The Modular Business Model Framework

The Development of a Business Model Framework that Preemptively Addresses Commonly-Faced Barriers of Entrepreneurs in Developing Nations and Incorporates Aspects of Sustainability and Circularity for Development - Case Study: Biogas in Ethiopia

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by

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at the Delft University of Technology,
to be defended publicly on March 2, 2021 at 14:30.

Date:	February 24, 2021	
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Preface / Acknowledgements

This thesis project was developed based on an initial request by Kathryn and Max Robinson, founders of the Nicolas Robinson School (NRS), to consider applying my master studies in Sustainable Energy Technology to help them set up a business plan based on reforestation in Mek'ele, Ethiopia. This business plan would act as a carbon offset plan for their political thriller series, Nariko's Voyage. The series describe the journey of a young woman raised in a comfortable home that stands up for action against climate change and saving her planet and all life on it. The film intends to raise awareness about climate change and the effects on animal extinction. Upon further conversations, it was decided that a business plan based on using biogas as an alternative, clean and reliable cooking fuel at the Nicolas Robinson School would be a topic closer to my studies and heart.

Formulating a business plan for biogas at a school in a developing country combines various things that are dear to me. First, it reflects two major components of my studies track (biomass technology and economics & society). Second, in doing so, I get to work on a multi-disciplinary project, which always captures my attention more strongly. Third, I get another opportunity to contribute to the Nicolas Robinson School, a project and business that I have admired and supported for many years. The project took a different route than first anticipated, and unfortunately, due to the covid-19 pandemic and the current struggle in Tigray, I was not able to visit the school and city again, but I hope that I have provided you with something useful nonetheless.

I would like to thank Kathryn and Max, first of all, for bringing this project to my attention, sharing their contacts, and providing me with any information they had available once contact with locals in Mek'ele was no longer possible. I also want to thank my two supervisors, Otto and Linda, for both supporting me and giving me the freedom to set up my own project. They have been invaluable for making it happen and have provided consistent feedback that has allowed me to push the boundaries of my knowledge in regards to business development and social influences thereupon. Digging deeper into both your research fields has been very interesting, and finding a balance of both while applying it to a biomass technology has been a fun challenge.

Similarly, I would like to thank all parties that helped me gather local information and talked to local parties in Mek'ele on my behalf when it was still possible. A warm thanks also to those six candidates that helped me better understand their [Ethiopian] culture by talking openly about it. The hospitable nature of Ethiopians is always very endearing. Further, I would like to extend my gratitude towards Ton van Kampen, Guido de Wit and Dr. David Russell for providing me with valuable feedback on the developed framework within a short period of time. Your insights were both valuable on an academic level for the development of the tool, as well as on a personal level to help me understand what additional aspects are important in the reality of business, such as the aspect of business resilience.

Last but not least, I would like to thank my family and Tom for their (long-distance) support through this process of ups and downs and motivating me when the lack of social contact showed its effect. Tom, you have started your own thesis, and I hope I can return the favor. Additionally, I would like to thank my father for his insights as a business man during our many phone calls that always left me a little bit wiser. Finally, I'd like to thank my brother for his completely unrelated, but always witty texts during this long period with little personal contact. They meant more to me than you know.

"A compromise is the art of dividing a cake in such a way that everyone believes he has the biggest piece."
- Ludwig Erhard

Carmen C. Platteeuw
Delft, February 2021

Foreword

Times of hardship are nothing new to the nation of Ethiopia. However, this past year (2020), with the covid-19 pandemic and the political tension and civil unrest in Tigray, a whole new set of challenges has descended over the nation. While all eyes were turned towards the presidential elections in the United States of America, the sudden escalation of political tension between the region of Tigray and the prime minister's government barely made the news. While the people of Tigray went without electricity, internet or cellular connection for several weeks, the world and media struggled to understand what had happened and why Nobel Peace Prize winner and prime minister, Abiy Ahmed, pursued an approach of military advancement towards his own people.

Working on this thesis project with the intention to set up a business model that introduces a bio-digester in Mek'ele, Tigray, Ethiopia, there was suddenly no more access to local and current information. Even until today (February 12, 2021), getting in contact is difficult and only possible by long distance call. Needing to rethink the project, it actually sparked an idea. The widespread dissemination of the biogas digesters in Ethiopia has been limited despite large-scale projects and efforts such as the National Biogas Programme Ethiopia (NBPE). Being able to give a boost in spreading awareness and knowledge about the technology would be a valuable contribution; and where better to start than in a school where young children get involved and informed of the benefits and challenges of a bio-digester from an early age, and transfer this knowledge to their families? Students at that school will intrinsically better understand how biogas can contribute to their lives and country in the future and what it means to be a bio-digester owner and operator. Even now, during the conflict, it has become clear that grid dependability can be of a disabling nature, much to the regret of those that had invested in electric cooking stoves. Additionally, a bio-digester installed at the school would mean that there is always a reliable and clean cooking source so that the food program and staff café can continue operating without requiring the cooking staff to sacrifice their health by using charcoal stoves.

Unfortunately, for now, the bio-digester will remain a plan for the future. But Ethiopia is a strong country and will not succumb to this set-back that extends further than just politics. They will find their peace again. Until then, we wait in anticipation.

Figure 1: Tigray People Liberation Front (TPLF) fighters and citizens marching on. Artwork at Martyr's Monument Museum Mek'ele, Ethiopia. Photo: own (2014)

Abstract

In Ethiopia, a nation-wide initiative to spread the installation and use of biogas digesters known as the National Biogas Programme Ethiopia (NBPE) was initiated in 2007. However, it has not managed to reach most of its targets over time. Literature suggests a long list of drivers and barriers for the project's limited success, including aspects of management, economics, technology, and culture. Many of the review papers in which these barriers are listed, constituted part of the NBPE's business strategy, but lacked to inspire the desired outcome in improvements. In fact, a move back to the use of traditional fuels was observed.

Biogas produced in a biogas digester from animal manure is a sustainable alternative to direct combustion of traditional fuels with additional health benefits through the removal of indoor air pollution. It is also a circular technology that uses a waste stream (e.g. cow dung) as a resource and produces biogas for cooking and bio-slurry as a liquid fertilizer. This fertilizer is reused to grow crops and fields of grass, which are fed to animals that produces more dung. The technology is not only environmentally attractive, but also fiscally, and in regards to the development of Ethiopia as a nation. Users can save both time and money. Time is saved because women no longer need to gather traditional fuels and tend to the fire, allowing them to increase their productivity and participate in income generating activities. Money is saved due to the savings on fuels (e.g. charcoal or electricity) and fertilizer. These benefits in health, improved income, improved female productivity, and environmental sustainability combine, give the technology the potential to meet most of the MDGs and help develop the nation. Therefore, it is important that such initiatives can overcome these barriers and preferably do so preemptively while setting up the business.

To aid in this, this thesis project examines whether a business model framework can be developed that omits common barriers during the formulation of the business plan. Based on the goals and reasoning of the MDGs, aspects of sustainbility and circularity should be integrated also. Therefore, the following research question is formulated: *How can a business model framework for developing nations be designed so that it preemptively addresses commonly faced barriers of businesses in such nations and includes aspects of sustainability and circularity? Does the developed business model framework for developing nations meet expectations when applied to the case study of biogas in Mek'ele, Ethiopia?* The research is conducted through two main parts. The first part reviews literature on existing business model frameworks and approaches, and on the barriers and drivers that have affected the NBPE and other businesses in developing nations over time. It also elaborates on topics that have been identified as relevant, such as the influence of local culture on business success. The result is a list of criteria that need to be fulfilled for a business model framework specifically developed for entrepreneurs in developing nations. The second part applies these criteria to develop such a business model framework. The framework is tested and evaluated on convenience and usefulness by applying it to the case study of biogas in Mek'ele, Ethiopia.

The resulting framework is a modular approach that uses the well-known Business Model Canvas (BMC) of A. Osterwalder and Y. Pigneur as a basis. The developed framework includes 6 steps, beginning with defining a vision, mission and the underlying assumptions. Step 2 focuses on the validation of assumptions to identify any initial mis-matches between perception and reality. Next, in step 3, the desired modules are identified. The modules reflect the entrepreneur's main goals and their order speak to the entrepreneurs priority, with the highest priority coming first. The modules that have been created in anticipation of the case study are modules *Frugality, Sustainability, Circularity, and Socio-Cultural Aspects)*. Some of the modules have additional components, such as *foresight* and *positive & negative externalities* to identify influential aspects that may affect the business in the future, as well as add future business goals. The additional components add emphasis to where the BMC falls short. In step 4 the BMC is filled in. Step 5 applies the modules to the BMC. The modules are a flexible and dynamic tool and act as an intuitive guide. This gives the entrepreneur the freedom to consider them in a broad brainstorm-like context or use them to dive into detail scenarios; or anything in between. Simultaneously, the modules are a constant reminder of the entrepreneur's goals and priorities, which is especially practical when making difficult decisions or formulating trade-offs. Finally, in step 6, the entrepreneur evaluates the final business model on strengths, weaknesses, opportunities and threats via a SWOT analysis and, if satisfied, sets up a business strategy and evaluation plan. The guidance delivered through the steps and modules allows for even the most inexperienced entrepreneur to use the tool and set up a sound business plan. In addition, the 'broad to narrow' approach allows for a good base

framework and added layers of detail without becoming an overwhelming or too complex process. To test the developed modular framework, it is successfully applied to the case study of introducing biogas at the Nicolas Robinson School in Mek'ele, Ethiopia, even though local information is currently difficult to acquire and local execution is not possible due to the civil war.

