Action research on the emergence of an innovation community in Hawassa, Ethiopia: The case of the implementation of aquaponics technology

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January 2018

Master thesis
Knowledge, technology and innovation group

Wageningen University

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Abstract:

A research project led by Wageningen University aimed at investigating the potential of small scale aquaponics farming as a business opportunity for poor households in Ethiopia. The “hardware” (i.e. the aquaponics infrastructure) had been installed and it seemed relevant to arrange the required changes in “software” (i.e. knowledge, vision, motivation… ) and “orgware” (organizational and institutional conditions) surrounding the project through an action-research process: iterative planning, implementation & observation and reflection cycles. The aim was to form an innovation community – an informal network composed of innovation promotors, to operate the aforesaid changes. General academic research question: How relevant is the innovation community framework in regard the aquaponics innovation process in Hawassa, Ethiopia? Practical question for the action research: What actions are needed to create an IC effective in the local context of Ethiopia to ensure the required technical, organizational and institutional innovation surrounding the implementation of aquaponics in Hawassa?

At the very beginning of the action research process, the aquaponics issue was not a priority in the agenda of Ethiopian partner NGO. It seemingly resulted in a certain disconnect of the staff with the formally established project objectives / planning and a significant lack of structure of the overall project organization.

Along the first cycle of the research, we opted for a formal structuring of the project organization. This formal approach appeared fruitful in setting up a clear organizational structure surrounding the project and led to the enactment of a proper project-team. Thus first a formal approach was needed to ensure the connection of the operational level with the envisioned formal project objectives. However, within the local project sphere, the knowledge capacities necessary to ensure the technical management of the project appeared to be highly insufficient.

Throughout the second cycle of the research, I acted as an innovation broker in order to identify promotors, outside the project boundaries, to tackle the knowledge barrier. By networking within the Ethiopian academic sphere, I did identified relevant promotors and assessed potential opportunities for collaboration.

Throughout the third cycle, I pursued the brokerage approach and created linkages among these promotors. I elaborated collectively with Hawassa University a research idea explicitely linking aquaponics to the field of nutrition. This work became a tool of alignment with the other promotors and eventually led to the emergence of an IC surrounding a new initiative complementing the current aquaponics project.

With these second and third research cycles, I have demonstrated that in the context of the aquaponics innovation process in Hawassa, a group ‘composition’ and ‘interaction’ could be actively (and informally) brokered by an innovation intermediate (in this case myself) to eventually take the form of an innovation community.
Introduction

**Problem statement:**

According to the FAO (2016), 32 percent of the Ethiopian population was undernourished in 2015. To tackle this issue, a research consortium composed of Wageningen University (WUR), Addis Abeba University (AAU), TGS Business and Development Initiatives (TGS, a Dutch consultancy firm) and Sunrise Ethiopia Development Program (SEDP, a local NGO) started to investigate the establishment of small scale aquaponics units in the country. Aquaponics is a food production system that combines aquaculture and hydroponics technologies, leading to two agricultural products: fishes and vegetables. For the research purposes, they have recently inaugurated the installation of the “hardware” in 8 low-income households in peri-urban areas of Hawassa, a city of 165,275 inhabitants (data from 2012). A training center managed by the missionary organization ‘Great Commission Ministry of Ethiopia’ (GCME) helps the participants with the different technical practicalities and provides them with the external supplies, mainly fish feed. However, the “software” (knowledge, vision, motivation…) and the “orgware” (organizational and institutional conditions) surrounding this innovative way of growing food are not yet settled and operationalized. Nonetheless, several local actors are showing great enthusiasm toward aquaponics. The aim is to identify among them (and possibly others) potential “champions” of innovation and connect them together to form an Innovation Community (IC) to arrange the required changes in software and orgware. In turn, it will allow me to investigate the relevance of the Innovation Community framework in Ethiopia.

**Academic and social relevance:**

**Academic relevance**

Very little literature about Innovation Communities (ICs) in the context of rural development intervention in emerging countries can be found. The studies of rural innovation processes tend to analyze separately the formal and informal layers of innovation and therewith highlight the importance of both layers. But in practice, these are two sides of the same coin. IC theory pays specific attention to the informal side as often overlooked in innovation project that start with formal organization and pay attention to formal network positions. But the framework also notes that some innovation communities start informal and then might lead to a formal arrangement (Fichter, 2012). In addition, the IC framework was elaborated though the study of western multi-organizational innovation processes. Thus this research will allow to “test” the relevance of the framework with the attention for the informal dynamics for a drastically different cultural context, as Ethiopia is known as a hierarchic society in which formal authority structures play an important role (fig 0.1).
Societal relevance

Agricultural innovation is seen as a solution to cope with issues such as food-safety, population growth and unemployment in developing countries (Berdegué & Escobar, 2002; Kerr & Kolavalli, 1999; Godfray et al., 2012; Filmer & Fox, 2014). Thus gaining a deeper understanding of the role that innovation process tasks and informal capacities play within innovation processes could potentially give insight on ways to create better synergies between both formal and informal capacities to facilitate agricultural innovation processes in such a way that they can successfully tackle issues such as food safety.

Theoretical framework:

In the last decades, substantial changes have impacted the landscape of innovation. Due to globalization, radical modifications in the information flows and extended division of labour, we have seen a major increase in the dynamics and the complexity of innovation processes (Fichter, 2012). It has affected the way such processes are dealt with, leading to a paradigmatic shift: from the “closed innovation” (within the firm boundaries) to the “open innovation” (Chesbrough, 2003). The latter paradigm acknowledges the increased mobility of skilled workforces and the increased complexity of the markets. In such a context innovation processes require the integration of scattered information and resources and a high level of coordination (Fichter, 2012). Therefore, as a consequence of these changes in the innovation landscape, innovation processes tend to be more effective/successful when they integrate external ideas/knowledge and resources. In line with this new reality, we witness a growing need for inter-organizational cooperation.

The field of innovation studies used to envision technology as a problem solving tool for society. Thus it focused on studying technological innovations and R&D capacities from the perspective of the firms or specific industrial sectors. Since then, the field has evolved and is now dominated by the innovation system thinking: it promotes a thorough understanding of innovation and focuses on the processes throughout which innovations emerge and is brought into economic use (Hall et al., 2006). Innovation is no longer reduced to technology, and its relation with the social and economic dimensions is problematised. The technology persists as an essential constituent of innovation: the ‘hardware’. In innovation system thinking, an innovation is defined as the
The combination of hardware, software and orgware. The hardware refers to any material apparatus (technological dimension), the software relates to the knowledge and finally the orgware concerns the organizational and institutional structures that enable and shape the innovation process. This school of thoughts is centered on the concept of Innovation System (IS): a network of individuals, companies and formal and/or informal organizations embedded within the institutional structures that concentrate their activities on converting new products, new processes or any innovative ideas into economic and social services (Hall et al., 2006). However, this approach often focuses on formally organized processes amongst organizations, but less attention is given to the ‘interpersonal micro-structure’ (informal relations and personal capacities) within ISs (Fichter, 2012).

Many authors argue that overcoming certain barriers is a condition of successful innovation processes (Hauschildt, 1999; Witte, 1977; Gemünden et al., 2007). We can determine four kind of barriers (Fichter, 2012): Knowledge, ignorance / opposition of decision makers and resources controllers, administrative and cooperation. They all relate to some extent to the formal layer of organizations, ingrained in the strategies, regulations and routines of every organization. For instance, Dougherty (1992) has shown that organizational routine limit the learning (knowledge barrier) as well as the collective action (cooperation barrier) that are necessary for successful innovation processes. Moreover, innovation relies a lot on tacit knowledge which can hardly be formalized (Leonard & Sensiper, 1998; Krogh et al., 2000). Therefore, in the context of innovation, the informal capacities of organizations also need to be explored because they may help overcoming the organizational barriers. In addition, tackling the aforesaid barriers require specific type of behaviour embodied by specific ‘key’ persons (Mansfeld et al., 2010). Hence, personal capacities are to be analysed if one wants to fully understand innovation processes. Champion/promotor theories are an attempt to address those considerations by acknowledging the importance of specific individuals with specific networks and competences acting as transformational leaders to overcome bottlenecks of innovation. Such actors, the so called champions, are defined as “individuals who informally emerge to actively and enthusiastically promote innovations through the crucial organizational stages” (Howell et al., 2005). Nonetheless, the scope of the promotor approach is limited to an intra-organizational perspective, therefore neglecting the inter-organizational aspect previously discussed. Drawing on the two previous concept, thus including both perspective, Fichter (2006) has elaborated a new conceptual framework: the “Innovation Communities” (ICs).

In his concept of ICs, Fichter (2012) conceptualizes an innovation system as a multi-leveled structure (figure 1.1). The first level is the company, which is in fact the traditional scope of promotor theory. Then value chain level: it encompasses the actors involved in a network of companies/individuals that promote an innovative idea. And finally, the framing and interlinking organizations: it is the ‘superstructure’ that enables the actors from the other levels to innovate (Winch & Courtney, 2007).

Fichter (2012) defined an IC as “an informal network of likeminded individuals, acting as universal or specialized promotors, often from more than one company and different organizations that team up in a project related fashion, and commonly promote a specific innovation, either on
one or across different levels of an innovation system”. To formally distinguish this new construct from other type of communities, ICs need to fulfill three criteria (Fichter, 2012):

1. The community has to be centered on a specific project or innovative idea.
2. Every member has to play a champion role in the innovation process
3. The members “collaborate closely and informally”, they identify themselves as a ‘team’ (with a sense of group identity).

Five main factors shape the IC and the way it contributes to an innovation success (Fichter & Beucker, 2008). First of all, the *distribution and availability of relevant resources*: the more resources are required, the less an individual actor has the monopoly of its control thus raising the need for cooperation. Secondly, the *lack of formal structures* surrounding the project may push the informal relation within the IC to become increasingly important. The greater this lack is, the more significant the IC will be. Thirdly, the *motivation* of the individual members – fostered through mutual feeling of trust and understanding - directly impact (positively) the consistency of the IC. Fourthly, the *conflict levels* have an important influence on the coherence of an IC: the community can compensate the lack of formal conflict solving mechanisms. Concerning internal conflicts, the close cooperation and the ‘team spirit’ of the members of an IC helps their resolution. And finally, *the situational configuration of the community* is also a notable factor: memberships adapt to the changing circumstances. Indeed, an IC goes through different development stages: the initiation (when the community establishes itself), the development phase (development and enhancement of the community performances) and the reconfiguration phase (setting of new objectives potentially inducing fundamental changes in the community). Each of this phases may require different skills, different resources, thus different members.
As said previously, the members of an IC are assumed to act as promotors. These ‘transformational leaders’ tend to have a specific behavior, “expressing enthusiasm and confidence about the success of the innovation, persisting under adversity, and getting the right people involved” (Howell et al., 2005:641). Drawing on promotor theories, we can distinguish four categories of promotors (adapted to the IC perspective).

- **The power promotor** is the link with (and depends on) important decision makers. Thus, he gets involved in projects that match the goals of his hierarchy. He has a rather political role: assisting the procurement of resources (through his ‘high end’ connections), helping with organizational issues and guiding the project (Chakrabarti & Hauschildt, 1989).

- **The expert promotor** contributes to the community mainly through his technical expertise along the innovation development. These ‘inventors’ are knowledgeable about “the technical alternatives, internal mechanisms, and the potential and limitations of the new product or process” (Chakrabarti & Hauschildt, 1989).

- **The process promotor**, thanks to his enterprising attitude, connects together the power promotors and the expert promotors. His activities mainly consist in “collecting, sorting through, translating, channeling, and passing information” to the members of the community (Rese & Baier, 2012).

- **The relationship promotor** has close personal connections with actors within and (in particular) outside the community. Therefore he is able to develop and maintain the relationships that the IC relies on. Some of his notable activities are the communication with the stakeholders, the pursuit of partners, the coordination of activities and the management of conflict and negotiation (Rese & Baier, 2012).

All these capacities are identified as essential to overcome bottlenecks in innovation processes (Fichter & Beucker, 2012).

The development of an innovation is usually progressive, thus the norms ruling and structuring the IC, if not formally established, are enacted gradually through the spontaneous / informal interaction of the members and the emergence of the group identity (Gerybadze, 2003; Postmes et al., 2000). Group identity and group interaction are therefore important characteristics of ICs. Group identity can be defined as the "individual’s knowledge that he belongs to certain groups together with some emotional and value significance to him and this group membership" (Tajfel, 1972:292). It only develops itself if the group members interact with one another (Rese & Baier, 2012). In addition, it is important to point out that ICs may establish through a “self-assembling” process (Beucker, 2007; Fichter, 2006), thus it cannot be taken for granted that all the requisite competences for the success of a collaborative innovation process (skills distributed amongst the different promotors) are readily available. Consequently, besides group identity and group interaction, another significant characteristic of an IC is the team composition. The performance of the community is associated to those three characteristics, mirroring the contribution of this informal network to a specific project. They can be renamed - accordingly to the IC terminology – respectively, **community composition, community identity and community interaction** (Fichter, 2012).
Each of the IC characteristics can be divided in sub-constructs that define its quality (Fichter, 2012). The quality of the community composition entails the *Completeness and Complementarity of Skills* (skills of the different promotor), the *Reconfiguration Capacity* (adaptation to changing circumstances) and the *Social Capital* of the community members. In this case, *Social Capital* is defined as the total amount of resources a social unit can mobilize through social relations, and can add value from (Fichter, 2012). The quality of the community identity depends on the *Clearness of Group Boundaries* (the members understand who belongs to the community and who does not), the *Functional Identity* of the group (mutual understanding of the overall goals and pertinence of the project) and the group *Cohesion* (feeling of being a ‘collective unit’). And finally, the quality of the community interaction encompasses adapted features from the “teamwork quality” concept, elaborated by Hogl & Gemunden (2001): the *Communication*, the *Coordination*, the *Balance of contributions*, the *Mutual support*, the *Trust and group climate* and the *Effort* (those elements are self-explanatory).

*Figure 0.3:* Influencing factors on the performance of innovation communities (Fichter, 2012, p 74)

Open innovation practices are very well established in developed countries. However, many authors argue that some factors – often related to technological, knowledge or policy infrastructures, tend to prevent the adoption of the paradigm by innovation actors (notably SMEs) in developing countries (Vrgovic et al., 2012; Sağ et al., 2016; Hailekiros et al., 2016). In Ethiopia, the context is also quite peculiar: it is a post-socialist system whose economy is often qualified as “closed” (Tassew, 1995; Kiyota et al., 2007). In addition, the Ethiopian society is culturally very
hierarchical (Prunier & Ficquet, 2015; Hofstede Insights, 2018). In other words, significant differences between the Ethiopian innovation landscape and the western/liberal context - upon which the IC framework was elaborated on, can be expected. And therefore, is not clear whether all elements highlighted above, and the IC building process as such will follow the same pattern.

To gain more insight on this issue, I wanted to conduct an action research on a collaborative innovation process surrounding the aquaponics technology. It would enable me to explore step by step what was needed for the progression of the innovation process. And in turn, it will help me to reflect upon the overall process of collaboration and the relevance of the IC theory.

We assume that the IC theory is relevant to guide the facilitation of the innovation process related to aquaponics in Ethiopia. However as the IC framework is developed in a western business culture, we want to assess the usefulness of this framework for the Ethiopian context. Hence our general question is:

**General academic research question:** How relevant is the innovation community framework in regard the aquaponics innovation process in Hawassa, Ethiopia?

**Practical question for the action research:** what actions are needed to create an IC effective in the local context of Ethiopia to ensure the required technical, organizational and institutional innovation surrounding the implementation of aquaponics in Hawassa?

**The action research methodology:**

The method I will use for this research is “Action-Research” (AR). It is actually more of an ‘open’ framework than a (strict) methodology in the sense that anyone who would conduct a literature review on action research would probably find himself overwhelmed by the different approaches that have been elaborated under the banner of “action research”. However, they all rely on some core principles: the five characteristics of AR.

