master thesis course at Uppsala University for your guidance and help throughout the process. Furthermore, thank you to the examiner Prof. Peter Lazor for your time and for providing comments guiding the work and final outcome of the thesis. And, thank you to Mr. Jody Radytya Hanindyawan Handoko who acted as opponent on this master thesis, for your critics, comments and valuable inputs as well as for your engagement in my work. Thank you, Ms. Freja Furumo for advising methods of analysis and offering critical comments towards the final production of this thesis, and to Mrs. Katarina Persson for guiding my work and provided valuable reflections. Thank you, Ms. Susanna Palling Huusko for proof-reading and providing comments in the final stages of this work. Furthermore, my deepest thank you to all friends and family who have supported me throughout this process in multiple and essential ways. Last but not least in the acknowledgments, I would like to formally thank all and every student colleague at the Master Program in Sustainable Development at CEMUS, Uppsala university 2016-2018 for to a less or larger extent having contributed to the finalization of this thesis in pro-active or active manner by providing critical comments, taking parts in discussions, shared your knowledge and insight and inspired me in numerous ways during the two years we spend together, thank you.
8. References


**Interviews**


## 9. Appendixes

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Appendix A. Interview Guide
Guiding document in the interview procedure

Interview Guide

Purpose and Methods

The purpose of the interview is to understand how collaboration is adding value to science. 29 individual scientists will be asked to participate in the survey-based interviews. The focus group is individual researchers participating in International Foundation for Science collaborative research approach pilot program 1. The qualification to participate is to have taken apart of pilot program 1 that started in late 2013, and to have delivered upon some sort of result in publication or report based of the collaborative program. The objective of this interview is therefor to understand how the participants of the collaborative program are receiving the programs outcomes. Further, the purpose is to identify the core benefits that the participants perceive that they have gained from the collaborative program, if there are synergies that would not have been possible without the collaborative aspect of the program and, thus, what value the collaboration as such has added to their projects, and individual careers as young researchers.

Information to the Respondent

Prior to the interview, an invitation to participate in the study and introduction of the contents will be sent out. Only respondents to the invitation will further receive interview questions. The first invitation is to be sent out by email, with email addresses extracted from the IFS database (this invitation is found in its completeness in Appendix B). The respondents will then be contacted again with supplementing information on how the interview will proceed. The respondents will be informed in the invitation on what the purpose of the interview is and information about the usage of the information. They will also receive information on the topics that will be brought up during the interview, in order for the respondents to be able to prepare for the interview and ultimately gain deeper responses. However, the questions will not be presented in its completeness. In the invitation, it will also be specified on the treatment of personal information during and after the interview process.

Questions

The questions will fall within the larger aim of this study. The objective of the interview is to understand how the participants of the collaborative program see that it has been of value for them to not only conduct the project, but to work in the collaborative environment.

The interview questions will be posed in two different ways. The first questions will be sent out via email, in the form of a word document. These questions will then provide a foundation for the continuous interview process. The first questions will be mainly focusing on the interviewees background and the nature of the collaborative team that they have taken/take part in. The additional set of questions will be for the purpose to map out what type of collaboration is occurring and what enabled this collaboration to continuously happen throughout the process. These questions will be posed by email and/or Skype and be individually formed based on the previous process. This information will be used to map out the IFS concept and acted realization of the term collaboration, and what value collaboration has brought to these individuals.
Analysis

The answers will be transcribed into a word-file and analyzed based on certain parameters and theory. The answers will be a foundation to enrich the discussion of collaborative programs for sustainable development.
Appendix B. Interview Invitation
Invitation letter to participate in interviews as sent to focus group.

Invitation to participate in interview conducted by Master student in Sustainable Development in collaboration with IFS with participants in the collaborative approach pilot 1

Practical information
**Time:** March 29th-April 10th 2018, interviews will be ongoing during this time. The expected time to answer the questions is approximately 20-30 minutes.

**Place:** Online, using e-mail for conversation.

**Format:** One initial set of questions will be sent over e-mail. The questions may be followed up with additional questions through e-mail and/or skype.

**Interviewer:** Jennie Persson (Ms)

**Interviewees:** Researchers who participated in Pilot 1 of the collaborative research approach at International Foundation for Science 2013-2017 and that are of teams that have finalized or partly reported on their projects.

Purpose of the interview
The purpose of the interview is to understand how the collaborative program participants are perceiving the program and how the collaborative aspect of their research has affected the processes and outcomes. Furthermore, the purpose is to understand how collaboration is occurring within the program and what enable the collaboration to continue as a process. All of the information will be used to map out the concept of and acted realisation of collaborative programs in science.

Issues and concepts central for the interview
- Interdisciplinary and multi-disciplinary collaborations
- Capacity building
- Group dynamics and group psychology
- Engagement and knowledge production
- The role of collaboration for sustainable development

Topic and questions
The questions will fall within the larger aim of this study, which is to identify the role of introductory collaborative programs within collaborative research in general for contemporary efforts to reach the United Nations Sustainable Development Goals. An initial set of questions will be on the researchers’ academic and nationality backgrounds, previous knowledge or experiences of working in teams and ways of working together. A later set of questions will be more in depth on the process of collaboration with the IFS program and ultimately the perceived outcomes of working together.
Treatment of personal information

Participation to the interview is voluntary. The interviewee has the right to terminate the interview at any time or to decline to answer any question.