Upon reflection, the tool is relatively time consuming, yet the guidance that the various steps deliver is valuable. A review panel with experience in the fields of entrepreneurship (in developing nations) and sustainable business development, assessed the modular framework as a well-argued tool with great potential; highlighting the modules as a clever way to help entrepreneurs in underdeveloped and developing nations navigate commonly faced challenges, as well as their strength to be exchanged for alternative goals and thus their broader application than currently presented. Some points of improvement include limiting the amount of steps as much as possible and presenting the tool in a graphically more appealing way to enhance 'curb-appeal' and reduce any sense of overwhelm. In addition, the modular framework should improve the distinction between vision and mission and emphasize the relationship between mission and business strategy, as well as further emphasize the importance of business resilience in developing nations.

Executive Summary

The main research question of this paper is ***How can a business model framework for developing nations be designed so that it preemptively addresses commonly faced barriers of businesses in such nations and includes aspects of sustainability and circularity? Does the developed business model framework for developing nations meet expectations when applied to the case study of biogas in Mek'ele, Ethiopia?***

To answer this multi-part question, eleven sub-questions are formulated to structurally answer the main research question. In addition, the report can symbolically be split into two parts. The first is a theoretical part based on literature review, desk study and interviews. The research focuses on determining what theory already exists on business model frameworks, specifically in relation to how experts of the field have addressed integrating circularity, sustainability, and entrepreneurship in developing nations. In addition, research is done on finding any previously determined drivers and barriers commonly faced by entrepreneurs in developing nations. To add a level of detail, a specific business endeavor is analyzed and cross-referenced for the barriers determined in more general literature on entrepreneurship in developing nations. The National Biogas Programme Ethiopia (NBPE) is chosen based on its alignment with the knowledge gap. It is a nation-wide program set up with a foreign partner that aims to fulfill several of the Millennium Development Goals (MDGs) to help alleviate poverty by focusing on disseminating a sustainable and circular technology. As one of the barriers was identified as cultural differences, an elaboration is done on Ethiopian culture by means of interviewing Ethiopians living abroad and foreigners working in Ethiopia. A list of cultural differences and how they may affect business is developed. The findings of part one result in a set of criteria that need to be fulfilled when developing a new business model framework specific to developing nations. The second part of the paper, which reflects the practical part of the research paper starts by developing a business model framework for developing nations, based on the criteria established in the first part, that preemptively addresses commonly-faced barriers of entrepreneurs in developing nations and incorporates the aspects of sustainability and circularity. Next, the case study is completed with the aim to demonstrate the use of the developed framework. It starts with an elaboration and evaluation on how biogas aids in alleviating poverty in a developing nation such as Ethiopia, by means of an assessment based on the MDGs. The case study then continues with the application of the developed business model framework to the business idea of biogas at the Nicolas Robinson School (NRS) in Mek'ele, Ethiopia. A rough business model with a financial overview is set up. There is potential to turn this business idea into a profitable business. Finally, the developed business model framework is evaluated by a 'review panel' of experts based on expected handling, meeting expectations, and potential for general application in developing nations.

To properly research and report on the various business model frameworks, a distinction in terminology is necessary. A Business Model Framework (BMF) is like a canvas or template that can be filled in to help an entrepreneur set up his business model, which is the actual business description / plan. A business model approach, or method, is similar to a BMF, but includes a description of steps and often includes an analysis of sorts.

The research on (sustainable and circular) business model frameworks for developing nations resulted in a large amount of findings in sustainable and/or circular business model frameworks and almost none, except for perhaps the Frugal Business Model Canvas (FBMC), in business model frameworks for developing nations. Five BMFs and seven business model approaches with a sustainable and/or circular focus, and one BMF and one business model approach with a link to developing nations were reviewed. Additionally, the Business Model Canvas (BMC) by A. Osterwalder and Y. Pigneur was reviewed as it formed the basis for most of the reviewed frameworks. The main limitations of the various concepts included not integrating the aspects of society and the influence of culture, not considering fore-sight and the effects of the future, and no clear link to the development of a business strategy. The limitations were translated into criteria. The full list can be found under section 3.3. Next, the known drivers and barriers of the National Biogas Programme Ethiopia (NBPE) are reviewed. The report discusses technical, political / institutional, economic, social and environmental drivers and barriers, which again were translated into a set of criteria. Some are: that the customer's need or want must be validated before a business is set up, that the delivered product must suit local conditions, that cultural habits should be respected and considered before setting up a business, etc. To be

able to generalize for the development of a framework for all developing nations, the drivers, barriers, and criteria from the NBPE are cross-referenced with literature that discusses common drivers and barriers for businesses in developing regions of the global South. Additionally, because cultural differences have been determined as a barrier, and in preparation of the case study in later chapters, interviews are conducted with Ethiopians living abroad and foreigners working in Ethiopia, to establish cultural differences that are noticeable when doing business with Ethiopians. Again, a list of criteria to consider is established. This final list is more detailed (section 4.3.4) and includes points like the different styles of time management, limitations in linguistic skills, potential barriers due to traditional hierarchies or vertical networks, etc. These four lists are bundled and cross-referenced with each other to create a final list in section 5 in table 5.1. Criteria resulting from the cultural evaluation have only been included if they have been mentioned in one of the other lists so that the criteria are applicable to developing nations in general. This does not make the list resulting from the cultural evaluation redundant, since understanding local culture and integrating cultural habits is a key criteria. The list of cultural differences / aspects enables meeting this criteria when working on the case study in part 2.

Based on a common piece of feedback found on BMFs in the reviewed papers - *it is too complex / overwhelming* - and a desire to create a framework that can be used by almost any level of experience and skill, the constructed framework is modular. It follows a path from broad and clear to added layers of depth and complexity. The entrepreneur working through the layers is in complete control on how in-depth he/she works out the various modules. To make the framework understandable by all, it has steps that can be followed and is therefore essentially a business model approach and business model framework in one. The six steps are: 1) Define the Vision, Mission and Assumptions, 2) Set up an Assumption Validation Strategy, 3) Define the Applicable Modules, 4) Fill in the Business Model Canvas by A. Osterwalder and Y. Pigneur, 5) Apply the Modules to the Business Model Canvas, 6) Complete a SWOT Analysis for a Business Strategy and Evaluation Plan. The modules are chosen based on the entrepreneur's major goals and given priority by the orderin them from highest priority to lowest priority. The entrepreneur is allowed to work through these modules as detailed as he/she wishes and may move back and forth between the modules to work out various scenarios that will help determine the best one before moving on to a final evaluation of the business model and the development of a business strategy and evaluation plan.

Before applying the modular framework and to introduce the case study, an additional evaluation is completed to demonstrate the significance of a sustainable and circular technology like biogas produced in a bio-digester for the development of a nation. The assessment is done based on the Millennium Development Goalss. Since 2016 this package of goals has been extended into the Sustainable Development Goals, but since the original NBPE was set up based on some spear points of the MDGss, the evaluation is based on the MDGs. In both direct and indirect paths, all eight Millennium Development Goalss are catered to, thereby reducing hunger, poverty and child mortality, and stimulating gender equality and female empowerment, education, improved health, environmental sustainability, and global partnerships. These goals represent the change that needs to happen to achieve a healthy and basic standard of living. That a simple technology like a bio-digester can make an impact in these areas, proves that developing a business model framework for developing nations that includes aspects of sustainability and stimulate a circular economy, is an important and relevant topic. Next, the modular framework is tested by applying it to the business idea of introducing biogas in Mek'ele, Ethiopia. Unfortunately, local political tensions resulted in a civil war with electric power and internet connections being cut off (November 2020). To this moment (February 2021), contact via internet has not been possible, limiting the amount of first-hand data. Fortunately, the founders of the Nicolas Robinson School, from whom this project idea originates, live in Europe and have shared any local information possible. The business model that is set up, introduces a bio-digester on the Nicolas Robinson School campus grounds to produce enough biogas to provide clean cooking at the school, resolving being dependent on an unstable electric grid and the use of unhealthy charcoal stoves. The business model has the potential to be profitable, if transportation costs are internalized. The various modules explore additional alternatives to the business model that should be considered and worked out in financial terms if the business is to be implemented in real life.

Upon reflection, the author was pleased with the general concept and application of the framework since the modules are an intuitive guide through the process. In addition, although the modules sometimes inspire ideas that will contradict one or more of the goals the entrepreneur has set for him-/herself, the order of the modules is a constant reminder of the priorities the entrepreneur has set. The review panel of experts agreed that the developed modular framework has the potential to be a valuable tool, especially in regards to

entrepreneurs in developing or underdeveloped nations, but also because it can be applied more broadly if other modules are created. In their review, they state that the modular framework aids entrepreneurs navigate the commonly encountered challenges inherent to such nations, such as possible supply chain disruptions, changes in political setting, etc. and includes the very important component of foresight.