**process orientation**

AR is based on the assumption that ‘social reality is continuously being created and recreated in a social process’ (Checkland & Holwell, 1998). The research takes part in this social process to influence the social reality: it aims at promoting change within the context of investigation through a straightaway implementation of its findings (Greenwood&Levin, 1998). Therefore it is a learning process through which the knowledge created is immediately applied. However, these processes are not under the (full) control of the researcher, the outcome of an AR can not be predicted (Brydon-Miller & Greenwood, 2006).

**an emerging learning process**

Aiming at a high connection with the context reality, the research design ought to be inductive. Thus it is loosely structured and becomes evident only progressively as the researcher refines its experience of the field and gains a better understanding of the context (Reason, 2006).
Throughout that process, it is expected that the researcher gradually loosen the ties with his profound convictions and rooted thinking patterns to make room for new ways of learning and acting (Rudolph et al., 2005). This characteristic of action research shall be even more obvious in cases where the researcher is very much unfamiliar with the situation under study: e.g. a foreigner in Ethiopia. My approach is to define assumptions at the beginning of each research cycle. These assumptions will be embodied in the planned actions of these cycles. Data collection on both the implementation process and the ex-post evaluation of these actions will serve as material to “test” these assumptions. Concerning the data, I do not wish its collection to interfere with the innovation process at stake. Therefore I will pay great attention to informal talks and participants observation. To monitor the innovation process, I will keep a diary and elaborate weekly report for TGS,

an iterative process

AR involves following repeatedly a similar type of inquiry scheme - the research cycles, forming together a spiraling progression (Berg, 2004). The components of these cycles varies from an approach to an other, but usually encompass phases of action and reflection. Personally, I appreciate the approach elaborated by Kemmis & McTaggart (1988) for its straightforwardness. It consists on (self-explanatory) repeated phases of planning, acting, observing and reflecting. However, I will use the terminology “implementation” rather than “action”. It seems to me that the idea of process is better transferred with that term, while the word “action” could suggest instantaneousness. In addition, to keep with this process-orientation, I choose to fuse the implementation and observation phases together. Indeed, knowledge can be created from both the implementation process and the post-implementation effects. Therefore process-oriented and impact-oriented observations are equally important. Then these observation are analyzed through a reflexive process to facilitate knowledge creation and help the planing phase of the next cycle (illustrated in figure 0.5).

It is also important to mentioned that the progress is not necessarily unidirectional as suggested by the figure. Anyway, following the research process through rigorous application of such an iterative approach can help generating “defensible generalization” of the research findings (Checkland & Holwell, 1998).

![Figure 0.4: The cycles of action research (adapted from Valencia College, 2016)](image)
In the planning phase of each cycle, I will select an issue related to the aquaponics innovation process to be tackled. I will elaborate a framework of idea to plan an action aimed at solving such issue and define a research question to guide the evaluation of the action impact.

**a problem-oriented process**

The driving force of AR is to create a positive social change. To do so, problems are formulated by the researcher together with the participants, and actions are taken with the aim to solve them. Since these problems are context-specific, the research results are not necessarily transferable to other situations (Berg, 2004).

**a participatory process**

Along the research process, the role of the researcher and the participants may vary, and potentially merge together. Indeed, in the ideal case where the participants also actively participate to the creation of knowledge, the researcher may somehow withdraw to a certain extent to let the participants “take over” his role (Bradbury & Reason, 2003). Thus, in some cases, the participants reach almost full control of the research. In other situation, their participation is enacted by their contribution to the research. However, the participants shall never be reduced to simple “object of study”, which would go against the AR philosophy (Bordokós, 2010). There is an interdependency between the level of participation and the role of the researcher, showed in figure 0.6.

![Role of the participants](image)

**Figure 0.5:** level of participation according to the role of the researcher (adapted from Bordokós, 2010)

The action-research will be ‘innovation-process’ oriented, i.e. the focus would mostly be on the facilitation of the implementation of aquaponics in Ethiopia. Therefore participants may vary from a cycle to another according to the needs of the innovation process.

**Integrating the IC framework with the AR approach**

The end of an AR is not research in itself, but rather the social change resulting from the process. Therefore it induces a rethinking of the conventional sense of validity. This approach advocates going “beyond concern for validity criteria as a form of policing research” and moving toward “validity as incitement to discourse” (Reason, 2006): promoting political, practical and moral considerations as concerns of validity. Indeed, in action research, it is the “actions” that leads the process rather than the Science. Such actions shall not be constrained by “validity criteria” but
rather driven by choices resulting from political, practical and/or moral considerations. In that sense, the “validity” of the research process lies in the discussion of these choices rather than deductive academic criteria. It is the context specificities rather than the theoretical framework that “drives” the research process. In other words, the creation of knowledge is directed in conjunction with the context-related issues.

However, as mentioned previously, I am also aiming at a certain academic relevance with this “intervention”. Researchers insist on the importance of relevant arguments embedded within a particular framework to support the “claims” of the action research (Checkland & Holwell, 1998; Toulmin el al., 1979, p. 27; Phillips, 1992, p. 108). Thus, to be consistent with this line of thoughts, I will pay attention along the research to root the IC framework within the AR process as illustrated in figure 0.7.

![Figure 0.6: Elements relevant to any piece of research (Checkland & Holwell, 1998)](image)

The integration of the IC and AR frameworks implies to a dual research objective: First of all, a societal objective - which extent and exact nature can not be predetermined, aiming at stimulating innovation towards large scale economic use of aquaponics in Ethiopia. And secondly, an academic objective, directly related to the research question.

**Planning and Costs:**

Social processes are "not homogeneous through time", therefore the act of withdrawing from the AR process is ultimately arbitrary: the elements under study will evidently further evolve (Checkland & Holwell, 1998). Thus it is the choice of the researcher to end the process, when he will judge that the later would have enable enough learning. For this reason, a strict planning goes against the AR mindset. And it is the reason why I decided to combined both my internship and thesis work to enable a field-work experience as long as possible (approximately 10months). This combination provides me with an other advantage: TGS, as company supervising my internship, will sponsor the trip fees to the field destination and eventual translation fees.
Preliminary assessment

September – October

Introduction:

At my arrival, I had been introduced by the Dutch project leader (Bouke Kappers, my internship supervisor) to the staff, the local project leader and the project beneficiaries. My presence in Hawassa was legitimized by the back-up of TGS and my (potential) contributions to the research project. To properly conduct my research, I judged necessary to develop an overview of the way the project was locally managed: it was to me an indispensable prerequisite for the examination of the establishment of the Innovation Community (IC). Because indeed, I intended to use the project as the foundation of an IC.

To develop such overview of the project management, I have conducted diverse activities in different fronts of the project, here are the main ones:

- For the purpose of the overall research, a baseline of the eight project beneficiaries had to be conducted. I endorsed the task with the help of Mamo Petros (the research assistant) who would translate the questionnaires and the answers of the respondents. The goal of this baseline was to assess the living standard of the beneficiaries households, encompassing information on their social and financial capitals. I also had to collect data on their identity (religion, ethnicity…) and on their expectations and intentions in regards the project.

- Then, the main farm - that we would call the ‘Training Centre’ (TC) - was completely under run. Thus I decided to help Kassa Mamito (the manager) to take care of it. Of course my knowledge on aquaponics technology was very limited when I arrived. Another difficulty was that I could not learn much from Kassa due to the language barrier (he did not speak English). Thus I went through an intense self-learning process. I would go through the different guides I had gathered and learn about all the components of the aquaponics ecosystem. From the fishes to the plants, from the water quality to the bacteria cycles... I would read about the way each parameter is inter-dependent. Then the TC would be the place for my own practical training: there from the symptoms I would witness, I would try to take action according to what I had read. I combined this newly acquired knowledge together with my ‘know-how’ in hydro-mechanics to improve the overall oxygenation of the farm. It gave me a good overview of the technical management of an aquaponics farm.

- It had been discussed with the project hierarchies – Bouke Kappers and Mihret Allem, the director of the local partner NGO (SREDP) - that the TC should be turned into a business to help the project reaching its targeted self-sustainability. Therefore I undertook the task of elaborating a business plan for the facility so that Mihret could process the paper work to obtain a business license.

- And finally, I have participated to/organized various meetings with the local staff to get to know them better and understand their management approach.
State of affairs and management-stakeholder assessment:

Mihret Allem was the director of SREDP and the local project leader, based in Addis Abeba. He had replaced Kibru, the “founder” of the NGO and initiator of the partnership between TGS and the Great Commission Ministry of Ethiopia (GCME). Mihret worked on a voluntary basis, i.e not paid. He was primarily a highly involved member of GCME. At the beginning, he was not interacting much with the project activities and was not ‘part’ of the information flow. Neither Bouke and I nor Kassa and Mamo were in regular contact with him.

Kassa Mamito was the manager of the project. His role was to visit on a weekly basis all the beneficiaries to provide them with technical support. He was also in charge of running the Training Center (TC). However, the TC was completely rundown: it had been left untouched since the last Dutch trainee departed Hawassa (January 2016). His involvement at the facility was reduced to feeding the fishes. However, an aquaponics farm requires much more efforts, such as the PH regulation of the water, taking care of the plants, harvesting, sawing… In addition, he did not appear to conduct the weekly visit of the other farms even though most of them suffered from technical issues (notably on the mechanical side). Aside the project, he was deeply involved in the missionary activities of GCME: among others, organizing preaching sessions and religious movie screenings.

Mamo Petros was the research assistant and business advisor. He had been hired under the initiative of Bouke at the very beginning of my stay. The director of SREDP (Mihret Allem, the ‘legal’ employer) who was based in Addis Abeba did not know him in person. Anyway, as the research assistant, his task consisted in collecting the data for the research program: essentially reporting death cases of fishes and gather figures of the vegetable production at the beneficiaries farms (on a weekly basis). An other argument for getting him hired is that he would speak English and could act as a translator to help me when needed. On the business side, he was expected to help the marketing of the beneficiaries products. However there was no production yet: all the beneficiaries farm were empty of any vegetable and two farms did not even have fishes yet. His main occupation was leading a protestant youth movement and then he undertook new studies at the university. By working for the project, his aim was to carry and fulfill his vision: “helping his community” (his own account).

Bouke Kappers was a former intern at TGS (August – December 2015). For his internship, he notably did a market research, experimented new crops at the TC, trained the beneficiaries from Shashamene and elaborated a grow guide. He then became an employee of the company and took over the leadership of the project. Based in the Netherlands, he would send me directives to follow, that I would apply and/or forward to the staff. With TGS, he was involved in many other projects and therefore did not have much time to dedicate to the Hawassa venture.
Desta Anulo was the former project manager, involved since the beginning of the project. He was also member of GCME. Bouke and him had a privileged relationship: they were good friends. They used to work together when Bouke was conducting his internship. According to the accounts of the latter, he was very pro-active and an absolute “fan” of aquaponics technology. He had been extensively trained on aquaponics management by the Dutch initiator of the project (Rutger Toorman). In addition, he was quite influenced by ‘western’ culture (his wife is American) enabling a fluent dialogue and the basis of a common understanding due to a reduced cultural gap with the Dutch parties involved. TGS used to deal directly with him for practical matters. Unfortunately I did not get to him well and only met him two-three times: he resigned from his position right before I arrived in Ethiopia to move to the USA.

And finally, on my side, I was in Hawassa to represent the interests of TGS. At the beginning my intervention was not very structured: I did not have a ‘mentor’ to guide me and I was doing a bit of everything to familiarize myself with the project, the technology, the people and a new culture. The aim of my intervention was to identify and arrange the changes in software and orgware downstream the value chain of the aquaponics products by establishing a local innovation community. The overall goal was to secure the marketing of the beneficiaries products, therefore conducting a “business intervention”. My task did not make much sense at that moment, since as said before, there was no production yet. Developing an overview of the way the project was managed was rather difficult. I faced a complete knowledge void concerning the practical information on the organizational aspects of the project. For instance, on the finance side, some funding had ‘disappeared’ from the treasury (handled by GCME). Investigating the running costs of the TC was hardly possible since no one knew how and where to access the electricity and water bills… It was very difficult to obtain information on the input suppliers. Overall, the information about the project organization were highly disseminated or plainly non-existent. My tasks were severely hampered by a significant lack of information traceability.

On site, in Hawassa, we were three people involved with the project: Kassa, Mamo and myself. Working together on completing the research baseline, Mamo and I got to know each other and got along pretty well. On the other hand, there was quite a big gap between Kassa and myself. However, Mamo and the latter were good friends, they had notably worked together on the construction of the aquaponics system for the beneficiaries. Therefore, our group was more or less split in two “duets”: Kassa - Mamo and Mamo – myself. In term of communication, there was a significant issue: Kassa did not speak English and I did not speak any Amharic at the beginning. Therefore sharing information and opinions was quite difficult between the two of us. Luckily, we would meet most of the time together with Mamo and the latter would translate for us. However, the use of an intermediary hampered the “openness” of the communication between the two of us. Mamo and I were working together quite often and thus managed to work in a coordinated way. He did not have so much time to dedicate to the project, therefore he always wanted to be as efficient as possible. On the other hand, between Kassa and myself, it was rather difficult. Without a proper working schedule and the impossibility to properly communicate, our actions were neither structured nor synchronized. And overall, he was not committed to his responsibilities of project manager.
There were informal rules that “regulated” the overall atmosphere and work climate. Indeed, as a missionary organization, religious values were taking an important space within the NGO. At the headquarters of GCME (where the TC was located), the members used to preach their religion to me and test my ‘faith’ by investigating the extent of my biblical knowledge. I had noticed that people tend to be very judgmental and do not easily conceive the idea upon which one would not believe in their God. Thus, seeing religion as a potential factor of division, I felt I was obliged to pretend I was Christian. I also followed (at least in appearance) elements of the “code of conducts” of the protestant community that I had discerned: making sure that my co-workers did not know I smoked and enjoyed a casual beer, things deemed to be sins in this community. Moreover, when Mihret agreed on the suggestion of Bouke to hire Mamo, he was more interested in his religious beliefs and which church he belonged to than getting to know about his skills and past experiences. In addition, GCME is a mono-ethnic organization. All members belong to the Kembatta ethnic group whereas Ethiopia counts more than eighty ethnicities. In other words, there were clear signs of the existence of informal rules that structured the activities and purpose of the local NGO (notably in term of inclusion).

On the other hand, there was a complete lack of formal structure regarding the project management. The staff did not have any work contracts and they were not receiving any salary at the beginning. Even the former project manager – Desta Anulo had had to wait a whole year to get paid for his services. Moreover, the activities of the staff and myself were neither monitored nor supervised by the local hierarchy of the project (i.e. Mihret). The latter was not consulted and did not contacted us at any moment whereas he was the “employer” of both Mamo and Kassa. And overall, we did not have any formal objective to attain. I did know the direction TGS intended the project to follow but could not manage and did not have the authority to transfer it to the project manager. In other words, there were strictly no formal agreements to “regulate” the project management.

Previous to my arrival, it seems that this lack of formal structure had somewhat impinge on the project progress. Indeed, there had been a clear lack of awareness and/or understanding of the formal obligations of non-profit organization vis-à-vis the legal framework of their practices that resulted in important administrative set-backs. First of all GCME had been chosen as a local partner organization to implement the project in Hawassa. However, as a non-secular organization it was not legally authorized to take part to the venture. As a consequence, they had to create a new organization from scratch: Sun Rise Ethiopia Development Program (SREDP), which constituted the (officially) secular branch of GCME. Secondly, the first intended group of beneficiaries that had been selected and trained were households from the city of Shashamene (about 25km away from Hawassa). But this city is part of the Oromia regional state, while Hawassa belongs to the Southern Nations, Nationalities, and Peoples' Region (SNNPR regional state). And as a matter of fact, SREDP only had jurisdiction under the SNNPR. Thus the beneficiaries of Shashamene were dismissed and a new batch was selected in Hawassa. In addition, since the initiation of the project, a lot of turnover had occurred, Basically, all the actors involved at the very beginning of the venture had now resigned (both within TGS and SREDP/GCME). And as a probable consequence of an
informal approach to management, knowledge transfer had been mostly informal as well (i.e. mostly oral and hardly traceable) along these turnovers.