Participants' personal data will not be shared to outsiders at any time. The e-mail interview will be transcribed into a text file. During transcription, the name of the interviewee and any third parties mentioned in the interview will be removed or replaced by pseudonyms. If need be, place names and other proper names (e.g. names of workplaces) will also be removed or altered in order to prevent any risk of identification.

Publications or presentations on the interviews will be written in a manner that no interviewee or third parties mentioned in the interview will be identifiable.

Publications outside of IFS, may include direct quotations from the e-mail interviews. The name, gender, age, nationality and occupation of the interviewee will in these instances not be mentioned in connection with the quotation.
Appendix C. Introductory questions
A set of questions first asked the responding researchers

Introductory questions for interview conducted by Master student in Sustainable Development in collaboration with IFS

What is your present position?

________________________________________________________________________

In what topic did you graduate your Master Degree and/or PhD?

________________________________________________________________________

How many different scientific disciplines are represented in your team? What are these?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

How far have you come in your collaborative research project? - Just started/about half-way/almost finished/finalized?

________________________________________________________________________

What is your previous experience of working in collaborative research teams?

________________________________________________________________________

________________________________________________________________________

What team constellation model did you choose to work within (see: end of this document)

________________________________________________________________________

________________________________________________________________________
1. **Common Group Learning**

This organisational model is well suited to small teams collaborating closely together. The research output reflects the common intellectual property of the entire research group. After defining the problem, the research is divided into areas based upon the expertise and interest of the collaborators of the research group. Subsequently, the input of the collaborators is discussed and evaluated in the group and written up by the team.

2. **Integration of research by a leader**

This organisational framework is considered effective for small research teams but requires a good leader to co-ordinate the complexities of managing research integration. The method is based on a division and allocation of parts of the research problem as separate tasks for different collaborators based on their expertise and then, later, an integration of the various contributions. It is important to ensure that enough time is taken in planning, which should be flexible and adaptive. Sometimes it is necessary that elements of the research are started at different times, where the use of tools, like network planning can be important.

3. **Common Research Component**

This organisational model is characterised by each researcher pursuing his/her own research, and simultaneously contributing to a common research component which adds both a new dimension and value to all their individual projects. Research outputs would be expected both from the individual researchers regarding their individual research projects as well as from the team regarding the common research component. This model is probably most suited to those who are already researching a specific topic and wish to continue with that, while at the same time collaborating with others on some element which can be developed together.

4. **Modelling**

This approach involves combined scientific work on a model and then researching its verification. The technique works best amongst closely related disciplines, because everyone has to agree on the approach used for modelling. Interdisciplinary models should be understandable for all collaborators.
Appendix D. Interview Themes and Questions

Interview themes and questions to be posed with slight individual consideration via e-mail, chat or Skype.

---

**Design and division of work**

i) When starting the project, your team was asked to present what collaboration model you were planning to use. You reported that your team chose collaboration model X (1-4). Based on this,

- why did you select this model?
- did you follow through using this model?
- how do you think the work division was in the project?
- If you would have started over, would you have made any changes in the division of the work?

ii) In your team, were there any competences you lacked and wish to have access to during the time? If so, which?

---

**Collaboration**

iii) Have there been moments in the project where you would not have been able to follow through if it were not for the collaborative dimension of within this project? If so, when and in what context?

iv) On the other hand, have there been moments when you would say that working together was more problematic than an asset?

v) In this project, you reported to have been working with researchers from X (1-5) different scientific disciplines. In what way would you say that engaging with people from other disciplines has affected you as a researcher?

vi) What has been important for you in order to keep the communication and collaboration going during the project?

vii) Have there been times where the connection and collaboration among you and your fellow collaborators have failed?

---

**IFS ambition with the program.**

viii) As a starting point of the collaborative program at IFS, IFS had identified seven main values that they would hope will emerge from enhanced collaboration among scientists. These included:

- **Sharing** of knowledge, skills and techniques
- Tacit **knowledge** transfer
- Learning the social and management **skills needed to work as a part of a team**
- Source of **creativity**
- Intellectual **companionship / expanded network**
- Greater scientific **visibility**
- And, **pooling equipment**

- Would you say that these have been realized or not realized for you in the context of working within the IFS collaborative program? If so, in what way?
- If not, what can you think of how this would have been possible and then, what would need to change?

---

**Outcome**

ix) Through this program, you got the chance to meet new co-workers from both different geographical locations and other disciplines. In contrast to previous collaborations of research or previous projects in your institutions, how do you think this aspect of crossing borders and disciplines has affected your projects outcome?
x) After this program, have you engaged in other collaborative research constellations? If so, in what way? If not? Why?

Sustainable Development

xi) In 2015, the United Nations presented Agenda 2030, with its 17 Sustainable Development Goals (SDGs). When talking about the SDGs, it is often mentioned that we need to collaborate more in order to reach these targets. Based on your experience of collaborating programs, what are your thoughts on this? And, how can this increased collaboration and research aligned with the targets be realized in academia?

Others

xii) Do you feel positive towards, or have you been engaging in further scientific collaborations? Why? Why not?

xiii) Is there anything else you would like to add?
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