As points of improvement, the author suggests some small adjustments in the the steps (integrate step 3 with step 5), some additional emphasis on creating a financial overview of the business idea after filling in the business model canvas, and some improvements in the visual presentation of the framework. The review panel adds that the framework could be made more clear by restating the framework in lesser steps. In addition, they recommend adding tips on how to build business resilience specifically in the setting of underdeveloped and developing nations. Finally, the module of Socio-Cultural Aspects should be adjusted slightly since it is fairly specific to (East) Africa. It should therefore either be broadened to be applicable in any developing nation, or made more specific and labeled accordingly.

These points of improvement should be considered in future research. Additionally, it is recommended to create various additional modules for specific development regions so that the framework can be used globally. Perhaps most important of all, however, is that the modular framework should be tested in real life; for example, by completing the business plan described in chapter 7 with local and current knowledge and executing the business to evaluate any components or issues the framework failed to address. Any additional findings could then be added to the framework.

All in all, the modular framework developed in chapter 6 allows commonly-faced barriers to be addressed preemptively by entrepreneurs in developing nations, while also incorporating aspects of sustainability and circularity. In addition, due to the modular approach, the entrepreneur is not limited to the modules developed in this thesis project (i.e. modules sustainability, frugality, circularity and socio-cultural aspects). New modules can be developed and applied, allowing the framework to be aused in a broader context than presented in this thesis project. Furthermore, the modules and the order they are applied in, reflect the entrepreneur's targets and their priority, which can aid the entrepreneur whilst making decisions and trade-offs. In addition, the entrepreneur is in control of how detailed the modules are applied. Although there are some points of improvement for the modular framework, it is a well-argued concept with a large potential to serve almost any entrepreneur.

List of Abbreviations

3R Reuse, Remanufacturing and Recycling.

BCE Biogas Construction Enterprise.

BMA Business Model Approach.

BMC Business Model Canvas.

BMF Business Model Framework.

BOP Bottom of Pyramid.

CBM Circular Business Model.

CBMC Circular Business Model Canvas.

CERs Certificate for the Emission Reductions.

DGIS Directorate-General for International Cooperation.

EBMC Extended Business Model Canvas.

EREDPC Ethiopian Rural Energy Promotion and Development Centre.

FBMC Frugal Business Model Canvas.

FGM Female Genital Mutilation.

KMG Kembatti Mentti Gezzima-Tope.

LCA Life Cycle Analysis.

MBMF Modular Business Model Framework.

MDGs Millennium Development Goals.

MEA Mines and Energy Agencies.

MFA Mass Flow Analysis.

MVP Minimum Viable Product.

NBPCO National Biogas Programme Coordination Offices.

NBPE National Biogas Programme Ethiopia.

NRS Nicolas Robinson School.

PASDEP Plan for Accelerated and Sustained Development to End Poverty.

PSS Product-Service System.

R4C Rainbows4Children.

RBPCO Regional Biogas Programme Coordination Offices.

REA Rapid Environmental Assessment.

SBM Sustainable Business Model.

SDGs Sustainable Development Goals.

SNNP The Southern Nations, Nationalities and People's region.

SNV Stichting Nederlandse Vrijwilligers.

SWOT strengths, weaknesses, opportunities and threats.

TDVA Tigray Disabled Veteran's Association.

TLBMC Triple Layer Business Model Canvas.

Contents

1

Introduction

This chapter discusses the background, setting and motivation behind this project to introduce and identify the knowledge gap that is addressed in this report. From the knowledge gap, the research question is derived, followed by an elaboration on the scientific and practical contribution of this thesis project.

1.1. Background

1.1.1. Developing Nations and the Millennium Development Goals- An Overview

A developing nation, as defined by the dictionary, is "a nation where the average income is much lower than in industrial nations, where the economy relies on a few export crops, and where farming is conducted by primitive methods. In many developing nations, rapid population growth threatens the supply of food. Developing nations have also been called underdeveloped nations. Most of them are in Africa, Asia, and Latin America" [1]. One often speaks of the Third World when referring to these nations. The Third World refers to the underdeveloped nations of the world that have widespread poverty and no alignment with the policies of the United States of America or the former Soviet Union [2]. The word 'World' indicates the vast amount of people living in extreme poverty. The preliminary estimate from the World Bank puts the number of people living in extreme poverty[1] in 2020 at 703-729 million people [3], which is 9.5% of the world's population and an increase from previous years, mainly as a result of the covid-19 pandemic [3]. However, while most underdeveloped countries show a decreasing trend of people living in extreme poverty, those in Sub-Saharan Africa show an increasing trend [4]. In fact, up to 42% of the population in Sub-Saharan Africa live in extreme poverty [5] and 27 out of 28 of the world's poorest nations are in Sub-Saharan Africa [6]. In addition, almost half of the people in Sub-Saharan Africa living in extreme poverty can be found in just five countries: Nigeria, the Democratic Republic of Congo, Tanzania, Ethiopia, and Madagascar [3].

Why certain countries have fallen into poverty or remain in poverty is heavily debated, but a common denominator of these nations is that they are often "small, fragile and conflict-affected countries" [5]. Other factors that are considered influential include politics, natural resource endowments, geography, history, culture, geo-politics, debts, economic policies, etc. [7]. Poverty is not purely financial, however, it is also social, educational, health-related and environmental [6]. It is reflected in the lack of freedom, of equal rights, of energy access, of property ownership, and of inclusiveness in decision-making, and in the levels of hunger, illiteracy, child mortality, and land health (erosion and productivity) [5, 6]. Because charitable financial development aid had regularly proven counter-productive [8] and poverty was being considered more 'holistically', the UN identified the 8 most important areas to work on alleviating poverty and formulated the Millennium Development Goals (MDGs) as a guide for both charitable / non-profit organizations and governments of such nations. The goals are based on improving areas of hunger, education, gender equality, child mortality, maternal health, disease combat, environmental sustainability and global partnerships. The goals were reviewed in 2015 to become more specific and include more aspects on sustainability and were renamed the Sustainable Development Goals (SDGs). They additionally include clean water, clean energy, economic growth, resilient infrastructure, sustainable cities and communities, responsible consumption, climate action, life underwater, life on land, and peace & justice [9]. The transition from charitable aid to sustainable

[1] The globally recognized threshold for the extreme poverty line lies at an income of $1.90 per day (9.2%, 2017). Other lines lay at $3.20 per day (24.1%, 2017) and $5.50 per day (43.6%, 2017) [3].

development is important because the latter allows nations to continue their development based on the good example they received, long after the aid-providing party has left. The classic proverb "*Give a man a fish and you feed him for a day; teach a man to fish and you feed him for a lifetime*" applies.

However, even though several nations have tried to incorporate the Millennium Development Goals in their policies or in nation-wide programs, their countries are only seeing small progress. An example that is analysed in more depth in this thesis project is the National Biogas Programme Ethiopia (NBPE) which is a nation-wide program to introduce and install bio-digesters that allow for the production of biogas and organic fertilizer. The program was set up in collaboration with a Dutch development organization, Stichting Nederlandse Vrijwilligers (SNV). Currently, the European Union is also a partner. The reason this program was set up was because the technology is simple, yet provides a large array of benefits. For example, biogas is a clean cooking alternative to traditional biomass fuels. The use of biogas as a cooking fuel reduces both the use of traditional biomass and deforestation, as well as improves female, child and elderly health (most afflicted due to their role or residence in cooking areas). Not being required to spend time on gathering biomass (wood, dung, charcoal, etc.), women and girls have more time to spend productively, increasing their opportunities to work, earn, and grow independence, thus stimulating female empowerment and gender equality. Since the resource of these installations is cow dung, the amount of released greenhouse gases is reduced, and a circular process improves the use of the cow dung. Since the installations need to be constructed and maintenance, the government hoped the wide-spread dissemination would improve free market and private sector development. To successfully implement and maintain the program, national and regional bodies were established for governance, and a 5-year evaluation plan was set up. Hereby, many of the MDGs would be fulfilled. Unfortunately, the program has not reached any of its targets so far, despite regular reevaluation, and dissemination is slower than anticipated. An elaboration on the NBPE, its drivers and barriers, and how biogas relates to the MDGs, can be found in section 4.1.1, 4.1, and 7.1, respectively.

The reason the National Biogas Programme Ethiopia is chosen as the exemplary initiative in this thesis project is because, first of all, it is a nation in Sub-Saharan Africa with one of the larger amounts of people living in extreme poverty. Second, it is an ambitious nation, compared to others in the region, in terms of stimulating economic growth. Furthermore, it is a great example of a national program with great potential to stimulate development and alleviate poverty in various areas of life, yet has not been as successful as anticipated despite efforts to improve. Finally, it is a nation for which data acquisition from abroad is possible through personal contacts of the author and the involvement of the SNV, which is based in the Netherlands. For further background on Ethiopia as a developing nation, the energy scenario in Ethiopia, and how biomass re-purposed can become a clean source of energy, see sub-sections 1.1.2, 1.1.3, and 1.1.4, respectively.