**Reflection and preparation of the first research cycle:**

Most literature drawing on the open innovation paradigm argue that innovation processes benefit from an “active” form of management to overcome innovation barriers (Swan et al., 1999; Hidalgo & Albors, 2008; Bessant et al., 2005). However, in this specific case, the lack of commitment demonstrated by the project manager and the total absence of a monitoring and evaluation mechanism reflected a mostly “passive” management. It resulted in an overall mess and a total lack of visibility whereas the project was entering a new (and crucial) phase. Indeed, the hardware had been installed, the technology “transferred”. Now the next step was about helping the beneficiaries to make a successful business out of this piece of hardware. Thus I considered that we were at the very “front end” of innovation process and more clarity was needed. In addition, many authors argue that too little structure at this stage of innovation can negatively affects the overall process, while some degree of structuring can facilitate the targeted application of the available capacities and guide the process (Gaubinger & Rabl, 2014; Gassmann & Schweitzer, 2014; Rodrigues et al., 2017). Yet the current approach of the project management demonstrated a complete lack of structure and did not seem to be able to provide the guidance necessary in leading this venture. This would be the first issue to tackle.
Cycle 1:  
October - December

Planning:

Throughout the previous preliminary assessment, I noticed a rather passive approach to the project management. In addition, the aquaponics project did not seem to be a genuine priority to either GCME or SREDP. It also prevented the overall clarity of the innovation process. Therefore, the business side of the project was not at the moment a relevant point to be tackled since it was undermined by this lack of clarity. On the other hand, facilitating the structuring of the project organization seemed like an absolute necessity.

The IC framework stresses that a lack of formal structure surrounding a project can lead to high levels of informal cooperation: such a lack of formal structuring can be compensated informally (Fichter, 2012). However, I interpreted the rather ‘narrow’ commitment of the local manager as a lack of motivation. Whereas the latter factor directly impacts the consistency of informal cooperation (Fichter, 2012). In addition, even though there was obviously a set of informal rules that sustained the structure of GCME, these were ethnic and religious based rules, whereas the project beneficiaries were from all horizons: mostly orthodox or protestants and belonging to different ethnic groups. The project was also research oriented, thus had a science focus and aimed at creating knowledge. Thus rules emanating from a spiritual sphere did not seem very appropriate to me. And finally, it was a problem/practical-oriented project, thus practical and/or pragmatic regulation seemed more relevant than ideological religious dogmas. Therefore I had great reservation about the relevance / applicability of these informal rules in regards the structuring of the aquaponics project organization. Hence, capitalizing on informal capacities to structure the project organization did not seem like a relevant starting point. In addition, many authors note the need of a balanced formal and informal approach structuring the early stages of innovation processes (Steiner, 2003; Van Aken & Weggeman, 2000; Quinn, 1987). Therefore, giving the context, it seemed adequate to temporary set aside the IC framework. Operating a formal structuring of the project - after which informal organization could grow upon, seemed to be a relevant approach.

It also seemed relevant to make a parallel between the lack of motivation of the staff with the ‘low maturity’ of followers (or employee/staff in this case) concerning the aquaponic project found in the situational leadership theory (fig 1.1). Following this theory, it seemed that a ‘high task and low relationship’ type of leadership would be an appropriate way to operate the project structuring. In addition, I assumed that such type of leadership would guide and enhanced significantly the delivery of inputs of effort (notably from the technical manager) which would eventually lead to an adequate technical management of the project farms.
Matters of project leadership should evidently be operated by the project leaders (i.e. Bouke and Mihret). Therefore I shared elements of the state of affair I had elaborated with Bouke and the need I perceived to formalize the project organization and strengthening the project leadership. I had notably suggested the elaboration of work contracts for the staff, which he totally agreed on. In addition, formalizing the overall project organization was also on the agenda of TGS. For instance, they were drawing up a contract detailing the agreement between the project beneficiaries and the leading organizations (SREDP / TGS). And Bouke also assigned us (the local team) to organize a ‘launch’ meeting which would gather all beneficiaries and the officials from SREDP (Mihret and Wondifraw, the accountant). He suggested the elaboration of a project guideline to help Mihret in leading more actively the project and in setting up tasks. Therefore, there was a general consensus between Bouke and I that the formalization of the project organization and leadership strengthening was deeply needed.

Multiple activities were planned to operate what I called the “formalization campaign”:

- The elaboration of work contracts for the staff to formalize their engagement to the project and hopefully phase out the issues of work ethic (especially Kassa)
- The elaboration of the project contract between SREDP and the beneficiaries to clarify the nature of their engagement towards each other
- The elaboration of a project guideline to guide Mihret in supervising the local project activities and to specify the objectives to be attain
- The organization of an official launch meeting to enable all stakeholders to meet and take note of / sign the aforesaid contracts
I expected the delivery of the aforesaid output to lead to a significant reconfiguration of the managerial structure of the project. Hence the research question of this cycle is:

**RQ:** What type of organizational managerial structure will emerge through (be disclosed by) the formalization of the project organization.

To monitor the effect of the “formalization campaign”, I intended to have a look at the distribution of leadership between Bouke and Mihret. Then, the establishment of contractual relationship would imply the clarification of relationships between the project stakeholders. I would thus pay attention to these and to the resulting power relations. As the formalization campaign should put the aquaponics project on the agenda of SREDP/GCME, I was willing to have a look at the organizational routines that will emerge and the commitment of the staff as well as the resulting technical progress of the project farms (notably the beneficiaries farms, whom Kassa was supposed to assist and supervise).

**Implementation and observation:**

Bouke put me in charge of elaborating the work contracts of the local staff. I did a draft that he completed by adding the hour of work due, together with the salaries. Once done, I showed them to the staffs, mentioning that TGS had elaborated them (I did not want them to know I had written them down mostly myself). The intention was to gather their opinion so that we could eventually do some modifications with Bouke according to their suggestion. However, they made me understand that I had no legitimacy to discuss such matter with them. They told me that their “official” employer was SREDP, thus contract matters should be negotiated with Mihret Allem, not through TGS and especially not myself. Therefore I had then let Mihret and Bouke taking care of that matter. It took approximately 3 weeks between the contract redaction and the signature by all parties.

The contract putting down on paper the engagements between the beneficiaries and the leading organizations (see annex 1) had been mostly elaborated by Bouke; I only helped on few details: calculations, cost estimations… He then asked me to send it to Mihret for approval. Part of the price of the aquaponics system were to be a loan that the farmers should payback. Here is an extract of the e-mail he sent me back:

“I have seen the document but because of the government’s policy we can not apply this. We are only allowed maximum 20% return from the beneficiaries. It’s strictly prohibited and if we go beyond it will be illegal. […] Please note that before you start doing anything please let me know, the government is very serious and since you don't know what works here and what do not work and taking any action with out prior consultation may cause the project to be terminated.”

At the beginning of the formalization campaign, I was doing the intermediaion between Bouke and Mihret. But it appeared that it was not the right way to proceed and some matters should have been discussed directly between the two parties. In addition, Mihret might have thought that I had taken such initiatives without consulting him, and - as he mentioned, without knowledge
whatsoever about the legal framework in Ethiopia. Anyway, after this episode, we all felt the necessity for more transparent communication. As a consequence, together with Bouke we started to make sure that our e-mail exchanges were fully inclusive and kept (almost) systematically Mihret in the loops. In addition, Mihret and I started to call each other on a regular basis. Overall, the communication scheme between Mihret, Bouke and myself changed: it became more ‘collective’ and direct.

Bouke elaborated a project guideline (see annex 2) that established in a more concrete way the tasks to be conducted, the timeframe within which they had to be performed and the different project cycles to go through. As a complement to the working contracts of the staff, it established concrete objectives to reach. The idea was also to make sure all stakeholder agreed on it and develop a common understanding of what had to be done and giving deadline to facilitate the monitoring and supervision by the project leaders.

The launch meeting was quite hectic to organize: the staff were not very collaborative and some cultural festivities were taking place at that period (most people would go join their families outside Hawassa). In addition they did not really see the point of such meeting and I think the fact that the request emanated from TGS and not SREDP did not help. Anyway, TGS was putting a lot of pressure concerning the organization of the event, therefore I organized it mostly by myself to make sure everything would be ready on time. Thanks to an improved and open communication with Mihret, I knew exactly what he expected from his visit to the site and Bouke had given me some instructions on what the expected to be done. It started with a speech from Mihret followed by a short training on the basics of business done by myself and translated by Mamo. Then we visited the Training Center and explained the functioning of the aquaponics system to Mihret and Wondifraw: it was something completely new for both of them. Mihret then explained and signed the (project) contracts with all the beneficiaries. After that, we did a collective demonstration of the fish harvest (everybody helped). Finally we visited 2 beneficiaries farms where we could show Mihret some technical difficulties the farmers were facing and we gave few instructions to all the farmers (notably on fish feeding practices).

The perspective TGS and I conceived and desired ought to be participative, however, SREDP had a more top-down approach. For instance, TGS wanted the farmers to choose together during the meeting the crops to grow and a marketing strategy they were willing to follow. However Kassa and Mamo more or less imposed to grow mostly lettuces that would be sold collectively. Of course, this choice was totally considered and rational, however the approach was going slightly against the ‘dutch’ expectations. And while giving his introductory speech, Mihret instructed the beneficiaries to strictly follow the directives of Kassa, Mamo and myself in the coming months. And overall the staff were quite reluctant to the idea of involving more deeply some of the beneficiaries: to my view some had valuable skills that could potentially benefit the project. Anyway, the beneficiaries were not very active either during the few participative moments of the event.

Then we went for a ‘lunch meeting’ including the staff, Mihret, Wondifraw and the accountant of GCME. We discussed about some funding request we had, notably in order to fill the lack of equipment we were facing at the TC, and we discussed the project guideline drawn by Bouke. Part of the meeting was conducted in Amharic, thus I could not grasp everything. Anyway,
Mihret discussed extensively with Kassa and Mamo their responsibilities and work contracts. This ‘official’ launch meeting constituted the closure of the formalization process of the project structure. All contracts were signed and the responsibilities of the staff properly defined and distributed. On my side, we decided that I shall focus on the business of the TC (production was about to start), take care of the coordination tasks (notably reporting to the hierarchies: both Mihret and Bouke) and assist Kassa on the technical side (specifically on the mechanical maintenance of the systems).

The hierarchical link between Mihret and the local staffs got formalized through both the signature of the work contracts and the launch meeting. During his visit in Hawassa, Mihret could finally meet Mamo whom he did not know. They discussed together with Kassa their roles within the project. I could not understand their conversation (in Amharic) but it was clearly top-down oriented. SREDP was the official employer of both staffs, therefore the (only) legitimate authority over the staff. Even though the project guideline stated that Kassa and Mamo should be accountable towards TGS, they were taking Mihret authority way more seriously. After the launch event, he started to call them on a regular basis and they would often report me some instructions he would have given them. When we would meet, Mamo would most of the time call him to ask for his opinion or his endorsement on action we planned to undertake. Basically, a genuine boss-employee between the staff and Mihret emerged after this formalization process. On my side as well, even though I did not have a direct hierarchical link with Mihret, I started to make myself fully accountable to him - counting him as my own boss, the same way I would with Bouke. This relation started naturally: I was open for it and I guess Mihret was more comfortable working that way. In addition he had a great sense of leadership which probably enabled the new nature of this relationship. Overall, Mihret became a major actor of the project leadership.

In Hawassa, the situation changed radically. A clear instruction flow was now emanating from SREDP and not a ‘foreign’ organization (that is TGS). All problems of work ethics and/or commitment phased out. We established some kind of working routine and met all together at least once a week. Step by step we managed to establish a weekly working schedule that facilitated a better coordination of our activities. Kassa and I were now interacting together very regularly (almost every two days) and got to know each other pretty well. He had “unleashed” the (very) little English he knew and I was learning the basics of the local language (Amharic) rather quickly. Together with some sign language, we managed to communicate together properly. We worked together at the training center, maintaining the facilities and applying some improvement. We were visiting every week some of the beneficiaries together. There we would saw some seeds, check on the fishes health and the overall systems. I was also training him on the “hydro-mechanical” side of aquaponics technology. On his side, Mamo was more of less independent, the data collection was a “one man job”. But we would meet the three of us at least once a week and plan activities for the coming week, gather questions and/or suggestions that I would send to Mihret and Bouke in the form of a report, including accounts of our progress. The group climate became more ‘professional’ in the sense that we would (mostly) discuss concerns relevant to the project rather than religion for instance.
The formalization campaign also operated changes at a more global level. It became a relationship of equals between TGS and SREDP. It goes without saying that the hierarchy from both organizations were highly included during the whole process. And Mihret, as the only knowledgeable person about the legal framework in Ethiopia, played a major role. In addition, the “officialization” of the local staff affiliation to SREDP allowed the two organizations to be formally represented in Hawassa. In sum, SREDP used to be somewhat excluded, but got integrated during the formalization campaign as an integral partner. The whole process had equilibrated the leadership between TGS and SREDP. In addition, Mihret insisted on the distinction between GCME and SREDP: he affirmed in a way the integrity of his organization, notably in regards to the Ethiopian government. Indeed, he stressed out the fact that the government monitors closely the activities of NGOs (both nationals and internationals) and that the success of the project was essential for the credibility of SREDP.

An other consequence of the whole formalization process is that procedures became somewhat bureaucratic. Previously, the focus of our meetings would be more on the desired outputs of the project (as business strategies, production etc), but it would not transfer into tangible actions. Such ideas were probably too broad and not concrete enough to be easily implemented. To relate to the previous cycle, the approach was more ‘ideological’ than ‘practical’. The formalization campaign changed the situation by establishing clear objectives and responsibilities in term of ‘input’ of effort to be followed. These were determined by Bouke and Mihret, and “transferred” to the staff by Mihret. It facilitated the settlement of a working routine and gave more structure to the way the project was carried. However, we had to face sometimes unexpected situations that would require unusual interventions. But it would be very difficult for the staff to step out of this working routine and take action. Indeed, the formalization established and distributed responsibilities, but it also ‘froze’ them in a way: any actions that would not be included in their ‘range of responsibility’ would need hierarchical back-up to be undertaken. For instance, during a meeting if we had found a potential improvement or an idea, we would never implement or take (minor) initiatives directly. Generally I would share those suggestions with Mihret and Bouke, and if approved they would be then transfered through SREDP to the staffs in the form of instructions. Thus the formal approach enabled to improved the workflow but ‘killed’ most potential of spirit of initiative. The staff became committed to the tasks they were asked to conduct, but they did without much critical thinking: the work routine was not entirely productive and would not be ‘output oriented’. In addition, each staff would not perform tasks that should be the responsibility of others. Basically, the project management became quite ‘rigid’ and would need hierarchical back-up when flexibility was required.

As for the ultimate aim of the formalization campaign: establishing an adequate technical management of the project farms, it unfortunately did not occur as expected. We were indeed facing many difficulties. Concerning the “hardware” (i.e. mechanical aspects), most problems were now solved. However, on the management of the “organic” components of the aquaponics system, there was a complete knowledge gap. An aquaponics system is basically an ecosystem in itself. It is a closed loop environment where fishes, plants and bacterias leave and ‘interact’ together. A problem occurring to one of these component of the system will have consequence on the whole ecosystem.
Therefore it is not a trivial farming technique. If there are not enough plants, the water filtration might no be well done and can harm the fishes. If bacterias are not well established, the ammonium from the fish waists won’t be transformed into nitrate, which would harm the fishes and prevent a proper plant growth. If the fishes are not eating sufficient amount of feed and/or the feed is not appropriate, there won’t be enough nutrient to grow healthy crops. If the water PH is not well balanced, either the bacterias, the fishes or the plants will suffer the consequences. In other words, it is quite a complex farming technique. And currently, none of the systems were doing well. The knowledge to manage the ecosystems was nonexistent. The project beneficiaries had obviously not been trained properly, and Kassa – the technical manager, neither had the theoretical background nor the experience/skills to carry out his duty properly. In addition, the self-learning process of the aquaponics technique I had been through was also very insufficient and could not assist Kassa on his tasks properly. And even though Bouke had the required knowledge, he was based in the Netherlands and thus could not provide the direct assistance we needed.

Reflection:

As mentioned previously, SREDP had been created from scratch for the very purpose of the project, as the secular branch of GCME. For this reason, I think TGS considered SREDP more as a ‘legal interface’ enabling them to work with GCME than a genuine organization. Indeed, they used to deal with GCME directly (through Desta Anulo, the former project manager) for most practical matters and they would deal with SREDP nearly solely for administrative concerns. In addition, Mihret and Desta would barely collaborate together, their relation was actually not very good.

TGS was accustomed to work with a project manager that had some international exposure which limited the cultural and language barriers. In addition, he appeared to be a genuine ‘champion’ and carried mostly by himself most project local activities. Thanks to his deep involvement/commitment and having a privileged relationship with Bouke, an informal and ‘horizontal’ approach to management was suitable and apparently effective. Thus my interpretation is that before I arrived, the management structure of the project used to rest on two ‘horizontal’ (meaning not hierarchical) pillars: the duo Bouke-Desta and the duo Bouke-Mihret (TGS-GCME / TGS-SREDP). Yet, the first collapsed just before I arrived in Hawassa with the resignation of Desta, which lead to a complete management gap. The connection between the ‘top management’ (project leaders, located in Addis Abeba and the Netherlands) and the ‘operational’ management (on site in Hawassa) of the project had been broken, resulting in a severe lack of leadership.

Prior to (and at the beginning of) the formalization campaign, TGS and I were preparing most of the work that was the co-responsibility of SREDP: for instance sending documents for approval rather than elaborating contracts together, not including him in information loops we judged unnecessary. Our intentions were to speed up the project progress. However, it appeared that it was not the right way to do, and I even felt like Mihret got offended to be set aside in such a way. The formalization campaign put things back the ‘Ethiopian way’ and equilibrated the leadership between SREDP and TGS. Basically the pillar ‘Bouke-Desta’ (TGS-GCME) had gotten replaced by
a new vertical (meaning ‘top-down’) backbone: SREDP > GCME (Mihret - Kassa/Mamo). Mihret both claimed and demonstrated that he was the right person to undertake the enterprise of the project formalization. In addition, I believe TGS did not have much knowledge about and/or experience in dealing with the ‘usual’ Ethiopian management ways (i.e highly formal) since they had been accustomed to a rather informal approach to management with Desta that was actually working out. Overall, the formalization “campaign” facilitated the re-integration of the linkage between the top-management and the ‘operational’ management and enabled the establishment of a ‘high task – low relationship’ type of leadership emanating from Mihret. This linkage is illustrated in fig 1.1.

The formalization of the project structure also clarified the nature of the relationship between the stakeholders of the project. For instance, at the operational level, in Hawassa, Kassa Mamo and I had become colleagues and identified ourself as the “project team”. Before, as a consequence of a complete lack of structure, the nature of our relationship was very fuzzy and totally non-cohesive due an overall lack of interaction. The formalization of the structure had also established formal rules of interaction, notably through the elaboration of a working schedule and a clear distribution of responsibilities. Informalities related to religion and ideology (partially) phased out. In addition, as I have mentioned previously, SREDP adopted a top-down approach in regards to the beneficiaries and there was an overall lack of pro-activeness from them. Therefore a sort of ‘assisted-assistant’ relationship emerged between the management structure and the beneficiaries. The nature of these relationships is also illustrated in fig 1.1.

Concerning the bureaucratic system that arose from the formalization campaign, I interpreted it as a consequence of the ethiopian work culture. Indeed, I have witnessed such working ways in many other organizations. Later on, when working together with Hawassa university, I was able to observe the same phenomenon at an even larger scale. For instance the whole nutrition department got ‘paralyzed’ when the head of the school left the country for some

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**Figure 1.1:** Power relations within the local project structure (formal agreement / implicit agreement)
seminars in Europe. I experienced the same kind of bureaucratic procedures when visiting multiple times the immigration office in Addis Abeba or the Addis Abeba University (AAU).

Fundamentally, Ethiopian organizations and institutions are extremely sectored and hierarchical which makes every procedure very bureaucratic. I believe that an other facet of the Ethiopian cultures might explain this tendency: fatalism. Such behavior is ever-present in Ethiopia, a lot of literature can be found on the links between religion and fatalism (Taffesse, 2011; Ruju, 2013) and I think it applies for Ethiopia as well. For instance a common saying would be ‘Exiaber yaoukhal’ (if God wills it) or ‘inch Allah’ in the Muslim community or even ‘Exiaber Estegnen’ (God will provide). Such expressions would often be used as ‘excuses’ to escape responsibilities and/or engagements: “we will meet tomorrow if god wills it” or saying “god will provide” to a street beggar.

Therefore, it seems that this general tendency to fatalism and the resulting ‘escaping’ from responsibilities requires close monitoring and supervision when progress is expected. As a result, the hierarchy gets more and more omni-present and its interventions vital. And to answer such issues, it seems like the hierarchy tend to sharply fragment the responsibilities hoping to reduce the ‘escaping’ phenomenon. However, the ubiquity of the hierarchy and the sectoring of responsibilities makes most activities that go beyond the working routine a highly procedural venture. Which, in turn, lowers the incentive for pro-activeness and closes the loop of a downward spiral (figure 2.2). And thus, it seems that in Ethiopia, bureaucracy and active forms of management go hand in hand.

The management was not carried by a single individual. It became more of a managerial structure that included Mihret, Bouke, Kassa and myself. Mihret was making sure that we would work according to the legal framework. He supervised Kassa and Mamo in their work (notably sending instruction). Kassa was the link between the beneficiaries and this so called managerial structure. He identified issues at the beneficiaries sites. Together with him, I would draw diagnosis of these issues and try to find and implement solutions. I was also facilitating the linkage between the top management and the operational management. Through the report I would send weekly, I
was helping the ‘constant’ monitoring and evaluation of the project. And Bouke was managing the budget and following the compliance with the project guideline.

The formalization of the project organization had enable the establishment of a proper managerial structure in the sense that it phased out issues of work ethics, defined clear and coordinated objectives to follow, and gave guidance to attain these goals through the definition / distribution of planning, tasks and responsibilities and the establishment of an adequate form of leadership. The activities were monitored, evaluated and closely supervised, notably through the intermediary of the weekly report I elaborated and a better inclusion of Mihret in the information flow. However, the whole cycle was based on the (obviously) mistaken and unanticipated assumption that Kassa, with my assistance, would have the capacities to carry out his duty of technical manager.

**Conclusion and transition to the next research cycle:**

*Key learning points*

The analysis of the newly establish/transformed managerial structure facilitated (my) learning of the Ethiopian management ways. The fatalist tendency coupled with the very hierarchical and sectored system enabled my understanding of the bureaucracy that seemingly appears to be inherent to local formal settings. This comprehension seemed essential to pursue the study of (and the active participation to) the aquaponics innovation process.

Through this research cycle, we had managed to overcome a significant barrier to the innovation process: a formerly passive and non-functional project management that was preventing adequate clarity of the process had now taken a more active and transparent form. In this regard, it appears that when a certain distance (in this case literally) separates the ‘top’ and the ‘operational’ management, first a formal approach is needed, notably to ensure the connection of the operational level with the envisioned formal project objectives.

This clarity enabled to shed light on a new barrier that hampered the innovation process: the capacities to undertake the technical management of the project farms were not available.

To further conduct the action-research process, I chose this newly disclosed barrier to the innovation process (“knowledge barrier”) as the next issue to be tackled. This barrier directly impinged – for evident reasons, on the demonstration of the economic feasibility of aquaponics in Hawassa (mandate of TGS). Nonetheless, the project stakeholders did not have the capacities to overcome this issue. In addition, this knowledge barrier - definitely inherent to the project, was also likely to be “global”: aquaponics can be qualified as an ‘alternative’ farming technique. Knowledge capacities regarding this technique can be scarce, especially in a country like Ethiopia. Thus the knowledge barrier seemed like an important factor to take into account in the perspective of the implementation of aquaponics technology on a larger scale in Ethiopia. Therefore it seemed both relevant and necessary to push the investigation outside the project boundaries, both to find the support (in term of knowledge) needed to sustain the project and investigate on this possibly global knowledge barrier (regarding aquaponics) in Ethiopia.
Cycle 2  
December - January

Planning:

The previous cycle had enabled some clarity regarding the innovation process and unveiled a new innovation barrier: a severe knowledge gap regarding the technical management of aquaponics. In other words, however, the organizations directly involved with the project (GCME, SREDP and TGS) did not have the capacities to (help) fill this gap. TGS had the aquaponics expertise but was based in the Netherlands, whereas neither GCME nor SREDP were familiar with any kind of farming practices. Thus to tackle this barrier it was necessary to involve new actors in the process.

The IC framework, as most concepts providing an understanding of innovation processes as collective and interactive (innovation platforms, public-private partnership…), is above all an analytical construct to study readily established networks (Klerkx et al., 2013). In other words, it is not a framework of intervention: it does not really give insights on the “operationalization” of innovation networks. Therefore, I had to lean toward a framework that could better suit an intervention approach. The ‘innovation brokerage’ theory seemed relevant. Indeed, it emphasizes on innovation networks that are primarily designed and managed by a ‘network broker’ (Batterink et al., 2010): a role that I could endorse. By analyzing the contributions of such brokers in innovation processes, the framework offers guidelines in the orchestration of innovation networks.

The network orchestration refers to the actions undertaken by the broker, aiming at ‘creating value’ with the network and ‘extracting value’ from it (Batterink et al., 2010). These deliberate actions can be categorized in three set of functions:

- The demand articulation (or ‘innovation initiation’), to answer the needs of the innovation process in term of funding, technology, knowledge ...
- The network composition, that entails activities such as “scanning, scoping, filtering and matchmaking of possible cooperation partners” aiming at initiating and sustaining linkages of relevant innovation actors (Howells, 2006).
- The innovation process management, referring to the ‘interface management’ (Smits & Kuhlmann, 2004) that aims at enhancing the alignment of heterogeneous actors and ensure the sustaining and productivity of the network.

So far the IC framework had shown very little relevance regarding the context specific issues raised. The problem orientation of the action research had only required the use of broader concepts emanating from leadership theory and elements of logical reasoning. But now, as I could not possibly find (or approach sources of) formal support on my own - not having the credibility, legitimacy nor the capacity - to tackle the knowledge barrier, an informal approach seemed relevant to privilege. And such an approach would be in line with the IC framework that stresses the “potential” of informal capacities / networks to overcome innovation barriers (Fichter, 2012). More than innovation brokerage theory, the IC framework elaborates on the role of informal networks of
individuals – notably in term of skills, roles or resources to successfully, to successfully contribute to collaborative innovation processes (Fichter, 2012). These requirements are embodied in the sub-construct “composition” of ICs elaborated in the research proposal. These could serve as recommendation for the network composition to be operated by the innovation broker (i.e. myself). Therefore, it seemed relevant to integrate elements of both framework together.

Thus, for this cycle, I planned to endorse the role of an innovation broker. By actively approaching and identifying individuals that could possibly cooperate with the aquaponics project in tackling the knowledge barrier, I intended to:

- Orchestrate a demand articulation
- Elaborate a network design

Through this networking activities, I expected to identify promotors and then evaluate their potential contribution to the aquaponics innovation process. Hence the research question of this cycle is:

**RQ:** What could be the composition of an IC aimed at tackling the knowledge barrier hampering the aquaponics innovation process?

The intended actions of this cycle were more or less limited to networking/identification activities, and thus would not induce significant social change. Therefore, this cycle was not aimed at elaborating an extended ex-post evaluation of these actions, and I did not consider the monitoring of the effect of these actions as an important element for this cycle. On the other hand, by networking outside the project boundaries, I would explore new opportunities for collaboration. Therefore, assessing the potential of these opportunities - as explicitly suggested by the conditional used in the research question, seemed essential. It would actually correspond to the foresight exercises (exploring new possibilities, articulating ideas...) induced by the demand articulation (Klerkx et al., 2009). Following the innovation brokerage framework, the demand articulation, driven by the aquaponics innovation process ‘needs’ (i.e. overcoming the knowledge barrier) should take into consideration the needs and capacities of potential collaborators. In addition, the motivation (to cooperate) of actors is an essential pre-requisite in an informal setting (Fichter, 2012). Therefore the willingness of these actors to cooperate would be another important point of this assessment. Concerning the network design - closely linked to the demand articulation, I would pay great attention to the elements of the sub-construct “composition” that characterize ICs, notably in term of ‘completeness and complementarity of skills’ and ‘social capital’.

Basically, the ultimate aim of this cycle was to elaborate a sort of real-time assessment of the potential to mobilise the necessary qualities for and IC to overcome the technical barrier.

**Implementation and Observation:**

To find relevant actors to tackle the knowledge barrier, I decided to orient the research toward local knowledge institutes. I expected more “experiential” forms of knowledge to be either
highly disseminated or plainly inexistent. Indeed, urban agriculture does not seem to be a common practice in Hawassa. Moreover, due to the competition of the very well developed fishery activities (the city borders a lake), I did not expect aquaculture activities to be developed in the area. Hence, I envisioned local academics as the relevant target group within which I would network to find individuals with whom to tackle the knowledge barrier that the innovation process was facing.

The Hawassa aquaponics project was part of a wider research program. Two other aquaponics sites had been established and managed by Addis Abeba University (AAU) with the support of NWO-WOTRO and Wageningen University. Thus I naturally thought about approaching AAU to look for the expertise we needed. It was very easy: I already had had few contacts with Abebe Tadesse, a professor of AAU who was the ‘field manager’ of the 2 two other aforesaid stations. However, I had met him in person only once, the first week of my arrival in Ethiopia. After informing him about the different technical problems we were facing, we started to call each other on a regular basis. Simply on the phone, by explaining symptoms we were witnessing (plant disease, fish behavior…) he would be able to diagnose some of the problem and help us finding solutions. He appeared to be extremely knowledgeable and worked on the technology for few years already. Our calls would be very friendly and he was very open to help us. Even though AAU was not (officially) directly involved with the Hawassa site, he showed great interest in following up our progress, and I started to send him the weekly reports I was elaborating for Bouke and Mihret. Basically, he is the single aquaponics expert in Ethiopia. He has a very holistic approach: knowing both the aquaculture and hycroponics sides of the technology and is a practice-oriented scientist. He is very open minded and aware about the bottlenecks of the local academic system. For instance, he criticized many times the lack of practical knowledge and the highly bureaucratic procedures of the local institutions. He has very good relations with Dr Abebe Guetahun, the director of the zoology department and leader of the AAU-aquaponics project. He was also asked to participate to the structuring of the newly established ‘ministry of livestock and fishery’ mentioned previously (however he refused).

By visiting Addis Abeba University multiple times and meeting most academics/students involved with aquaponics, I got to learn from them about the involvement of the university in the domain of aquaponics. It was the first organization involved with aquaponics technology in Ethiopia. Prior to this project, they were working for another program funded by the FAO in Zeway. They have elaborated an extended manual on the theories which aquaponics draws on. In addition two PHDs focusing on the technology are ongoing (Abebe himself and one of his students). There even is a station on the campus itself. Thus the university, specifically the zoology department, devotes a lot of effort to study and develop aquaponics in the country. The department is lead by Dr Abebe Guetahun (not to be confused with Abebe Tadesse), a highly respected scientist.

The city of Hawassa hosts an agricultural college (sub-school of Hawasa University, HU) and luckily I had few friends who studied there. Thus I could try without difficulty to get introduced into the academic sphere of the university to solicit there help. A friend knew very well the head of the nutrition school of Hawassa agricultural college: Fikadu Reta. I had told him my interest in meeting the later, and some weeks later they came together at a party I had organized. It is thus in a completely informal context that we had our first encounter. He was very curious about the project
and eager to visit the TR. Therefore I invited join me at the GCME compound some days later so that he could see the installation. He was really amazed and enthusiastic about it and started imagining students coming over to learn about aquaculture and bacterial cycles... He directly suggested that we should find a way to collaborate and potentially elaborate a partnership together. We then met plenty of times, generally in a relaxed atmosphere – bar and restaurants. Our encounters were not necessarily meant to talk about the project/aquaponics. We had many other common interests and we actually became very good friends.