1.1.2. Ethiopia as a Developing Country

Ethiopia is a developing nation in East Africa with an estimated 114.964 million inhabitants (2020 estimate [10]). After the Ethiopian Civil War (1974-1991) and the Eritrean-Ethiopian War (1998-2000), Ethiopia became a landlocked nation with a need to rebuild and develop most of the country. As such, it has been using Djibouti's ports for the last two decades and set a goal to resume using the international ports in Eritrea, a former part of the country [11]. As one of the poorest countries in the region, with a GDP of $1066 (2020 estimate [12]), the country has been determined to become the fastest growing economy in the region [11]. The targets are described by the 2nd phase Growth and Transformation Plan (GTP II – 2019/20): have a lower-middle income status by 2025, 20% average industrial growth, 11% average GDP growth annually, steady increase in job creation and a reduction of poverty [11][13]. With a strategic location close to the Middle Eastern markets and large public investments in infrastructure to stimulate economic growth [14], the country has reached 9.9% average economic growth between 2007/08 and 2017/18 (7.7% GDP growth in 2017/18); the surrounding regions average 5.4% average economic growth [11]. The largest contributors to this growth were the construction and service industry, followed by the agricultural and manufacturing sectors [11][13]. With a demand-side growth increasing and a clear trend in poverty reduction[2] in both rural and urban areas [11], the country is on its way to reaching its targets.

However, this growth does not come unchallenged. Sustaining growth, accelerating poverty reduction, creating jobs, improving governance, limiting political disruptions, developing the private sector, increasing trade and market competitiveness, and increasing manufacturing and exports are the main challenges the country faces. All need to be addressed to reach the set targets and stimulate (foreign) investment in the country [11]). Besides formulating target growth plans, the government is also investing a large amount of its

[2] Population living below the national poverty line reduction trend: 30% (2011) to 24% (2016) [11].

budget into pro-poor programs[3] and industrial parks to sustain Ethiopia's growth momentum [11].

Historically, the country has always been strong and independent. It succeeded in evading occupation by Europeans, unlike most African nations, but has not been free of hardship. Over the past 150 years, the country has seen many leaders, both good and bad. At the end of the 19th century, after fighting off the Italians and becoming an independent state, Emperor Menelik II rules. In 1930, Emperor Haile Selassie I succeeds him, but is dethroned by the Italians during World War II, and reinstated by the Allies in 1941. He ruled until 1974, after which he was overthrown during a military coup, placing General Terefi Benti in power, starting the civil war. The general was assassinated only three years thereafter and replaced by Colonel Mengistu Haile Mariam - a Marxist dictator. For two years his reign was known as "The Red Terror", killing thousands that opposed him, but also defending Ethiopia from Somali invasion. In 1987, he was elected president. From hereon tension within Ethiopia and with neighboring Eritrea started to build. Being unhappy with the reign of Mengistu, he was ousted by the Ethiopian People's Revolutionary Democratic Front in 1991, known as the fall of the Derg, ending the civil war that started in the 70s. Eritrea declared formal independence soon thereafter in 1993; an unsupported decision amongst many Ethiopians. 5 years later, tensions erupted, leading to the Ethiopia-Eritrean war. By 2000, the countries have a peace treaty, but tensions still exist. In 1995, Ethiopia had elected its first parliament, prime minister and president. With some ups and downs over the years, the country found a certain stability in which it could expand economically. However, what was often overlooked is that most leaders came from the Northern region of Tigray; an area representing only 5-6% of the population. With the election of Abiy Ahmed in 2018, the first Oromo prime minister was elected. Upon being elected, he worked on his relationship with the prime minister or Eritrea to restore their former relation and secure sea ports for use. He received the Nobel Peace Prize for these accomplishments and officially ending the war with Eritrea. Although this was considered great leadership, even in the Northern region of Tigray (family members could now freely visit family in Eritrea), his next step to reshuffle the government and remove most Tigrayans holding office caused new tensions between the North and the rest of the country. Together with his nationalist approach, this made Tigrayans outsiders and a minority. With the arrival of covid-19, Abiy Ahmed forbade elections for new government officials. The North disregarded this order and held elections anyway and argued that he was no longer the rightful leader because he was unwilling to make way for a newly elected leader. This made tensions overflow and after a provocation - it is unclear which 'side' did it - military force was used against the city of Mek'ele, Tigray, Ethiopia, followed by a period of incomplete information and unclarity because the media is being refused and the internet, electricity and telephone lines have been shut down. There were many casualties and within three weeks 40,000 refugees have been counted at the Sudanese border. The amount of refugees is expected to increase to 200,000 in the coming months [15].

For Ethiopia this is a set-back in many ways. The incident occurred mid-harvest. Also, in cities such as Mek'ele, people are dependent on electricity for bank payments and money withdrawals to pay for food, along with other general comforts such as refrigeration, radio and other communication methods [16]. For some families, it means not being able to cook. In relation to this project, it means that direct data acquisition via local contacts was no longer possible after November 4, 2020.

1.1.3. Ethiopia's Energy Scenario

In terms of energy, the country relies heavily on hydropower [13]. With plans to increase capacity to 13.5 GW by 2040, Ethiopia would become the second-largest hydropower producer in Africa (IEA 2019). The country also has plans to provide electricity access to all by 2030. Momentarily, only around 45% of the population has access to electricity (data from 2018 [13]). The country, however, faces geopolitical disputes over the construction of the Grand Ethiopian Renaissance Dam (GERD) with Egypt and Sudan, who rely on the Blue Nile's water supply for their own industry. The Egyptian media has presented the dispute as a proxy war for Qatar, Turkey and Iran. Meanwhile, Israel is being accused of supporting Ethiopia through technology and military aid to secure the dam [17]. Therefore, although the dam was built with grand intentions to make a leap in energy security, this project is at risk for being known as the project that changed way of life along the Nile and being an example of mismanagement and continuing blunders [18].

The country has plans to include wind, solar and geothermal in the energy mix [13]. Biomass is a disputed topic due to the vast deforestation that has occurred over the past 60-70 years [16] due to the traditional use of biomass in cooking [13]. Momentarily (2018 data), 93% of the population uses traditional, non-electric sources: charcoal (8%), traditional biomass(84%), and coal and kerosene (1%). Expectations for 2030 are

[3] Pro-poor programs are programs that target and include the poor specifically to alleviate poverty.

that the overall percentage will still be around 67% [13]. Additional benefits of moving away from traditional fuels to cooking with gas or electricity are not only environmentally motivated, but also medically, as it is a major cause of respiratory diseases [19][20]. However, if managed correctly, reforestation programs and smart forest management could lead to a stable and sustainable supply of biomass [21][22]. The country has put policies in place to support and finance reforestation projects [23].

This is a very optimistic outlook, but concerns exist for the consequences of creating welfare. For example, a fourfold increase of private vehicles is expected, increasing related oil consumption by 300%. In addition, with large projects in infrastructure and construction, the production of cement is increasing energy demand significantly [13]. An increased dependency on large fossil fuel imports could increase geopolitical disputes, open the door for political extortion, or lead to a trade deficit that could lead to increased monetary devaluation and a loss of built welfare [24][25][26] [4]. Fortunately, "a high degree of dependency on imported fuels [...] and a range of infrastructure development challenges underline the case for the development of hydropower and other renewables" [13][14]. In addition, R. Fouquet argues that "the speed of uptake of new technologies and energy transitions is influenced by the rise in demand for energy services", suggesting that economic growth (i.e. high income elasticities and rising incomes) is a catalyst for the energy transition [27]. The IEA further argues that introducing efficiency standards would help supply energy to a much larger economy [13]. However, for now, the country still relies on imports of oil and coal. The IEA recommends building on the excellent hydro resource and developing the somewhat limited natural gas reserves while accelerating electrification [13]. Currently, however, electricity is highly subsidized, which puts the nation in greater debt and stimulates currency devaluation [28]. It also influences normal market and sustainable development negatively to an extent because, although meant well, it acts as a barrier due to the minimized amount of savings when exploring market opportunities or alternative sustainable energy sources, such as initiatives that introduce biogas as an energy source (see section 7.7.1 for an example).

1.1.4. A New Role for the Use of Biomass

The main challenge of renewables often remains: "rethinking" (i.e. changing mindsets). Dr. Liborio F. Nanni wrote in CEO Worldwide Expert File: "companies are made of people, and if people don't understand the game they're playing, they will lose". Understanding and grasping the concept of a kilo-watt-hour is difficult; linking it to something tangible makes understanding easier and chance of success larger [29]. Therefore, being able to use a method/source the population is familiar with – biomass – may have its benefits.