Spending a lot of time in the campus, and as I even lived inside - at a later stage of the research (thanks to Fikadu), I was able to witness his management approach and some of the tasks he would perform. As the head of the School of Nutrition, Food Science and Technology (SNFST), he pays a peculiar attention to the projects which the department is involved in. However he does not participate to the fieldwork activities but focuses exclusively on managerial tasks. He even defines himself as part of the “new generation of bureaucrats” - in contrast with the older somewhat conservative generation. I spent a lot of time with him within the school premises and could witness how he would manage the department. He was challenging his staffs by setting ambitious goals, he was looking for Phd opportunities for some of his colleagues and was constantly motivating his team. He would continuously court calls for proposal and seek funding opportunities for the department. He would even participate actively to the writing of such proposal. He was also managing the Ethiopian on-line platform of the ‘Agriculture-Nutrition Community of Practice’ (ag2nut platform), that aimed at connecting nutrition professional and academics from all over the country. He was someone really active, hard worker, able to align the interests of his team and bring people together. He demonstrated a great sens of leadership and people admired him.

Concerning the college of agriculture of Hawassa University (HU), it is a rather small structure providing education to some two to three thousands students. It is divided in four ‘schools’: the aforesaid SNFST, the ‘School of Animal and Range Science’, the ‘School of Plant and Horticultural Science’ and the ‘School of Environment, Gender and Development Studies’. However, the SNFST is department is much more than an academic center: it is also renown for its expertise in conducting fieldwork activities such as nutrition follow-ups or malnutrition assessments (notably in rural areas). Since its establishment, it has followed different capacity building programs (e.g. NICHE and NUFFIC programs) and partners regularly with international organizations for nutrition-safety related projects (FAO, USAID...).

Through Fikadu, I got again in touch with someone I had met before but lost contact with: Darasa Tamiru. The later was one of his staff and had done his master thesis on the impact of pond culture on the nutritional status of farmers in some rural areas in the southern region. The two of them were working very closely. Darasa acted as the assistant of Fikadu to whom the latter would rely on and delegate some work. They were functioning as a duo, spend most of their free time together and even lived in the same compound. However, Darasa would never impinge on the responsibilities of Fikadu and would not have the same kind of resourcefulness: he was more ‘operational’ and had a good experience of fieldwork in the nutrition domain.

During his master thesis, Darasa worked together with Bereket Haji who is now the manager (and initiator) of the aquaculture research center of Hawassa – a substructure of the Southern Agricultural Research Institute (SARI). Darasa introduced me to his former colleague and we
visited together both installations: his research facilities and the TR. He was very interested and curious about its functioning: asking many questions and putting effort in understanding the sciences behind aquaponics farming. On my side I was also really exited about his researches at the center: he focused mainly on fish feeds and on the cohabitation of cat fishes and Tilapias in ponds. His knowledge in those 2 domains could potentially be very helpful for the project success (we used Tilapias as well), especially since we suspected that the feed we were using not to be appropriate. He stated that he would be totally open to collaborate. We also met several times afterwards, in more formal context but very friendly ambiance anyway. He notably shared with me his professional/academics accomplishments and promoted his organization.

As the instigator of the research center, Bereket had lobbied to obtain the funding, he made the design himself and found the land. He fought (together with other scientist) for the recognition of aquaculture as a farming practice by officials and raised awareness among the political sphere. In addition, he appeared to be a passionate scientist and seemed to value knowledge creation as the solution for the development of his country. He was a practical scientist with great fieldwork experience.

His organization, SARI, is an applied research institute. In the field of aquaculture, their approach is to test new methods at the ‘Hawassa aquaculture research center’ and implement at the farmers level in rural areas. Currently the extension activities are somewhat subsidies: e.g. free provision of fish fingerlings to the farmers. One important activity they focus on is to convinced farmers to use external fish feed provision to increase the yields, through locally elaborated recipes. An other important part of their work is to experiment on integrated aquaculture systems that include vegetable production. It relies on the same concept that aquaponics is build upon: the nitrification of the ammonium contained in the fish waists. As a public institute, it is a tool to implement the agricultural policies elaborated by both the “ministry of agriculture and national resources” and the “ministry of livestock and fishery”. Therefore, the efforts SARI undertake in the field of aquaculture reflect one of the strategies of rural development set by the government.

Reflection:

To engage successfully in innovation intermediation activities, Kolodny et al. (2001) established several requirement for adequate brokerage. The broker should be trustworthy, visible and accessible to innovation actors. He should have access to relevant sources of knowledge about the innovation process and be credible regarding these sources. And finally, the broker should also be responsive to the demands of innovation actors it serves and complement their possible unfamiliarity with inter-organizational project (Kolodny et al. 2001). When approaching individuals from the aforesaid knowledge institute, I was introducing myself as a student from Wageningen University conducting research on aquaponics with a focus on innovation processes. To my surprise, they all knew the university and had a lot of admiration for the institution. Wageningen was like a “quality stamp”, and it seemed that this prestige gave me credibility. Also, at that point, I had become quite knowledgeable about aquaponics technology, which also helped my credibility by being able to answer their various question on the technical aspects of aquaponics farming. In addition, I did not explicitly insist on my affiliation with TGS, to make sure that they would not perceive me as protecting the corporate interests of a private/foreign company; which could have
hamper my trustworthiness. Then, as a foreigner, people were very accessible. Since there was only very few foreigners in Hawassa, I guess I was visible enough and aroused the curiosity of people easily. This role of broker was (almost) my full time occupation and thus I was fully available for them. As I was directly involved with the project, I had full access to the different facilities and was disposed to negotiate access for them with my own hierarchy. Thus it seemed that overall, I complied to a great extent with most of the requirement to engage successfully in innovation intermediation activities formulated by Kolodny et al. (2001). Therefore I think I had the legitimacy to undertake the role of an innovation broker. In addition, being a foreigner appeared to be an advantage, and as most academics in Ethiopia have a good command of English, the language barrier was not a problem.

Part of the demand articulation had been operated in the previous cycle. Indeed, if framed with the brokerage theory terminology, the previous cycle enabled a “problem diagnosis” (Batterink et al., 2010) that led to the articulation of the innovation needs: overcoming the knowledge barrier. However, to articulate a corresponding demand, it was necessary to assess the ‘offer’ - i.e. the available knowledge capacities relevant to the aquaponics innovation process. Throughout this networking phase, I witnessed that experiential forms of knowledge relevant to the aquaponics innovation process were available within the local academic sphere. First of all, in Addis Abeba University, Abebe was a genuine expert promotor in the domain of aquaponics. However, for evident logistical reasons, his expertise was not directly ‘transferable’ to Hawassa. Concerning SARI, applied forms of scientific knowledge are the drivers of the organization. Indeed it is an applied research institute aimed at implementing ‘good practices’ at the farmers level. Currently one of their priority is the development of aquaculture, and Bereket has developed extended practical and academic knowledge regarding tilapia farming. He was also involved with the institute in investigations on integrated aquaculture techniques (symbiosis between plants and fishes). However, these activities were still at an early experimental stage and he had not developed an expertise yet. Anyway, expertise on aquaculture was available in Hawassa. Nonetheless, it is important to remind that ‘aquaculture’ is only one of the components of an aquaponics system. In other words, aquaculture expertise is not enough to run successfully an aquaponics farm. Therefore, expertise relevant to aquaponics was available, but unfortunately either not directly applicable to the Hawassa project (‘complete’ expertise available, but in Addis Abeba) or insufficient (only aquaculture expertise available in Hawassa). Concerning Hawassa University, all science-based sources of knowledge relevant for aquaponics were available (aquaculture / horticulture / chemistry …). However, this knowledge was not available on a practical / operational form, thus neither directly operational for aquaponics application: I did not encounter expert promotors. Anyway, there was overall a knowledge basis available that could possibly be ‘transformed’ into expertise for aquaponics application in Hawassa.

The demand articulation is not only driven by the needs of the innovation process, it also entails the articulation of the needs of actors with a stake or mobilised in relation to innovation (Howells, 2006). However, in this case, since I was dealing primarily with individuals rather than organization, the terminology ‘need’ did not seem appropriate. I would rather use the terms ‘interests’ and ‘intrinsic motivation’. By multiplying interaction with the identified individuals, I
had been able to articulate their interests in relation to aquaponics. Abebe was not formally involved with the Hawassa project, but he was part of the wider research program. He had been involved in every aquaponics related projects in Ethiopia. He firmly believed that the technology could help the development of his country. It seemed like he had a genuine intrinsic motivation to contribute to the development of aquaponics. In addition, he had been so far very helpful and highly cooperative whenever I would inquire his help on the phone. This technology was something completely new for Bereket. He was very excited about it and saw a possible cooperation as a way to learn about this technology and access ‘high end’ research facilities through the training center. Moreover SARI is the hub of research for aquaculture in Ethiopia and he was willing to sensitize his organization about aquaponics. Concerning Fikadu, he had a great interest in aquaculture in general. But above all, as a member of the top management of the agricultural college, he felt that it was part of his responsibility to look for / promote opportunities that could lead to employment in the rural/agricultural sector for the newly educated generation of Ethiopia. He notably raised the fact that the students lacked of practical experience. He stressed that the project was ideally located (proximity of the project farms with the university) and was eager to see students involved so that they could learn from practice, as part of master thesis projects for instance. Concerning the innovation needs of the related organizations, it seems that Ethiopian public knowledge institutes - due to ambitious development goals, are overall under great pressure to innovate. However, in this case, the focus was not only on the ‘innovation needs’ of such organizations. Through the wider aquaponics research program, the project in Hawassa was formally linked to Addis Abeba University. The project was also very much in line with the agenda of SARI and represented new learning opportunities for Hawassa University.

Whereas more traditional approaches to innovation brokerage takes as a departure point of an innovation project the needs of the actors (Batterink et al., 2010). Here, the departure point was the needs to successfully implement the technology: the necessity of finding and/or developing appropriate knowledge. In other words, the ‘innovation needs’ were imposed to rather than formulated by the individuals I approached. Thus, the early stages of the demand articulation was rather complex. It encompassed the ‘matchmaking’ of the innovation needs (i.e. overcoming the knowledge barrier) and the identified organizational and individual capacities as well a ‘matchmaking’ of the hardware (i.e. the technology) with the ‘innovation agenda’ of these organizations and the personal interests/drives of the persons I met.

In term of network design, for the long term, the organizations identified disclosed a great complementarity. Not only for the Hawassa project, but possibly also for an implementation of aquaponics on a larger scale. The Agriculture college of Hawassa could serve as a ‘pool’ of student to be trained by Addis Abeba University and then ‘dispersed’ as aquaponics trainers through extension activities by SARI. With the Hawassa aquaponics project that could serve as a training/research station (ideally located in this regard). However, due to the (currently) informal nature of the approach, these formal/organizational capacities could not be mobilized on the short term.

Anyway, as explained above, a knowledge basis that could be ‘transformed’ for aquaponics application was readily available in Hawassa, yet not operational. Thus organizing capacity building activities to operationalize this knowledge seemed like a good way to overcome the innovation
barrier. However, such activities would require further fundings that the research consortium was not able to provide. On the other hand, Bereket and Fikadu had great experience in fund raising/proposal elaboration with both national and international funding bodies. And Abebe had a comprehensive expertise, readily operational, in the domain of aquaponics. He could thus possibly play a role in determining the form the capacity building activities should take according to the knowledge basis available in Hawassa. In other words, Abebe was an expert promotor whereas Bereket and Fikadu showed interesting power promotor behavior in the sense that they were well aware of (financial) resources attribution mechanisms. Therefore, if brought together, these actors could possibly put at use these personal capacities to help overcoming both the knowledge and (financial) resource barriers, and even facilitate and structure the access to the aforesaid formal/organizational capacities.

On my side, as a networker, I had throughout this cycle endorsed the relationship promotor role. However, it has been assessed that the ‘success rate’ of innovation processes is increased when all promotor roles can be found in the network composition (Fichter, 2012). Therefore, with this design, the process promotor role was lacking. So far, I had limited my interaction with these innovation actors to networking activities. Nonetheless, the orchestration of an innovation network goes beyond, and should encompass innovation process management tasks that are explicitly related to the role of a process promotor (Batterink et al., 2010; Howells, 2006). Currently, the network was still at a design stage, (i.e. not ‘composed’ yet / lack of linkages) therefore it was too early to undertake process management tasks. But in a later stage, by engaging in such type of activities, I would endorse the role of a process promotor as well. And by doing so, this network would entail the four kind of promotor behavior described by Fichter (2012): process, expert, relationship and power promotors.

**Conclusion and transition to the next research cycle:**

**Key learning points**

This cycle disclosed that readily operational knowledge capacities for aquaponics application were nonexistent in Hawassa. However, it shed light on a basis of knowledge available in the academic/research sphere of Hawassa which capacity could be built upon and disclosed the availability of comprehensive expertise in the domain of aquaponics in Addis Abeba University.

Promotors from the academic/research sphere from both Hawassa and Addis Abeba had been identified and were willing to cooperate in the aquaponics innovation process. However, this cooperation would require further funding or at least forms of formal support to be operationalized.

My position as a broker seemed perceived as legitimate notably due to my affiliation with Wageningen University and my demonstrated general knowledge regarding aquaponics.

As I did not have the legitimacy nor the capacity to mobilize formally these organization towards the aquaponics innovation process, I judged relevant for the next cycle to capitalize my effort on the mobilization and fulfillment of these informal/individual capacities I had identified. In addition, some of them had explicitly formulated their willingness to cooperate in the form of research. They were obviously all deeply embedded in the academic sphere and both Bereket and Abebe were even conducting PhDs. In addition, the funding / support needed to materialize our
cooperation could be gained through the granting of research fundings. Therefore it became quickly evident that the innovation process should pursue a research approach, and thus that the innovation network should take research-driven form.

I had voluntarily decided to focus this action-research cycle on innovation actors outside the Hawassa project boundaries. This shift of focus decreased my attention to the organizations, beneficiaries and staff of the Hawassa aquaponics project. However, they were not ‘excluded’ from the scope of my research. First of all, the intended orchestration of an innovation network composed of local academics/researcher could directly benefit the beneficiaries, by connecting the project to adequate knowledge resources. Then, concerning the organizations (TGS / SREDP), they were not able to tackle the knowledge barrier. Mihret, conscious of that fact, had expressed the need he perceived to outsource the technical management of the project: he was willing to replace Kassa, the current technical manager. And on the side of TGS, Bouke had explicitly told me that they were looking for an organization to take over the project. Therefore, this innovation brokerage approach was in line with their agendas. Hence, for the next cycle, I intended to pursue the broker role I had undertaken to mobilize these individuals and together operationalize a research strategy aiming at mobilizing resources (knowledge / fundings) to facilitate capacity buildings activities for aquaponics application in Hawassa. Yet, the form and direct target of both this research and activities were to be determined.
Cycle 3:  
*February – April*

**Planning:**

Throughout the previous cycle, I had identified promotors that could (and were willing to) cooperate in the aquaponics innovation process. Corroborating with the ‘demand articulation’, I had elaborated a network design seemingly interested and capable of answering the ‘needs’ of the innovation process: knowledge. The concern to be tackled for this cycle was now to mobilize these promotors.

As mentioned in the previous cycle, some of the promotors had explicitly express their willingness to cooperate in the form of research. As they were all deeply embedded within the academic / research sphere, this demand articulation seemed evident and influenced my own vision on the way to pursue the aquaponics innovation process: as a new research initiative complementing the current aquaponics project rather than a ‘follow-up’ of the current project. But also, a research orientation would possibly facilitate the effective development of a common framework of understanding (as they were all linked to the academic sphere), an essential element to build-up the functional identity of an IC and enable adequate communication between group members (Fichter, 2012). In addition, a very interesting opportunity came up: the university of Hawassa was organizing the “Second National Nutrition and Food Industries conference” (in February). An event that would gather representatives from most Ethiopian universities, several (international and local) NGOs, ministries and the Agriculture for Nutrition and Health program (A4NH). The theme was on capacity building and employment for a “better nutrition and sustainable development in Ethiopia”. For the occasion, the A4NH program launched the “Ethiopian Food Systems for Healthier Diets Research Program” and organized a call for posters on innovative research ideas. Darasa (staff member of the Nutrition department of HU) disclosed to me the A4NH initiative and suggested that we could answer that call and present at the conference a paper linking aquaponics technology to the field of nutrition. As aquaponics enables the production of both fish and vegetables - high nutritional value products, it seemed indeed relevant. And framing the technology as a potential nutrition safety solution / intervention could possibly be a way to advocate the need for further support towards aquaponics-related research in Ethiopia. Therefore, this opportunity and the pro-activity of Darasa also precipitated the decision to opt for a research driven innovation network. In addition, a rapprochement with the field of nutrition seemed to be a relevant angle. What is more, the expertise of HU in this field of study was readily available (through both Fikadu and Darasa).

The innovation network was currently only ‘designed’, but not genuinely composed. Thus it was important to keep up with the pro-active approach I had undertaken. Pursuing my role of broker was clear: it was necessary to link-up together the promotors I had identified. Fikadu was already very enthusiastic about the initiative suggested by Darasa, but aligning Bereket and Abebe towards a rapprochement with the nutrition sphere was also needed. And a certain ‘interface management’
would be necessary to facilitate the integration of the different actors domains (Smits and Kuhlmann, 2004).

Therefore, assuming that a rapprochement between aquaponics and the field of nutrition was relevant and that I would manage to align both Abebe and Bereket in this perspective, I planned the following actions:

- ‘Refining’ the demand articulation: a rapprochement with the nutrition sphere would necessarily induces taking new factors into account and possibly involve a different framing of the technology (the current framing promoted by the project leaders was: aquaponics as a business opportunity for poor households).
- Network composition: initiating linkages between the promotors I had identified in the previous cycle. In other words, bringing to ‘life’ the network design.
- Innovation process management: alignment of actors towards a rapprochement with the nutrition domain and interface management between the different actors domains. And facilitating the alignment of this initiative with the Hawassa project stakeholders (TGS / SREDP) and the ‘needs’ of the aquaponics innovation process (in term of knowledge).

Through this network orchestration I intended to establish an research-driven innovation network. Nonetheless, my intentions were greater: I expected this network to take the form of a dynamic, self-organizing innovation community. Hence the research question of this cycle is:

**RQ:** Can brokerage towards a nutrition safety research project stimulate the development of an IC for aquaponics farming in Ethiopia?

Unlike the previous cycle, the expected outcomes of these actions would induce significant social change. Monitoring the efforts of actors in transferring / developing knowledge and skills for the Hawassa aquaponics project would be essential. Then, the relevance of a rapprochement with the nutrition sphere should be further assessed. For that, the outcomes of the conference and the feedback of external academics would be important to collect and analyze. Furthermore, drawing on the IC framework, I would pay considerable attention to the interaction, identity and composition components of the innovation network and on the ways the brokerage approach stimulated the quality of these components.

**Implementation and observation:**

Elaborating our ‘innovative research idea’ with Darasa was a complex process that took us around two weeks. We come from different worlds: he is highly specialized (field of nutrition) while I am more of a generalist. He is a natural scientist while I am from the social science sphere. And no need to say that we are from very different cultures. Therefore it took us a lot of time to develop a common framework of understanding. However, we found quickly some common grounds. For instance nutrition and social science are related in some ways: in both cases we are dealing with humans / society. Indeed, nutrition studies are not limited to chemistry-type of
investigation, it is also about consumer behavior, theories of change etc. Therefore we were both familiar with similar research methodology. I initiated him to action research and he really loved the methodology. He valued operational-type of research a lot.

Through this process I learned a lot from him about some of the challenges of his country regarding nutrition and food safety and on his side he learn from me about what aquaponics technology could offer and the current challenges hampering its implementation. Our aim was to elaborate a document that would take all some of these components into consideration. Therefore we undertook an analytical work (further explained in fig 3.1) that helped us to find the idea of framing aquaponics as an innovative intervention model to answer the issue of nutrition safety of communities that do not have access to high nutritious value products. We notably stressed the low water consumption of the technology and the fact that it is a soil-less technique, making its implementation in infertile and/or drought-prone areas possible. We also promoted its feasibility in urban setting which could secure/create fish supply in cities. This discourse served as the justification for the necessity of facilitating the building of capacities toward aquaponics farming technical management. We suggested that such capacity building could take the form of an action research project.

It was difficult to put everything on a single poster, therefore we decided to elaborate both a poster and a concept note. Maja Slingerland - the overarching project leader (WUR), really appreciated our initiative. She helped us in editing the documents and gave us some advices. The two final products are visible in Annex 3 and 4.

The posters were hanged on a wall and we presented our work during a break to the interested passers by. Overall, people were very curious. We also distributed the concept note to those who wanted more details. We explained the whole thing in more details to the members of the A4NH program: Dr Inge Brouwer and Dr Kaleab Baye, respectively leader and Ethiopian program coordinator of the Food Systems for Healthier Diets flagship. It was a success, and we were granted the first prize.

Few days later, I arranged to meet Abebe Tadesse in Addis Abeba so that we could brainstorm on this success and discuss the future opportunity it could represent. We proceeded to an analysis of the current difficulties hampering the establishment of the technology in Ethiopia and the opportunities that could enable further development/support (further explained in fig 3.1). The latter were very limited, thus he also got quite convinced about the potential opportunity that an explicit rapprochement with the field of nutrition could offer in term of financial support. Indeed, nutrition safety is a “hot” topic in Ethiopia and he was aware of that. Nutrition was the priority in the agenda of many international (research and/or development) funding bodies (e.g. Gates Foundation, WFP, A4NH, GIZ...) and government fund (e.g. Agricultural Growth Program: AGP II that encompass an explicit nutrition component).

In addition, the approach we presented with Darasa at the conference led to a reconciliation between the technology and the academic / research sphere. However, I knew that Abebe was not really keen on that. He judged the Ethiopian academics (in general) as too theoretical and unfamiliar with applied sciences. Thus he did not considered them as relevant actors in regards to the implementation of aquaponics. Nonetheless, we came both to the same conclusion: without a further integration of the technology within the academic sphere, it would be very difficult to find
the required support to sustain the current projects and enable the further developments needed (notably in term of capacity building) to make aquaponics a feasible economic activity. Abebe already knew Darasa and Fikadu, I had introduced them together during a visit of both Abebe and Bouke in Hawassa. The idea of collaborating together on the topic was already ongoing, but this new initiative increased the willingness to cooperate.

We then met together with Kaleab and promoted the technology. We shared with him our belief that such farming technique could serve nutrition safety purposes and explained him that we required support to explore this potential. He explained us that such innovative farming practices could match the A4NH priorities, and we shared with him our knowledge about the conduction of such study, but they were very experienced in the domain. Unfortunately, they did not have any fund to operationalize such a research. Thus one of their task was to find the needed resources (through research proposals, with my help) and then conduct such a research. The fundings were granted later (September 2017) by Hawassa University, as part of a thematic research proposal on aquaculture (submitted in June) with the participation of both Bereket and I.

To be able to conduct the nutrition impact study, we had to make sure that the project beneficiaries (in Hawassa) reached a decent production. That is where Abebe and Bereket intervened. Bereket had found a potential staff that could succeed to Kassa and Mamo, and take over (on a full-time basis) the local management of the project: Nigatu. Abebe agreed on training him while Bereket was willing to supervise him locally in Hawassa (as mentioned multiple times, Abebe was based in Addis Ababa). This staff ‘transition’ had already been discussed with the project leaders (the idea actually originated from Mihret), notably throughout the visit of Bouke in beginning of February. I had already introduced him to both Nigatu and Bereket. Anyway, in April Abebe and I organized an aquaponics training session in Addis Ababa. The primary objective was indeed to train Nigatu. But the aim was bigger: Bereket, Darasa, Abebe and myself wanted to gather altogether, this event would have been the ideal opportunity. They all knew each-other at least by name / function / potential contribution but not necessarily directly: Abebe and Bereket did not know each other directly. So far, I had facilitated the communication between Abebe and the other...
had never met each other. But they were all eager to meet (and/or get to know better) each other in person. In addition, it would have been the opportunity to introduced this newly formed network to Mihret who joined as well. Unfortunately, neither Darasa nor Fikadu could join. It was very difficult to coordinate a date that could fit everyone and not impinge (too much) on the formal obligations of each person. Moreover, since the training was in Addis Abeba, it implied for the people of Hawassa (Darasa, Fikadu, Bereket, Nigatu and I) leaving our “duty station” for at least one full day. Whereas the cooperation between all of us was still at a fully informal stage...

Anyhow, Mihret (SREDP), Bereket (SARI), Nigatu (SARI), Abebe (AAU) and I (WUR/TGS) participated to the training session. Mihret notably discussed with Bereket and Nigatu the terms of employment of the latter. And all together we agreed that we shall put as much effort as possible in making the project in Hawassa a “showcase” of the technology to convince future potential funding bodies. We were all excited about the potential opportunity the A4NH program could offer and we all consent that this seek of funding was deeply necessary and should be research oriented with an explicit link to the field of nutrition.

<table>
<thead>
<tr>
<th>Knowledge infrastructure</th>
<th>Local project leader (SREDP)</th>
<th>Dutch project leader (WUR/TGS)</th>
<th>Technical expert (Abebe Tadesse)</th>
<th>Research and knowledge institutes (SARI/AAU/HU)</th>
<th>A4NH program (Kaleab Baye)</th>
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<td><strong>Knowledge barriers</strong></td>
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<td>Physical infrastructure</td>
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<td>Very little funding available</td>
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<td>Emerging vision and enhancement of informal capacities</td>
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<td>Opportunity for a wider local collaboration</td>
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<td>Market structure</td>
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<td>Market opportunity: High end clients such as hotel, restaurants</td>
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<td>Creation of jobs through aquaponics farming</td>
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**Figure 3.1:** System analysis of the barriers and opportunities to the implementation of aquaponics technology

The figure 3.1 takes as a model the matrix inspired by the system failure framework. It is a personal choice. No workshop was organized, and it was not punctual: it was a complete “go with the flow” venture that I have facilitated and participated actively by gathering and elaborating thoughts together with the aforesaid actors (Darasa, Fikadu, Abebe and Berket). It started when
Darasa and I worked on the poster for the conference. We did not follow the system failure framework, but I have chosen to use the matrix in this essay to present this analysis in a more structured way.

The analysis enabled us to collectively acknowledge the two main barriers I had identified in the previous cycle: knowledge and funding. It also disclosed opportunities that could potentially help breaking these bottlenecks. For instance, we came to realize that the theoretical knowledge needed to maintain an aquaponics ecosystem existed, but was “scattered” among different academic disciplines (aquaculture, horticulture, chemistry…). We saw the integration and “operationalization” of this knowledge as a solution to break this barrier. For this reason, we believed that students could be better target to become future aquaponics farm managers, employees or entrepreneurs. In addition, the Ethiopian government had recently launched a ten billion birr “Youth Fund” to provide financial assistance for youth employment creation. Youth / recent-graduate unemployment was an issue that the government was prioritizing and our line of thinking was going along that. Then the idea upon which further financial support was required to help the technology “mature” was also unanimous. To tackle the funding barrier, as said multiple times previously, we opted for a rapprochement with the nutrition sphere that seemingly attracted the attention of potential funding bodies. In addition, we all came to the conclusion that a strong collaboration was needed: expertise (in nutrition/aquaponics/aquaculture/extension) was scattered and should be better coordinated to tackle these innovation barriers.

Moreover, the project top management (Mihret and Bouke) were totally on board with this new strategy. The ultimate goal of TGS was to make the project self-sustainable. Economically, it was currently impossible. However, this approach was an attempt to make the management, the knowledge and the funding independent from the dutch stakeholders (WUR / TGS) that were going to withdraw from the project (January 2018 / end of WOTRO fundings). Bouke was even mentioning that he would like HU to take over the project. On the side of SREDP, Mihret had realized the complete lack of (aquaponics-relevant) knowledge of his own organization and that “opening up” the project boundaries to new actors and opportunities was strictly necessary.

Along these meetings and brainstorming sessions with Fikadu, Darasa, Abebe and Bereket, we had progressively developed a memorandum of understanding notably embodied in clear interdependent goals to follow:

- Facilitating a functional demonstration site (aquaponics project in Hawassa) though the involvement of Abebe, Bereket and Nigatu with the support of the current top management (Mihret and Bouke)
- Working on a scientific assessment of the (hopefully) positive correlation between the technology implementation and an improved nutritional status of the communities surrounding the current aquaponics infrastructures (mostly the beneficiary households of the current aquaponics project) through the efforts of Hawassa University (Fikadu and Darasa)

If reached, these would demonstrate that we had the capacities together with a readily operational (yet still informal) managerial core (Bereket, Abebe, Fikadu) scattered throughout organizations with complementary expertise: nutrition (HU), aquaponics (AAU) and extension (SARI) to undertake a nutrition safety / aquaponics related research project. This would hopefully enable us to
reach our ultimate goal: launching together a research project on aquaponics capacity building for students. We were aiming notably at the A4NH program, but we also wanted to look for other research funding opportunities. Therefore scouting call for proposals was also part of our strategy, with a deep involvement of Fikadu and Bereket on that side.

Reflection:

community interaction

The ultimate aim of this cycle was to mobilize the individual capacities and facilitate their cooperation towards the aquaponics innovation process. As the quality of the group members interaction is an essential factor of successful collaboration within ICs (Fichter, 2012), it was an essential element to analyze.

First of all, ‘Communication’ was not necessarily direct. As mentioned before, Abebe was not based in Hawassa. I was his ‘privileged’ interlocutor and was in a way bridging the distance gap that made direct communication between him and the other stakeholders difficult. On the other hand, communication between Fikadu, Bereket, Darasa and myself was mostly direct. Our interactions gave a lot of space for sharing personal opinions and reflections and we were not specifically representing our respective organizations and resulting interests: it was overall very informal. And as we were all closely linked to the research/science sphere, the basis of a common language was already established. It seems that these elements facilitated an ‘open’ form of communication, an important factor of group interaction quality (Fichter, 2012).

Then, in term of ‘trust and group climate’, the openness and the informal form of the communication between stakeholders enabled to disclose the personal interests of each of us. I had already investigated that point in the previous cycle, but by multiplying interactions, these interests became more clear and transparent (i.e. openly shared). Bereket – undergoing his PhD on Tilapia stocking density, had clearly stated his excitement in the opportunity of using the training center as a research facility. Concerning Abebe, being part of this initiative was a way to pursue his ‘legacy’. He had put a lot of effort in developing aquaponics in Ethiopia. But he was afraid that any further development in the domain would stop as the current (and insufficient) funding phase out. Fikadu, was willing to explore opportunities for the university students. But also for his staff: he was hoping that the initiative could lead to a PhD opportunity for Darasa and the latter was also very much excited about such a perspective. On my side, I had openly shared with all of them that they were the subjects of my action-research, and that being part of this innovation process was the way to collect my data. These individual interests were mutually compatible, thus not prone to lead to conflict of interests. And I never witnessed signs of individualistic behavior. In addition, these interests were also in a certain way inter-dependent, thus possibly increasing the need for cooperation. I think this transparency and interdependency of individual interests facilitated the development of trust and a positive group climate.

Concerning the ‘coordination’, it was a missing element between the promotors. As a central factor of team cooperation (Fichter, 2012), its lack was a significant weakness. Therefore, I have myself operated the coordination of our initiative through the brokerage activities I conducted. First, by working with Darasa on the poster/concept note for the conference, we actually built what became later a ‘tool’ of alignment with the other actors. Indeed, during this event, we had
‘convinced’ various academics and the A4NH program coordinators. It (formally) legitimized the relevance of (exploring) an explicit link with the field of nutrition. To cope with this new reality, it was necessary to refine the demand articulation of the previous cycle. But this time, collectively and from a holistic perspective (not limited to the Hawassa project). This demand articulation is embodied in the analysis illustrated in fig 3.1. Due to its collective nature and to the scattering and multidisciplinary of our network, I orchestrated what Smits and Kulmann (2004) qualified as ‘interface management’: facilitating the synergy amongst the different actor domains. This ‘boundary work’ was primarily ‘internal’: with the promotors – Abebe, Bereket, Fikadu and Darasa. Then, the interface management was also ‘external’: aiming at enhancing the synergy with external organization/actors, such as TGS (Bouke), SREDP (Mihret) and the A4NH (Kaleab). It also encompassed the demand articulation of these actors. On the one hand the needs of the project organization for the staff transition: their expectations, conditions etc… And on the other hand, the articulation of the strategy of the A4NH program, to give us guidance in attempting a possible affiliation with the program and operationalize the nutrition impact study. This ‘external’ interface management helped us to define tasks in synergy with these external actors. Basically, it is through these demand articulations and this ‘dual’ (i.e. internal / external) interface management that I orchestrated the coordination and the alignment of our initiative.