Biomass has a large variety of applications that can benefit many sectors. It can be converted to biogas or a biofuel, demonstrating substantial potential for natural gas grids, alternative electricity or hydrogen production, and substituting fossil fuels in various applications [30][21][31]. It can also be used as a chemical building block or platform chemical in various production procedures, supporting the movement of green chemistry [32]. In addition, as biomass has both the options for direct use and storage, it can serve as a grid balancing energy source in both the short and long-term [30]. Biomass has its critics, however. An example is Michael Moore, who produced the documentary Planet of the Humans. Others are P. Moriarty and D. Honnery in their paper *Can renewable energy power the future?* [33]. They discuss issues of renewable energies, including bio-energy, which are often overlooked, such as gross over-estimation of yield and geographical potential [33]. Issues of scale and transition time, that are often ignored in the discussion of any renewable energy source, are discussed by V. Smil in [31].

In Ethiopia, biomass has long played a role as a source for cooking fuel. Momentarily, the majority of the population still depends on burning various forms of biomass for cooking. However, this has depleted overall forest coverage to a bare minimum, with all the related consequences (i.e. soil erosion, etc.), making it difficult to sustain this trend. Because wood is difficult to come by and coal is expensive, many families have turned to drying and burning animal dung [16]. Burning any of these is extremely bad for the user's health. Deaths due to indoor air pollution account for 3.8 million premature deaths a year on a global scale [20]. In Ethiopia, an estimated 70,000 die of indoor air pollution, affecting mostly women, young children and elderly people [34]. However, used correctly, dung is a fantastic and clean fuel. In a biodigester, dung mixed with water will break down via anaerobic digestion, releasing biogas and creating a side product known as bio-slurry [32]. The biogas can be used for clean lighting and cooking and the bio-slurry can be used as fertilizer, making it a circular technology also. Tests and observations have shown that the bio-slurry is a more effective fertilizer than the chemical alternative, and being of organic origin, it also saves indirect environmental pollution from chemical fertilizers [34–37]. Being able to have lighting and cook on biogas has the additional

[4] With the installation of renewables, geopolitical disputes don't necessarily all disappear. They may also transform into new or adapted disputes [25].

benefit of becoming independent from the unstable national electricity grid, which is plagued by regular shortages [16, 38] and cut-offs for political reasons, as is the case now with the Tigray conflict [16, 39, 40]. Biogas is not new to Ethiopia. On the contrary; it was already introduced in 1979 [41]. Over a period of 25 years, 1000 biogas plants had been installed, but ca. 40% were non-functional by the end of that period (ca. 2004) NBPE [41]. With depleting resources for cooking, and an increased amount of time and money spent on collecting and buying fuel, respectively, poverty was being stimulated, rather than relieved, spiking renewed interest in biogas [16, 41]. This led to the creation of the National Biogas Programme Ethiopia (NBPE) in 2007. The technology of biogas fit well within the country's Plan for Accelerated and Sustained Development to End Poverty (PASDEP), environmental sustainability plans [35], and Millenium Development Goals (MDG 4: reducing child mortality; MDG 5: improve maternal health) [34]. This large scale, national project with international support has continued to exist with various phases in which the plan was reviewed and adapted, and although the overall project has been handled professionally, it has rarely met any of its targets and functionality rates are still not what they should be. The NBPE is discussed in more detail in section 4.1.1.

1.2. Problem Statement

The United Nations identified 8 areas that, when improved, can alleviate poverty in developing nations and improve their overall welfare [9]. These 8 areas became the Millennium Development Goals (MDGs). In 2015, these goals were extended to include aspects of sustainability and circularity that aid in nation development in more detail. The list was extended to include 17 areas, and they were called the Sustainable Development Goals (SDGs). Several developing nations, such as Ethiopia, have embraced this recommendation and set up nation-wide programs that aim to fulfill these targets. One of these programs is the NBPE. This program was set up together with an international partner, the Stichting Nederlandse Vrijwilligers (SNV), with various of the MDGs in mind [41]. However, after 13 years, the program has still not reached its targets despite regular review, evaluation and adjustment of the program. Therefore, the question remains: why is this the case and is there a way that could have altered the outcome or prevented certain barriers?

In literature, several common factors that can cause the failure of a project in a developing nation include, among others, a sudden or non-strategically planned exit of the benefactor, a lack of ownership, lack of stakeholder alignment, non-commitment, and corruption [42, 43]. However, the NBPE still has its benefactor, including a new one: the European Union. It displays good leadership through various national and regional governing bodies and by delegating work and ownership to stakeholders and investors. There is also a relatively clear role division amongst the governing and acting parties although sources state some misalignment among stakeholders [43]. The program and Ethiopian government seem committed, however, through their continuous perseverance, subsidies to increase affordability, and expanding activities and evaluation reports over the past 13 years. Furthermore, there are no openly stated reports on corruption, although this is difficult to identify from the outside. From these few factors, it seems that the program is relatively well-built, but clearly leaves room for improvement [44]. To identify areas of improvement and try and address them ahead of time in similar endeavors in the future, both the drivers and barriers of this program should be reviewed, as well as commonly identified barriers for foreign endeavors in developing nations and business model frameworks that can be used to set up such endeavors.

The evaluation reports and adjacent literature suggest a long list of technical, political / institutional, economic, social and environmental drivers and barriers of the NBPE, which are elaborated in section 4.1. For commonly encountered barriers of foreign endeavors in developing nations, relevant, although limited literature can be found. There are also a seemingly endless amount of business model frameworks, business model development methods and approaches that could be applied to endeavors such as biogas that consider both sustainability and circular aspects. Literature on business model development for endeavors in developing nations is almost non-existent, for example. This means that there is no business model framework that caters to entrepreneurs wishing to develop a business in a developing nation. Because the MDGs and the SDGs emphasize the importance of integrating sustainability and circularity to help alleviate poverty, a business model framework for developing nations should also include the principles of sustainability and circularity to inherently include these aspects in the business and thus help development, whether intended or not. This thesis project aims to address this problem by developing a business model framework for developing nations that preemptively addresses barriers common to (foreign) businesses in developing nations and includes principles of sustainability and circularity to indirectly strive to meet the MDGs and SDGs.

1.2.1. Knowledge Gap

To determine the knowledge gap, the amount of available related literature is reviewed. The relevant literature was identified as literature on drivers and barriers of the National Biogas Programme Ethiopia (NBPE), common barriers for entrepreneurs in developing nations, and business model frameworks / methods relating to sustainability, circularity and developing nations. For the literature research conducted, Google Scholar and Science Direct were used as the main research media. Results from the year 2010 onward were included in the search to limit the amount of outdated information. The University of Technology Delft repository was consulted at times also.

For literature on drivers and barriers of the NBPE, common barriers for entrepreneurs in developing nations, and business model frameworks / methods relating to sustainability and circularity, there was an abundance of literature to be reviewed in all three research media.

The search on a business model framework that was designed specifically for developing nations, however, produced a limited amount of specific results; usually only related subjects were found, but no results that addressed the specific problem statement. In the initial search, the terms *business framework* AND *developing nation* were used. Science Direct delivered 7 results, but none were specific to the search terms. Adjusting the search terms to *business model framework* AND *developing nation* and *business model canvas* AND *developing nation* both delivered 5 results. None were specific frameworks for developing nations. Adjusting the terms to *business model framework* AND *low-income economies*, resulted in zero results, same as *business model canvas* AND *low-income economies*. Google Scholar delivered 49 results on the first set of search terms with several relevant papers relating to the subject, but no papers specific on frameworks. The second set of search terms delivered 12 results with another paper relating to value creation in low-income markets, but no results on existing frameworks. The third set of search terms resulted in 20 results with matches lying closer to the subject, but still no specific frameworks and canvases being mentioned. The fourth search term resulted in 3 results with one match including a chapter with relevant content: [8]. The chapter explains various relationships that exist between a developed and developing nation and how sustainable entrepreneurship can be achieved via the Extended Business Model Canvas (EBMC), an adaptation of the Business Model Canvas (BMC) of Osterwalder and Pigneur [45]. The framework addresses social and environmental aspects, but does not specifically discuss and include barriers faced by entrepreneurs in developing nations. The final search term delivers 8 results with one result containing related supportive information and another being the same as before [8].

From the initial search in the research media, there are very few to no related papers and business model frameworks that address barriers commonly face by entrepreneurs in developing nations, as well as sustainable and circular aspects. Papers on the topics separately exist in abundance, but no papers combine these into a framework that can help an entrepreneur in a developing nation set up a business that preemptively addresses barriers, but also allows for the integration of sustainable and circular aspects. Therefore, the knowledge gap can be identified as:

There is a lack of inclusive business model frameworks that have been developed specifically for developing nations, that actively address common barriers entrepreneurs in these regionis face and allow for the integration of sustainable and circular aspects.

1.2.2. Research Question & Sub-Questions

To contribute to the knowledge gap, the research question, as stated below, has been formulated.

How can a business model framework for developing nations be designed so that it preemptively addresses commonly faced barriers of businesses in such nations and includes aspects of sustainability and circularity? Does the developed business model framework for developing nations meet expectations when applied to the case study of biogas in Mek'ele, Ethiopia?