When I left, we were still in a sort of transition between the initiation and development phases of our initiative. Fikadu and Darasa were still working on a proposal whereas the staff transition was still in process. Thus decisive/tangible turns did not actually take place along the data collection period: our expected outputs were not completed yet, and their outcome could not be witnessed/reflected upon. Nonetheless, we had developed a clear memorandum of understanding concerning what had to be done, by whom and how; which reflected a good ‘balance of contribution’ as defined by Fichter (2012). Overall, I am confident in saying that the interface management I orchestrated greatly facilitated our memorandum of understanding which in turn enabled the somewhat self-organized process of definition/distribution of tasks.

**community identity**

In a formal context, the identity of project teams is established by its formal objectives. But in the case of ICs, as they develop informally, they tend to maintain their informal form. Due to this informal nature, the members of an IC do not have formal obligations to cooperate neither the imperative to remain as a member (Gerybadze 2003). Thus the identity of an IC is not trivial, but nonetheless essential.

Concerning the ‘functional identity’ of an IC, its development relies on a general understanding of its members of the pertinence and purpose of the innovation project (Fichter, 2012). In our case, we shared an intrinsic interest for aquaculture and saw great potential in aquaponics. We wanted to support its implementation in Ethiopia and the rapprochement with the nutrition sphere allowed us to developed a concrete objective: the affiliation with a wider nutrition-related research project (possibly the A4NH). By sharing together our elements of analysis - through the ‘refined’ demand articulation explained above, we also developed a common framework of understanding, notably embodied in a collective framing of the technology: a (potential) nutrition safety ‘solution’. It was also a way of advocating and legitimizing the need for
funding (or program affiliation). Therefore, we had a clear purpose and a common understanding that united us as a group and inferred us with a great ‘functional identity’.

In term of ‘group cohesion’, the feeling of strong cohesive unit was not really existing yet, the network was newly formed (and a bit scattered) thus not very matured. However, it was an intermeshing of friendship relations. Darasa Fikadu and I became very close friends. Bereket and Darasa knew each other for a while already and Abebe and I also became pretty good friends. But there was a strong overall willingness to cooperate.

The group identity is also linked with the ‘clearness of the group boundaries’ (Fichter, 2012). In this case, it is something difficult to elaborate on: it is mostly based on the perception of non-members: it is the ‘outward image’ that reflect the clearness of the boundaries (Fichter, 2012). However, I did not really push the research outside these boundaries.

Anyway, unlike the group interaction, the group identity is not something that can be (strictly speaking) ‘brokered’: the innovation brokerage framework emphasize mostly on aspects of network interaction and composition but does not really tackle matters pertinent to the group identity as defined by Fichter (2012). In this case, the identity building process of our group occurred in a rather self-organized manner. Nonetheless it can be assumed that the enhancement of the ‘group interaction’ can facilitate the emergence of a ‘group identity’. For instance, the functional identity of our group notably emanated from the development of a common framework understanding which itself benefited from the interface management I operated. In other words, it seems that the intervention of an innovation broker can indirectly (and positively) enhance the feeling of a group identity in the context of a research driven IC in Ethiopia.

**community composition**

During the previous cycle, I had ‘designed’ in a certain way the group boundaries. This upstream brokering on the ‘group composition’ had been essential: I can’t see how these actors could have possibly come together on the topic of aquaponics without my intervention. But also, it appeared that it was beneficial to keep this ‘design’ flexible to leave space for the actors to appropriate themselves the initiative and possibly welcome unanticipated actors. For instance, I had not expected such a deep involvement of Darasa, whereas he actually played a major role in the constitution of the community. Through the foresight exercise I conducted in the previous cycle, I had already elaborated (in a speculative manner) on the group composition. I think it infers in a self-explanatory way throughout this cycle that we showed a great ‘completeness and complementarity of skills’ available, thus demonstrating to a certain extent the relevance of this (flexible) network design. And the participation of Fikadu and Darasa became even more relevant in regards the rapprochement with the nutrition sphere. The innovation community is illustrated in fig 3.2 (network of promotors, in red).
Conclusion and closure of the action-research process:

key learning points

The main learning point were that in this context, an IC could actually be brokered. Indeed, I have first envisioned a community composition and then facilitated its enactment, by creating linkages and stimulating interaction among relevant promotors. In other words, I have demonstrated that in the context of the aquaponics innovation process in Hawassa, a group ‘composition’ and ‘interaction’ could be actively (and informally) brokered by an innovation intermediate (in this case myself) to eventually take the form of an IC.

As this cycle corroborated with the conclusion of my field work and my withdrawal as an innovation broker, the question of the ‘reconfiguration capacity’ of the community seemed like the essential element of reflection to provide regarding the community composition.

I had become the coordinating ‘body’ of our initiative and was endorsing both the roles of relationship and process promotors. Each type of promotor behavior is essential within an IC (Fichter, 2012). However, by leaving the field, both process and relationship capacities disappeared simultaneously, without any form of substitution. Indeed, I had not ‘planned’ my withdrawal and
did not take into consideration the unsustainability of my own position. I guess I got a bit ‘carried away’ by this initiative, which blinded me on this point. But also, my intention was to stay until August, however, I suddenly decided to shorten my stay and faced issues renewing my visa. Basically end of May, I was expecting (and expected) to stay until August but eventually left mid-June. Therefore, I did not set up any coordination mechanisms that could facilitate a sort of transition/reconfiguration.

The main scope of IC research focuses on informal networks embedded within wider structures (multi-organizational project, consortium...), where the community comes in support to (and is supported by) a formal structure. Fichter (2012) also stresses that ICs may emerge to work on formal rules when these are missing. But in either cases, the framework insist on the establishment of informal rules of interaction within the community itself. On the other hand, innovation brokerage literature stresses the importance of establishing formal coordination mechanisms (such as formal agreement, contracts...) between network member. It also underlines that the broker himself should take the lead in setting up these arrangements (Klerkx, 2009). In our case, the situation was rather complex: it was an informal initiative without any (or very little) form of formal support. Formalizing this initiative was our objective and was expected through the (potential) granting of research funding or the integration to a ‘greater’ and more structured research program (such as the A4NH program). Thus reaching this objective would necessarily involve the establishment of formal rules of interaction. Signs of formalization appeared, notably with the (expected) employment of Nigatu. But overall, at this stage, there were no rules - either formal or informal, of interaction. As I was in the field, this lack of rules was actually not an issue since I was stimulating myself the members interaction. Anyway, Informal rules may establish organically, throughout time (Fichter, 2012), but the community was not very matured yet. And concerning possible formal rules of interaction, I did not have the capacities to lead their establishment.

The question of whether I left too early is then very legitimate. And I say yes without any doubt. I left with the intuition that the whole initiative would collapsed, and it is more or less what happened afterwards. The community probably did not survive the sudden ‘isolation’ and lack of leadership of the innovation process management. I could have maybe found a way to stay longer, but my position did not benefited from any form of formal support either, which somehow relates in a way to the difficulties inherent to the broker position. As the impact of innovation brokers tend to be difficult to assess (Howell, 2006), it seems evident that it also difficult to legitimize the need of formal support to sustain their position. In addition, I also faced - following Fichter literature (2012), what could be called a clash of ‘identity’: my primary functional identity (being a student) and my ‘tertiary’ functional identity (innovation broker) were not compatible on a long term perspective.
Conclusion:

To conclude this report, it seemed important to do a retrospective - going through the whole action research, elaborating the contribution of my action to the aquaponics innovation process and the main learning points in each cycle, and the relevance of IC theory for enacting an aquaponics innovation process in Hawassa, Ethiopia.

Preliminary assessment and cycle 1:

At the very beginning of the action research process, the aquaponics issue was not a priority in the agenda of the project staff (Mamo/Kassa). They were extremely committed to their position of ‘spiritual leaders’ but not genuinely focused on the aquaponics project related activities. It seemingly resulted in a certain disconnect of the staff with the formally established project objectives / planning and a significant lack of structure of the overall aquaponics project organization. Along the first cycle of the research, we opted with Bouke for a formal structuring of the project organization. And thus the issue at stake was whether the formalization of the project structure would enable a functional form of organizational management of the project. This approach appeared fruitful in setting up a clear organizational structure surrounding the project, it enabled a great integration of Mihret (direct hierarchy with the project staff) and lead to a collaboration of the project staff and myself in a project-team related fashion. The ‘ideal’ case of a balanced formal/informal approach to project management – widely promoted in innovation literature, did not appear to be feasible at this phase of the innovation process. And the absence of self-motivated promotors within the local project sphere made the IC theory a rather impertinent framework of analysis at this stage of the innovation process.

Throughout this phase of the research, my major contributions to the project was the facilitation of the connection between the ‘top’ and the ‘operational’ management of the project, notably by helping the monitoring and evaluation of the project. I also assisted the hierarchies of both TGS and SREDP (i.e. Bouke and Mihret) in the formalization of the project organization, by helping the elaboration of contracts and organizing the launch meeting. The key learning points concerned first a better apprehension of the Ethiopian management ‘ways’: highly formal and inducing rather bureaucratic procedures. It also appeared that when a certain distance (in this case literally) separates the ‘top’ and the ‘operational’ management (i.e. hierarchies → Bouke/Mihret and employees → Mamo/Kassa), first a formal approach is needed to ensure the connection of the operational level with the envisioned formal project objectives. And finally, this cycle also disclosed that the organization directly involved (SREDP/TGS) were not able to provide the knowledge resources needed to operate the technical management of the project.

Cycle 2 and 3:

Throughout the second and third cycle, I judged necessary to take a more pro-active role in the research, using the innovation brokerage theory as a framework to guide facilitation related tasks. The issues at stake were first to identify and then mobilize promotors outside the project boundaries in tackling the knowledge barrier. Throughout the second cycle, by networking within the local academic sphere, I did identified relevant promotors and assessed potential opportunities for collaboration through the facilitation of their demand articulation. I then envisioned a network
design taking into consideration a complementarity of promotor roles: power and expert promotors roles distributed among the individuals I had identified, and envisioning myself as a relationship and process promoter. Throughout the third cycle, I have created linkages among these promotors and worked with Darasa on an approach linking aquaponics explicitly to the nutrition sphere. This collective work became a tool of alignment with the other promotors and eventually led to the emergence of an IC surrounding a new initiative complementing the current aquaponics project.

The mandate of TGS was to investigate the economic feasibility of aquaponics in Hawassa, assuming the technical feasibility of the project. However, the major obstacle to the project success proved to be rather ‘technical’ (knowledge barrier). Seemingly due to this gap between the ground reality and formal expectations, knowledge resources were not adapted to tackle this issue. Thus, in such a context, a well-balanced formal/informal approach to manage the innovation process was anew difficult. In this phase, leaning towards the informal layer of innovation became increasingly necessary due to unfit formal support mechanism – notably in term of (knowledge) resource mobilization. In this regard, IC theory – combined with innovation broker theory, became a very relevant analytical framework, not only as a way to understand reality, but also and above all as a way to ‘shape’ it.

The main learning point were that in this context, an IC could actually be brokered. Indeed, I have first envisioned a community composition and then facilitated its enactment, by creating linkages and stimulating interaction among relevant promotors. In other words, I have demonstrated that in the context of the aquaponics innovation process in Hawassa, a group ‘composition’ and ‘interaction’ could be actively (and informally) brokered by an innovation intermediate (in this case myself) to eventually take the form of an IC.

Contributions of the research to the IC debate:

IC theory as a framework of analysis

IC theory takes as a prerequisite the existence of promotor-type of individuals, to overcome the emerging obstacles that tend to constrain an innovation processes. However the expectation of finding an informal social structure composed of promotors within an existing project can be rather difficult. In this peculiar context, the involvement of the project staff was not only based on their individuals capacities to fulfil the formal project objective. Informal type of criteria, closely linked to ethnic and religious values, played a major role in defining their position as project staff. In other words, great attention was given to some informal aspects of the social structure surrounding the aquaponics project, but these were obviously not directly connected to the aquaponics innovation objectives but rather other objectives of the organisation. Due to unclarity and inconsistencies of the project task, no dynamic focussed team work tended to emerge.

Fichter (2012) elaborates on a certain ‘climate’ that can be considered as a condition to the emergence of an IC. Important elements characterizing such climate are a great distribution and availability of relevant resources, a lack of rigid formal structure and a strong motivation of individuals (Fichter, 2012). But it seems that the Ethiopian management ways - favouring strong formal structures and somehow inducing the establishment of bureaucratic procedures, do not genuinely comply with some of these elements. Participatory structures – known to promote dynamics self-organised group work, are not common in Ethiopia. The fatalist tendency witnessed
seems to induce regular exercise of formal power to secure ‘potential for action’ (in the project, power was exercised by Mihret). In our case, it appears that strong hierarchical structures tend to be a norm, yet ever-present hierarchy may hamper the creative self-organising quality of team interaction (Fichter, 212); which in turn may prevent an IC to emerge. Therefore, it seems to me that the formal management ways in the Ethiopian project context were not really compatible with the IC spirit. Hence, using the IC theory as a framework of analysis in the context of formally executed projects in Ethiopia is in my opinion rather limited in relevance.

**Integration of innovation brokerage and IC theories as a framework of intervention**

Along the second phase of the research (cycle 2 and 3), IC theory gave me directions on a possible way to gain access to the knowledge capacities the project needed: through the establishment of an informal network of promotors. Whereas the brokerage framework guided me on how to identify and mobilize such promotors and orchestrate such a network. As mentioned above, IC theory tends to focus on self-constructing communities, and elaborates extensively on conditional factors that can possibly facilitate the emergence of ICs, In this case, the innovation process matched the personal interests and intrinsic motivation of the promotors I had identified. Then, the initiative we came up with required a wide range of knowledge resources: nutrition and aquaponics. It also required a certain awareness and familiarity with financial resource attribution mechanisms. These resources were evenly distributed throughout our network. And finally, this initiative did not emanate directly from the current project, it was more of a complementary initiative. It was ‘bypassing’ the formal structure of the current project and could be considered as the (very) early stage of an innovation project in itself. It was at this present stage not regulated by any sort of rigid formal (and/or hierarchical) structure. In other words, the innovation ‘climate’ was favourable to the emergence of an IC. However, the IC did not emerged in a self-constructing way: by elaborating on the pro-active building process of an innovation community, I illustrate the contribution of an innovation broker (i.e. myself) to such a process. This approach of combining both IC and innovation brokerage theories together enables to fill what is to my view a gap in the IC framework: it does not really look into the ‘active’ contributions of individuals in the IC building process.

**Concrete contribution to the academic debate on ICs:**

This integration of both IC and innovation broker framework may guide future project managers in paying attention to non formal personal qualities and process strategies needed to stimulate innovation processes, especially in contexts where formal support capacities are not adapted or not yet existing (typically the early stage of an innovation process).

**Suggestions for further research:**

I think a more in depth investigation on the individual contributions of IC members to the IC building process is essential to gain deeper insights on possible ways to stimulate pro-actively the emergence of ICs. With this piece of work, I illustrate my own contribution by elaborating on the innovation broker role I endorsed. This kind of contribution might not be an isolated case: other
networks orchestrated by innovation brokers may take the form of ICs. Thus, further research in this direction may support defensible generalization of the findings of this action-research.