To work through the information necessary to answer this research question, several guiding sub-questions have been developed. They are as follows:

1. What sustainable and/or circular business model frameworks and approaches exist and are there any that focus specifically on developing nations?
2. What are the advantages and limitations of the reviewed business model frameworks and approaches?
3. Based on the advantages and limitations of the reviewed business model frameworks, what criteria can be established for the design of a business model framework for developing nations that incorporates the principles of sustainability and circularity?
4. What are the drivers and barriers of a business in a developing nation with a foreign partner or owner, such as the National Biogas Programme Ethiopia (NBPE)?
5. How do the drivers and barriers from the NBPE differ or coincide with those found in literature from similar initiatives in developing nations?
6. To what extent does culture play a role in the success or failure of such initiatives?
7. What criteria can be derived from the coinciding drivers and barriers for the design of a sustainable and circular business model framework that allows to preemptively address commonly-faced barriers by entrepreneurs in developing nations?
8. How does a business model framework for developing nations look based on the established criteria?
9. Case Study: Biogas in Mek'ele, Ethiopia - How does biogas, as a sustainable and circular energy technology, represent an opportunity for development in Ethiopia?
10. Case Study: Biogas in Mek'ele, Ethiopia - How does the business model for the introduction of biogas at the Nicolas Robinson School in Mek'ele, Ethiopia look when based on the developed business model framework for developing nations?
11. Does the developed business model framework for developing nations deliver on its promises to preemptively address commonly faced barriers in developing nations and include aspects of sustainability and circularity, and does it meet the expectation of experts?

1.2.3. Scientific and Practical Relevance

This research provides an academic contribution to the knowledge on business model frameworks for developing nations by analysing existing business model frameworks and methods / approaches, and assessing the main barriers and drivers experienced by entrepreneurs in developing nations. To achieve the latter, a specific example business initiative is evaluated that has a foreign benefactor and focuses on alleviating poverty by fulfilling the Millennium Development Goals (MDGs). Additionally, the effects of local culture on business conduct and the interpretation thereof by foreigners is analysed. Furthermore, these findings will be integrated in a new business model framework, specifically developed for use in developing nations with the aim to address common barriers within the framework, as well as integrate aspects of sustainability and circularity based on the reasoning that both contribute to combating climate change as well as poverty. This new business model framework should aid entrepreneurs in developing nations set up well-thought-out business plans that result in long-term and successful business endeavors.

The academic contribution of designing a new business model framework for developing nations opens the opportunity to make a practical contribution also. By testing the dexterity of the framework on a case study composed of a real business idea, a fundamental business plan can be established. The specific case

study introduces biogas at the Nicolas Robinson School (NRS). This specific project is chosen because it was a personal request by the founders of the school, Kathryn and Max Robinson, as well as an advantageous choice in relation to data acquisition and local knowledge under the current circumstances of the covid-19 pandemic and political and military struggle in Ethiopia. Furthermore, this business allows introducing a sustainable and circular technology to hundreds of students who will benefit from learning about such technologies in theory and experiencing it in practice. The choice of biogas in this project also relates back to the example business that will be evaluated for drivers and barriers, the National Biogas Programme Ethiopia (NBPE), which is a program and 'business' based on the MDGs and thus caters to alleviating poverty in one of the poorest countries of Sub-Saharan Africa.

1.2.4. Scope of the Research

The scope of this research is delimited by choices in various categories. The categories are business model frameworks and methods, countries, drivers and barriers of business endeavors in developing nations, and the case study.

1. Business model frameworks and methods: There are a very large amount of business model frameworks / canvases and methods / approaches available for review in literature. In relation to the knowledge gap and problem statement, this research focuses on those that relate to sustainability, circularity, developing nations, or a combination of these.

2. Countries: Ideally, the research results should be applicable to developing nations on a global scale. However, because not all nations are the same and analysing all would be disproportionate to the research task, the scope is reduced to the poorest region of the world: Sub-Saharan Africa. In addition, one specific country is addressed for a more detailed case study: Ethiopia, which is one of the poorest nation in the region.

3. Drivers and barriers of business endeavors in developing nations: Almost any business endeavor could be used. To limit the amount of research and yet provide a detailed and relevant analysis, one business is chosen to evaluate in detail. To remain relevant to the knowledge gap, this business endeavor should have an international partner and incorporate a sustainable and circular aspect or technology with the goal to alleviate poverty and stimulate economic growth. It is then cross-referenced with general / review literature that discusses drivers and barriers of foreign endeavors in developing nations in general. Defining the scope so, will create a balance between aspects that are region-specific and related to developing nations in general. In addition, the research will not elaborate on any of the found aspects unless available and specific literature is lacking.

4. Case study: This thesis will focus on one case study that benefits from completion of the knowledge gap. This means that the case applies to a business with a foreign partner or owner in a developing nation with a sustainable and/or circular aspect that aims to inherently address issues related to poverty. The research will not work out a business plan in detail, but formulate a base from which a complete business plan can be developed. The focus of the case study is on demonstrating how the developed framework can be applied and how it serves the knowledge gap.

2

Methodology

This chapter presents the research methodology that has been applied to complete this report. First, the general research approach is explained, followed by the methodology and research conducted for each sub-question.

2.1. General Research Approach

The overall research approach of this thesis project can be divided into two parts. Part 1 represents the theoretical relevance of this thesis project. As indicated in the introduction, there are two main contributors to the theory that needs to be reviewed. From this review, criteria for a new business model framework can be established. See Part 1 below. Part 2 represents the practical relevance of this thesis project, including the development of the sustainable and circular business model framework for developing nations and its application to the case study of biogas in Mek'ele, Ethiopia.

Where part 1 is fairly linear, part 2 will be completed in a linear fashion first, to set up a basis, after which the developed framework and case study will enter an iterative process to improve the framework. Finally, the insights of experts will result in an evaluation and list of recommendations.

Each part will require the use of its own method(s) discussed in the sections below. To arrive at a complete answer of the research question stated in the previous chapter, guiding sub-questions have been formulated. How each sub-question is answered is explained below.

Part I: Literature research of the two core concepts

- Part 1.1: The Existing Theory on Sustainable and/or Circular Business Model Frameworks
- Part 1.2: Drivers and Barriers of Business Endeavors in Developing Nations
- Part 1.3: Establishment of Criteria for the Development of a New Business Model Framework for Developing Nations

Part II: Development of a general sustainable and circular business model framework for developing nations

- Part 2.1: Development of a Business Model Framework for Developing Nations that Preemptively Addresses Commonly Faced Barriers in such Nations and Incorporates Aspects of Sustainability and Circularity
- Part 2.2: Case Study: The Significance of Biogas to Developing Nations
- Part 2.3: Case Study: Applying the Framework to the Business Idea: Biogas in Mek'ele, Ethiopia
- Part 2.4: Developed Business Model Framework Analysis on User-friendliness and Meeting Expectations via a Review Panel of Experts

2.2. Research Methodology

Any large research question requires the guidance of sub-questions to make sure the question is answered in a balanced manner, including as many factors as possible. To this end, the sub-questions listed in section 1.2.2 have been formulated. For the data acquisition in this report, various methodologies have been applied. Which sub-question is answered in which part of the thesis is listed in table 2.1, along with the applied methodology of the sub-question. Thereafter, a short explanation to the approach and use of methodology in answering each sub-question is provided. Throughout the report, the addressed sub-questions will be referenced.

2.2.1. Methodology - Data Acquisition

When acquiring data for research, there are various methods one can apply. Throughout the various parts of the research approach, different methods or combinations of methods will be used. The methods are reviewed here below, followed by the application of the various methods per sub-question (table 2.1). Within that table, the transition between theoretical/scientific and practical relevance is clearly marked.

Literature Review: A comprehensive and objective summary and evaluation of the current knowledge on a certain topic. Scholarly articles, books, reviews, and other sources are allowed to be used, as long as they have been reviewed and written by experts of the field.
Desk Research: Also known as secondary research, is used for the same intentions as the literature review; to gain a deeper understanding of the subject. As the sources include websites, governmental publications, newspaper, company reports, etc., the focus is more on practical application of a certain subject than the theory behind it.
Action Research: Concerns itself with creating both knowledge and action, as it "works towards a kind of change" [46]. Action research includes identifying a problem, researching probable cause, and propose, test, and evaluate a possible solution. This often results in a cyclic or iterative process.
Interview: The process of when an interviewer asks the interviewee questions and guides the conversation through the topics under investigation. Interviews can be structured, semi-structured, and non-structured interviews. The first consists of a clear set of questions that the interviewee should answer directly and usually in order. The second also consists of a set of questions that need to be answered, but the interviewer and interviewee are free to engage in related conversation; it is the interviewers responsibility to end up with the desired answers. The third, the non-structured interview, is when no clear set of questions have been created for the interviewer to ask the interviewee. The two engage in open conversation about the desired topic and deepen their knowledge by discussing freely.
Model: A pictorial or graphic representation of a key concept or system within the defined boundaries. It should clearly represent key variables and the relationship between them.

2.2.2. Methodology - Sub-Questions

Each sub-question is answered by its own approach and use of methodology. Below, the specific approach is discussed per sub-question, followed by a summary of the methodology per sub-question in table 2.1.