**Difficulties conducting the research and related effect on quality of research findings:**

Conducting this research, a great issue I had to deal with was that the reality on the ground was very different than what we anticipated with TGS. Expecting to work at the value chain level, following a product orientation, I had done extensive upstream literature search on business approach, value chain intervention... However, I had to adapt my position and worked still at the value chain level, but with a ‘technology orientation’. And thus, in term of academic background, I was not very well ‘equipped’ to face the ground reality. These difficulties resulted in a significant lack of structure, thus involving a lot of ‘post-fieldwork’ structuring.

An other significant difficulty I faced was to step back from the relationship I had with the research participants. Indeed, with the action research methodology, the relationships between the participants and the researcher can be very different than in the context of more ‘traditional’ approaches to research. The participants are much more than ‘objects of study’ of the researcher. In this case, the participants and I were colleagues, or even friends. And therefore, the biases inherent to this type of relationship are necessarily deeply embedded within both the research findings and the action undertaken along the fieldwork.
References:


Stapleton, A. (2005). Research as design-design as research.


Annex 1:

Aquaponics system contract – Hawassa Project

Between:
SREDP, so called “provider”

And

.................................................................

Born at ........................................ Lving in .................................

So called “beneficiary”.

The two Parties herewith agree and declare as follows:

A. PURPOSE:

• The purpose of this contract is to provide the terms under which an aquaponics system is provided by the provider to the beneficiary in the NWO project: “Developing a business model for sustainable implementation of small scale aquaponics systems improving food and nutrition security of rural and peri-urban households in Ethiopia”.

B. STATEMENT OF MUTUAL INTERESTS AND BENEFITS:

• To increase nutrition security of rural households in Ethiopia the project aims to increase the production of fish and vegetables while saving scarce natural resources, through the transfer of prototype aquaponics systems to rural and peri-urban households in Ethiopia.

• An aquaponics system is provided to the beneficiary for the purpose of growing fish and vegetables at household level with the aim of increasing the income and food security of the beneficiary. During the first 2 years the aquaponics system and its impact on the livelihood will be studied by the provider.

C. TERMS OF THE CONTRACT:

System use and training
1. The provider will provide aquaponics training and a small scale aquaponics system to the beneficiary.
2. The training and system construction is finalized by the end of September 2016.
3. The provider will visit the beneficiary on a three weekly basis and provide ongoing training and support to help the beneficiary be successful in aquaponics farming.
4. The beneficiary will decide in consultation with the other 7 beneficiaries and the provider about the fish/vegetable combinations that will be maintained throughout the project.
5. The beneficiary will conduct daily maintenance (cleaning, feeding, weeding, harvesting, planting) and keep track of all data using the data sheets as provided by the project.
   1. Filling in the cashbook
   2. Filling the weekly data collection sheets
   3. Filling in the monthly data collection sheets
6. After each cycle period of 6 months, all 8 beneficiaries come together and discuss about the past production cycle. At this meeting the new fish/vegetable combination is decided for the next cycle.
7. Beneficiaries are obligated to attend regular meetings for follow-up, project progress and trainings. Project staff will call for these meetings, but farmers can do so as well if there is a shared need to meet and discuss.
8. For the first cycle the beneficiaries receive fish fingerlings, fish feed and vegetable seeds as a loan. Provided that the beneficiary has performed according to the agreements the loan will be turned into a gift.
9. In the second cycle the beneficiaries receive the fish fingerlings and fish feed as a loan. Provided that the beneficiary has performed according to the agreements the loan will be turned into a gift. The beneficiary has to buy the vegetable seeds himself
10. The third cycle the beneficiary has to buy the fish fingerlings, fish feed and vegetables himself. For this cycle there will be no loans available

**System value and service fees**

11. The value of the system is 24,000 birr
12. The system is the property of the beneficiary as being part of the project. Beneficiaries will have to pay 25% (6000 birr) of the systems value in exchange for training, inputs and all help provided by the project.
13. The down payment for the system is: 1500 birr. The down payment will be subtracted from the 6000 birr.
14. If the beneficiary neglects to take good care of the system or does not comply with the terms in this contract, all support will be suspended and further measures will be taken as decided upon by the local project staff in consultation with the project leaders.

15. If payments are over two months late, the provider will visit the beneficiary and all support will be given to solve production problems. Action mentioned under 12 will be taken.

16. Payment of service fees will differ throughout the project
   1. Downpayment at start: 1500 birr
   2. Cycle 1 (6months): No service fees
   3. Cycle 2 (6months): 300 birr monthly
   4. Cycle 3 (6months): 450 birr monthly
   5. At the end of cycle 3 beneficiaries have payed 6000 birr and are free to use the system to continue running their business

D. DURATION AND TERMINATION

17. After a total payment of 5.200 birr, the aquaponics system is owned by the beneficiary.

18. The training and support that is provided by the provider within the aquaponics project finishes with the project in March 2018.

September 2016, Hawassa, Ethiopia

Signed by

The provider: Mihret Alem
The beneficiary:  

........................................
........................................
Annex 2:

Aquaponics Hawassa
General project outline

September 2016 – March 2018

Sun Rise Ethiopia Development Program
&
TGS business and development initiatives
**Project objectives**

- Aid eight households in running an Aquaponics system as a local business.
- Develop a business model for small-scale Aquaponics farms.
- Performing research that with that will benefit the project and aid the development of possible future projects.

**Project Execution**

**Phase 1 (October 2015 – September 2016)**

1. Build the aquaponics systems
2. Train beneficiaries:
   a. Business and entrepreneurial skills training
   b. Technical training

**Phase 2 (October 2016 – March 2018)**

**Cycle 1 (October 2016 – February 2017):**

1. October 2016: Households discuss together about the plan for the next 3 months:
   a. All households agree on which crops to grow and grow the same crops in the same part of the system (these conditions remain the same throughout the whole project):
      i. The ratio is equal for all (e.g. 300 lettuces and 100 cabbages in the NFT pipe system and 9 plants of Cucumber in the red ash growbed).
      ii. Harvest times can differ slightly according to different growth rates in the systems.
      iii. During theses 3 months several crop cycles can be completed as agreed upon before hand
      iv. 4 weeks before the end of the 3 months period households get together to decide on the next 3 months. Straight after this meeting farmers will prepare their seeds in order to be able to plant as soon as the next period of three months starts.
   b. All households agree on a marketing strategy
      i. Individual or group marketing
      ii. Aid from project staff in reaching the market (e.g. easier to reach high-end market)

2. A start meeting is held before October 15th where households will plant their seeds and learn how to grow them to seedlings (Project staff can decide together whether seedlings will be produced at the Training centre or at the local compounds).
3. As required by staff or households extra meetings/trainings can be conducted. Households can request possible topics that they require extra training upon.
4. For the first cycle the beneficiaries receive fish fingerlings, fish feed and vegetable seeds as a loan. Provided that the beneficiary has performed according to the agreements the loan will be turned into a gift.
5. After 6 months Phase 2 is finished and all produce (fish and vegetables) is harvested.

**Cycle 2 (March 2017 – August 2017)**

1. At the end of January a meeting will be held to decide on the cropping pattern of cycle 2 for the full 6 months. This to allow farmers enough time to grow their seeds to seedlings before the start of cycle 2.
2. In the second cycle the beneficiaries receive the fish fingerlings and fish feed as a loan. Provided that the beneficiary has performed according to the agreements the loan will be turned into a gift. The beneficiary has to buy the vegetable seeds himself from the training centre for the local market value.
3. After 6 months Phase 2 is finished and all produce (fish and vegetables) is harvested.

**Cycle 3 (September 2017 – February 2018)**

1. At the end of July a meeting will be held to decide on the cropping pattern of cycle 3 for the full 6 months to allow farmers enough time to grow their seeds to seedlings before the start of cycle 3.

2. In the third cycle the beneficiary has to buy the fish fingerlings, fish feed and vegetables himself from the training centre. For this cycle there will be no loans available.

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**Research and staff visits**

1. On a weekly basis households keep track of the systems performance:
   a. Filling the data collection sheets weekly columns
   b. Filling the cash flow book
   c. During the first 2 weeks staff will visit all beneficiaries to aid and show them how to keep track of data.

2. On a monthly basis staff and households will fill in the data collection sheets monthly columns together.

3. Staff responsibility:
   a. As written in the contract for each staff member
   b. Staff will visit every beneficiary at least every three weeks.
   c. Whenever beneficiaries want to meet at least one staff member needs to be present.
   d. Staff is final responsible for data collection and will be held responsible if beneficiaries fail in collecting data. When staff visits beneficiaries they will fill the data collection sheet together with the household representative to make sure the data is correct.
   e. Staff will present any issues that arise to TGS or SREDP, depending on the content of the issue.
   f. Staff will take a pro-active role in diagnosing problems and coming up with possible solutions
   g. Staff will aid beneficiaries in marketing their crops and developing the business.
   h. Staff will take care of the research centre and maintain it as a good example to the beneficiaries.

**Project supervision**

1. Project leaders:
   a. TGS
      i. Bouke Kappers
      ii. Klaas Evers
   b. SREDP
      i. Mihret Alem (Director)
      ii. Wondifraw (Project manager)
2. **Local project staff**
   a. Kassa Mamito
   b. Mamo Petros

3. **Link between project leaders and local project staff:**
   a. Local project staff will report to the project leaders on a bi-weekly basis through an email update.
   b. At least every three weeks a skype call will be held between the local project staff and TGS.
   c. From September 2016 – May 2017 TGS will be represented through Jean-Eudes Fournial. Most communication with TGS will take place through him.
   d. Local staff will receive orders from both TGS and SREDP
Annex 3:

Knowledge integration for aquaponics application in Ethiopia:

Promoting healthy diet through aquaponics farming

Authors: Danasa Tamina, Jean-Eudes Fourniaux
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Aquaponics: integrating aquaculture and hydroponics (soil-less farming) to produce both fish and vegetables

Context:
- Diet diversification is necessary
- Water scarcity
- Declining soil fertility
- Necessity to increase employment of newly graduated

Relevance of aquaponics technology:
- Two agricultural commodities produced: promoting dietary diversification
- Applicable in areas facing issues of water scarcity/soil infertility
- Sustainable: use of organic wastes as plant fertilizer
- Need for academic knowledge: employing/training young graduates
- Higher productivity

Aquaponics: a systematic approach

Value chain thinking: Upstream the value chains of aquaponics farming, several options are available:
- Fish fingerling and fish feed can be supplied by external producers (e.g. in Debra Zeit)
- Fish feed component like wheat bran can be available from different flour factories.
- Fish fingerling and fish feed can be self-produced directly at the farm site. This is already practiced at the aquaponics stations of Shoa Robbit and Metehara.
- Other inputs (electricity/water/seeds) are widely available in Ethiopia

Downstream the value chain, it all depends on the purpose of the farm commercial (business), social (NGO), household consumption (small scale).

Implementation/production: As an integrated agricultural technique, aquaponics farming requires more knowledge than traditional agriculture. Water quality, fish behavior and plant health are essential parameters. Therefore, capacity building is necessary (purpose of our research).

Outcomes of aquaponics farming:
- Increased production of (organic) fish and vegetables: diversified healthy dietary intakes of the neighboring community
- Increased income of the producer(s) (household / enterprise / young graduates)
- Job creation

Challenges of aquaponics application in Ethiopia: Lack of expertise / Considerable costs required

Research Project
The implementation of aquaponics farming faces an important challenge: the lack of ‘holistic’ and practical knowledge. We believe that a solution to cope with this implication is to facilitate the knowledge integration of young graduates.

GRQ: How to integrate the knowledge and skills of young graduates for aquaponics application in Ethiopia?

More information on the concept note
The dietary intake of Ethiopians - mainly composed of Cereals/Grains – is mostly monotonous. These diet patterns have a direct impact on the nutritional status of individuals: the national prevalence of stunting among children is 44.4% while the underweight and wasting rates reach respectively 28.7% and 9.7% of the population (CSA, 2011). The Ethiopian government has identified aquaculture as one of the strategic areas of intervention to address the problem of food insecurity and poverty. However, to allow a better dietary diversification, efforts from all agricultural sectors are necessary. For that reason, we believe that developing integrated agriculture and thus increasing the local availability of diverse food products is one of the solutions for Ethiopia.

Aquaponics technology enables to produce both fish and vegetables by integrating aquaculture and hydroponics (soil-less farming) together:

Different scales are possible: from small scale station (example: household level) to big scale farm (example: commercial farm). This technology saves up to 80% of water compared to traditional irrigated agriculture and can be implemented on non-fertile lands as it is a soil-less growing technique. Therefore aquaponics farming is highly suitable to support vulnerable communities facing droughts and/or lacking arable lands in facilitating the local provision of diverse food products.

Upstream the value chain of aquaponics farming, several options are available. Concerning the fish fingerling supply and the fish feed provision, external suppliers can be approached. However, to optimize the self-sustainability of the farm and to facilitate its implementation in remote areas, it is preferable to self-produce those inputs directly near the farm site. This is already practiced at the aquaponics stations of Shoa...
Robbit and Metahara. The only critical input required for aquaponics concerns the external minerals to cope with eventual nutrient deficiency. An agreement between a neighbouring big scale farm can be elaborated to secure such supply (for instance, the aquaponics project in Awassa is collaborating with a nearby flower farm). Otherwise a supplier is available in Zeway. The other inputs (electricity/water/seeds) are widely available in Ethiopia and in the long run, seeds can also be produced on site. Downstream the value chain, the extent of opportunities depends on the purpose of the farm (commercial farm, social farm, household farm...) as well as the location (urban / rural) and the scale of the station itself. One of the challenges of this technology is the considerable cost of installation. However, due to its high productivity the payback time (assuming a business purpose) can be kept under 3 years.

Aquaponics seems to us to be the ideal integrated agricultural technology that matches both the political agenda and the population needs to answer the issue of malnutrition. However, the implementation of this technology faces an important challenge: the lack of “holistic” and practical knowledge. Indeed, aquaponics farming involves knowledge from multiple disciplines: aquaculture, horticulture, fluid mechanics, management, business... We believe that a solution to cope with this implication is to facilitate the knowledge integration and ‘practicalisation’ (from theory to practice) of young graduates from different fields of study. Thus our research project aims at exploring the potential of a multidisciplinary project team composed of young graduates to implement aquaponics farming in Ethiopia.

GRQ: How to integrate the knowledge and skills of young graduates for aquaponics application in Ethiopia?

SRQ1: What is the theoretical knowledge necessary along the different establishment steps of an aquaponics farm?
SRQ2: How can theoretical knowledge be used to answer the practical implication of aquaponics technology?

To answer this research questions, the researchers will lead the establishment of an aquaponics farm by young graduates and follow up their progress through different cycles of action research. They will take into consideration the bottlenecks and strength of the current aquaponics projects in Ethiopia. Special attention will be given to the Metahara farm (AAU project): a large scale station managed by young unemployed.

Steps of the project (farm implementation):

- Farm design
- Farm construction
- Production initiation
- Production sustaining / Marketing

Action research cycles:

The planning and implementation phases of a research cycle will initiate a specific step of the project. The researchers will assess and put in place the resources (project team composition: multidisciplinary knowledge) and facilitate the knowledge transformation (relevant collective training: practical and interdisciplinary knowledge) needed to successfully conduct the project step. Then the researchers will observe the project team conducting the whole step. Finally, they will reflect on theappropriateness of their own actions (planning and implementation) with regard to the team performances (observation phase). This reflection phase will help the researchers to plan and implement the next research cycle (initiation of the next project step).

Along each step of the project, the team members will be invited to use the same type of implementation loop (from planning to reflection). As part of their observation, the researchers will facilitate the reflexion of
the project team on both their own work (leading the project step) and the research items (resources and knowledge transformation). This moment will be crucial for data collection. In case of difficulty in conducting a project step, additional research cycle(s) - which planning would take into consideration the bottlenecks experienced in the previous cycle(s) - would be included.

As the outcome of this research project, we intend to establish a fully functional and sustainable aquaponics farm managed and implemented by young graduates. In addition, the action research will give recommendations on the theoretical knowledge needed along the different implementation steps of such farms and on the ways this knowledge needs to be transformed to successfully implement aquaponics technology in Ethiopia. These recommendations could then be used by NGOs, universities (example: community service) or entrepreneurs to establish aquaponics farms (by employing young graduates) to support the provision of diverse food products and promote diet diversification to vulnerable communities in Ethiopia.