SQ 1: What sustainable and/or circular business model frameworks and approaches exist and are there any that focus specifically on developing nations? Because most business model frameworks are based on the Business Model Canvas (BMC) of A. Osterwalder and Y. Pigneur, it will be reviewed first. Following the BMC, additional findings on sustainable and/or circular business model frameworks from the literature review are presented. In addition, the existence of business model frameworks for developing nations is explored.

SQ 2: What are the advantages and limitations of the reviewed business model frameworks and approaches? Extending the research from SQ 1, this sub-question is answered by reviewing review papers and literature concerning the frameworks presented under SQ 1.

SQ 3: Based on the advantages and limitations of the reviewed business model frameworks, what criteria can be established for the design of a business model framework for developing nations that incorporates the principles of sustainability and circularity? The answers to SQ 1 and SQ 2 result in an initial list of criteria that should be considered during the development of a new business model framework for developing nations that includes aspects of sustainability and circularity. No additional research is required to answer this question.

SQ 4: What are the drivers and barriers of a business in a developing nation with a foreign partner or owner, such as the National Biogas Programme Ethiopia (NBPE)? This sub-question is answered by reviewing the intentions of the National Biogas Programme Ethiopia (NBPE) in general, as well as literature evaluating the program over the years. The answer to this sub-question will help establish criteria that allow preemptively addressing barriers in a business model framework for developing nations.

SQ 5: How do the drivers and barriers from the NBPE differ or coincide with those found in literature from similar initiatives in developing nations? To establish criteria that are applicable to a business model framework for any developing nation, the barriers from the NBPE need to be cross-referenced with literature on common barriers encountered by entrepreneurs in developing nations.

SQ 6: To what extent does culture play a role in the success or failure of such initiatives? Since cultural differences are listed as a main barriers, an elaboration on culture and the related social institutions is necessary. Both are considered because there is always a balance between the subjective and objective, respectively. In anticipation of the case study, the Ethiopian culture is evaluated. This is done by interviewing Ethiopians living abroad and foreigners working in Ethiopia. These settings allow both parties to see the contrast between Ethiopian and other cultures and potential obstacles that this forms for businesses. A list is formulated for the consideration in the final list of criteria and / or case study in Mek'ele, Ethiopia.

SQ 7: What criteria can be derived from the coinciding drivers and barriers for the design of a sustainable and circular business model framework that allows to preemptively address commonly-faced barriers by entrepreneurs in developing nations? This question is answered by combining the findings from SQ 4, 5 and 6. This final list is used to develop the outset business model framework for developing nations.

SQ 8: How does a business model framework for developing nations look based on the established criteria? To answer this question, the approach to the outset business model framework is explained, followed by the development of the model based on the list of criteria established under SQ 7.

SQ 9: Case Study: Biogas in Mek'ele, Ethiopia - How does biogas, as a sustainable and circular energy technology, represent an opportunity for development in Ethiopia? To provide additional background as to why biogas is a relevant and good example of a sustainable and circular technology that helps alleviate poverty and stimulates growth, an assessment of the technology in relation to the Millennium Development Goals is completed.

SQ 10: Case Study: Biogas in Mek'ele, Ethiopia - How does the business model for the introduction of biogas at the Nicolas Robinson School in Mek'ele, Ethiopia look when based on the developed business model framework for developing nations? This sub-question is answered by applying the developed framework to the business idea of biogas in Mek'ele, Ethiopia. To ensure a sufficient amount of local information can be acquired, the business idea is applied in the setting of a school of which the owners will take the role of client and deliver additional information whenever necessary. Several scenarios are discussed both qualitatively as well as in a rough fiscal overview, but the business plan will not be developed in detail (see the scope in section 1.2.4).

SQ 11: Does the developed business model framework for developing nations deliver on its promises to preemptively address commonly faced barriers in developing nations and include aspects of sustainability and circularity, and does it meet the expectation of experts? This sub-question will be answered based on an evaluation of the author's experiences while applying the business model framework to the case study. Additionally, a review panel of experts will provide their insights and assessment on the potential of developed framework for its application in developing nations, as well as meeting expectations by delivering on its promises.

Table 2.1: Sub-question distribution throughout the parts of the thesis project including research methodology per sub-question. The asterix (n/a*) indicates a part that does not specifically acquire new data, nor models results graphically. It represents parts of the thesis project in which propositions are made based on the findings from the conducted research that will be applied in later stages of modeling.

Part	Sub-question	Chapter	Research Method
1.1	1	3 - 3.2	Literature Review
1.1	2	3 - 3.2	Literature Review
1.1 & 1.3	3	3.3	n/a*
1.2	4	4 - 4.2	Literature Review, Desk Research
1.2	5	4 - 4.2, 5	Literature Review, Desk Research
1.2 & 1.3	6	4.3	Desk Research, Interview
1.3	7	5	n/a*
2.1	8	6	Model
2.2	9	7.1	Literature Review, Desk Research
2.3	10	7.2 - 7.9	Action Research, Desk Research, Model, Interview
2.4	11	8	Interview

2.3. Reading Guide

The structure of the report follows a general trend from theoretical towards practical and is split into two parts, accordingly. Chapters 3 through 5 belong to part I; chapters 6 through 8 belong to part II. Chapters 1 and 2 provide the relevant background, knowledge gap, and methodology to address the knowledge gap within this report. Chapters 9 and 10 discuss and conclude the accomplished work in this report.

Chapter 1 provides an introduction that covers any relevant background information to help establish the knowledge gap, as well as any information necessary to help understand the setting of the report and its case study. In this chapter, the research and sub-questions are established. Chapter 2 elaborates on the method that is applied to answer the research question. The various methods of data acquisition and their use per sub-question are presented. Chapter 3 reviews various works of literature related to sustainable and/or circular business model frameworks, as well as business model frameworks related to developing nations and the Business Model Canvas (BMC) of A. Osterwalder and Y. Pigneur. In addition, various approaches to setting up business models are covered and a list of criteria for a business model framework for developing nations is presented. Chapter 4 reviews the various drivers and barriers experienced by entrepreneurs in developing nations through a specific example, the National Biogas Programme Ethiopia (NBPE), and additional general literature. Preliminary lists of criteria are established. The chapter also covers an elaboration on Ethiopian culture and doing business in Ethiopia as a foreigner, based on one of the common criteria. A list of recommendations for entrepreneurs or businessmen/-women to consider during the case study is also established. Chapter 5 cross-references the lists of criteria and recommendations and presents a final list of criteria for the business model framework for developing nations. These criteria are applied to the development of this framework in chapter 6, where the new framework, Modular Business Model Framework (MBMF), is presented. Chapter 7 applies the developed MBMF to the case study of biogas in Mek'ele, Ethiopia. Additionally, for a better understanding of the impact biogas can have on a developing nation, the chapter broadly assesses its potential based on the Millennium Development Goals (MDGs). Chapter 8 presents an evaluation of the developed framework and its applicability and user-friendliness through an evaluation of the author and the opinions of a review panel of experts. Finally, chapter 9 discusses the work achieved in this thesis report along with recommendations for further research. Chapter 10 concludes the thesis report by answering the specific sub-questions and main research question.

Part I

3

Sustainable, Circular and/or for Developing Nations - An Overview of Existing Business Model Frameworks and Approaches

The information reviewed in this chapter originates from pieces of literature and desk research. During the literature review, however, it became clear that there is a distinction between a Business Model Framework and a Business Model Approach (BMA). A BMF is like a canvas or template that can be filled in to help an entrepreneur set up his business model, which is the actual business description or plan. A BMA, or method, is similar to a BMF, but includes a description of steps and often includes an analysis of sorts. Business Model Approach can lead to successful business models - with and without a Business Model Framework - and are therefore valuable tools. Both are reviewed to develop criteria for a business model framework that includes aspects of sustainability and circularity, as well as prepares for the specific setting of a developing nation. Reviewing both as is done in this chapter is not uncommon; they are often assessed together [47].

This chapter is divided into three main sections. The first reviews existing sustainable and circular Business Model Framework. Additionally, it explores any frameworks in relation to developing nations. The second section reviews Business Model Approach in relation to sustainability, circularity, or developing nations. Sometimes one framework or approach has more than one aspect included. Finally, the third section summarizes the criteria that can be established from the reviewed literature and other sources for the development of a business model framework in developing nations. The first two sections simultaneously answer sub-questions 1 and 2. Sub-question 3 is answered in the final section.

3.1. Business Model Frameworks

This section answers the first two sub-questions of the thesis project: *SQ 1: What sustainable and/or circular business model frameworks and approaches exist and are there any that focus specifically on developing nations?* and *SQ 2: What are the advantages and limitations of the reviewed business model frameworks and approaches?* As the questions indicate, the focus is on sustainable and/or circular business model frameworks (BMFs) due to the relevance of sustainability and circularity for the development of developing nations (see section 1.1.1). In accordance with this, the frameworks that are reviewed are linked to sustainability and/or circularity. Exceptions to this are the Business Model Canvas (BMC) created by Osterwalder and Pigneur, because most of the reviewed frameworks are based on the BMC, and any frameworks developed specifically for developing nations.

To avoid re-doing valuable work previously completed by other researchers, and to avoid reviewing several hundred papers on business model frameworks and approaches, review papers will be used. Reviews are written to help researchers in the field gain an overview of the main achievements, main areas of debate, and main research gaps [48]. This requires a critical and consistent author [48]. As critical thinking is partially based on values (e.g. school of thought), principles and personality, papers can have a certain bias [48]. This

can lead to new insights and inspiration, but also affect the analysis and conclusions. To avoid getting caught up in this, an attempt will be made to review several points of view, or refer back to the original paper for cross-referencing.

3.1.1. The Business Model Canvas by A. Osterwalder and Y. Pigneur 2010

As mentioned before, the only exceptions to the review focus of sustainable and/or circular business model frameworks are the model of Osterwalder and Pigneur and frameworks developed specifically for developing nations. The framework created by Osterwalder and Pigneur, called the Business Model Canvas (BMC), can be considered a 'linear' model and is likely the most well-known and used framework [47, 49, 50]. The canvas is composed of nine building blocks with the value proposition at its center, as illustrated below. Since many frameworks and approaches find their origin in this framework, it is important to review and understand. A short description of each of the components can be found in section 6.5.

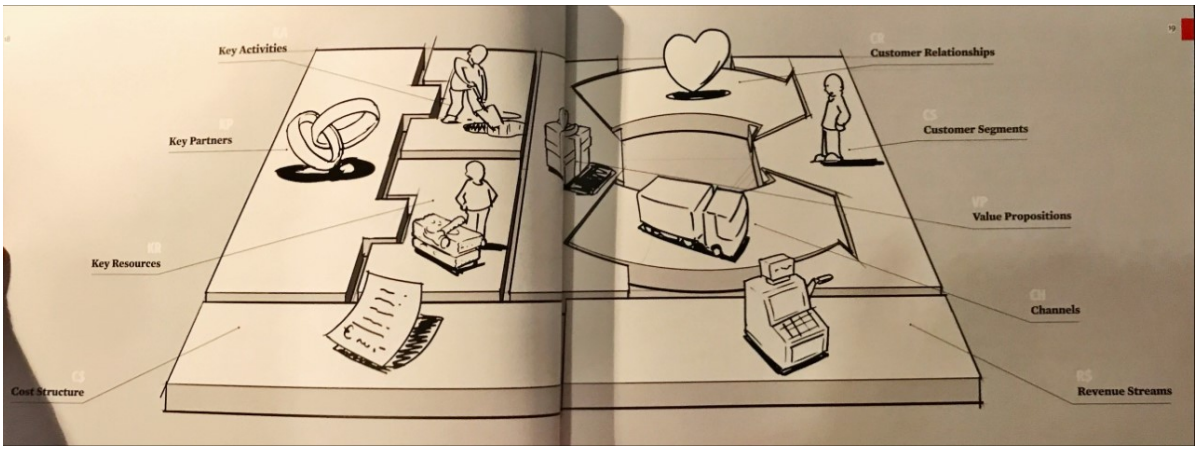

Figure 3.1: The Business Model Canvas (BMC) as proposed by A. Osterwalder and Y. Pigneur. Figure from [45].

Osterwalder and Pigneur define a business model as: "A business model describes the rationale of how an organization creates, delivers, and captures value" [45], which is reflected in each of the components. The BMC and the handbook that were created around it are therefore a clear and practical tool, especially also to those that have no or little academic background [51]. Filling in the blocks of the BMC force the entrepreneur / business-owner to carefully consider all aspects that could influence the outcome of the initiative [8, 45]. The handbook offers additional benefits, as it goes beyond the theory and into experience, explains the relation to strategy, and presents practical approaches to business model design [45, 51]. For example, chapter four introduces the possibility of using strengths, weaknesses, opportunities and threats (SWOT) analysis and chapter 5 explains five phases of business model design [45, 51]. Both are elaborated upon in the next subsection. Therefore, most will agree that it is a very valuable and practical tool, but there have been many adaptations of the framework based on criticism since its publication, as is discussed in various sub-sections below.

3.1.2. The Extended Business Model Canvas by B. Vastbinder et al. 2011

One example criticism is that it is not well-enough equipped for business in lower-income economies, which requires (socially and environmentally) sustainable entrepreneurship [8]. In lower-income economies, this requires finding a balance between for-profit and non-profit, as choosing one of the two (i.e. colonialism and development aid, respectively) has proven to be unsuccessful and often even counterproductive in the past [8]. The framework proposed, the Extended Business Model Canvas (EBMC), introduces four new building blocks to "reflect the extra goals that have to be met for sustainable entrepreneurship" [8]: 'Social costs', 'ecological costs', 'social revenues', 'ecological revenues' [8] (see figure 3.2). These new components allow for the consideration of the costs and revenues of multiple stakeholders, preventing the exploitation of a stakeholder by stimulating equality between the customer and entrepreneur [8]. For example, the previously underprivileged employee can receive additional revenue in the form of education for them or their children, healthcare, housing, donations etc. This stimulates loyalty, which is additional revenue for the entrepreneur, and so they balance each other [8]. The authors consider the EBMC to be successful in "describing, analysing and designing individual business models" [8] in low-income economies, especially when sustainability should be

embedded, but there are also some issues with the model. Three main issues focus on the lack of 'active' attention towards key components such as internal management, the social and institutional context of the entrepreneurial initiative, and mutual value creation [8]. An example is that management is now integrated within *key activities*, but should likely have a more active visual role to signify its importance. Two other main issues are that some unclarity remains on the role of beneficiaries such as NGO's and volunteers, and how their exit from initiatives can be completed with minimal effects on the initiative [8]. The authors suggest research in the social environment (infrastructure) in which these businesses need to succeed. One of the authors has done so in the book *Cross-cultural Entrepreneurship and Social Transformation - Innovative Capacity in the Global South* [42]. It expands on the importance of social values and finding a balance therein when doing business in lower-income and/or transitioning economies. Rather than a framework, however, the author proposes an approach - the SURE approach - which will be elaborated upon below in the next sub-section.

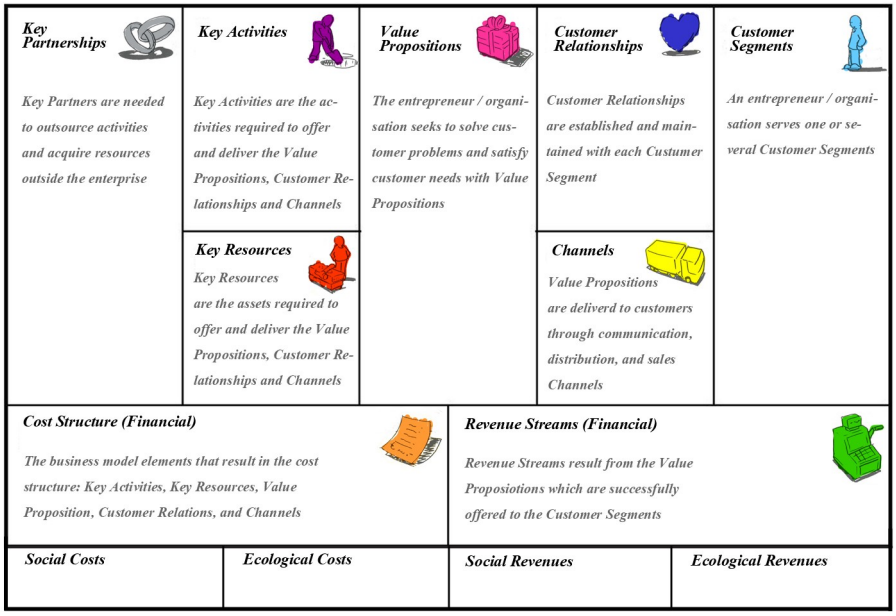

Figure 3.2: The Extended Business Model Canvas (EBMC) as proposed by B. Vastbinder, O. Kroesen, E. Blom and R. Ortt in 2011. Figure from [8].

3.1.3. The Triple Layer Business Model Canvas by A. Joyce and R.L. Paquin 2016

The concept of mutual value creation, which increases the likelihood of long-term viability [8, 52, 53], has been accepted within other approaches and frameworks also [49, 54]. Nostarabadi et al. (2019) review 66 articles to "present the state of the art of Sustainable Business Model (SBM) in the individual application areas" [53] of 14 assorted categories/taxonomies. The authors do not list which frameworks have been used (if any) to create the business models, but they note that the common goal was found to be: create value for the triple bottom line. The Triple Layer Business Model Canvas (TLBMC) by Joyce and Pacquin (2016) is an example of a Business Model Framework that is based on the triple bottom line perspective to sustainability [49]. This means that all three layers - economic, social and environmental, also known as the 3P's (profit, people, planet, respectively) [52] - contribute to transforming an organization to be more sustainable by considering the environment and society as key stakeholders [8, 49, 52–54]. The triple bottom line was introduced by John Elkington in the 1990s and is commonly used to 'measure' sustainability within businesses, although the 'quantification' of the measurement still remains difficult [52]. Within the Triple Layer Business Model Canvas, each 'P' receives its own layer. A visual representation of the framework can be found below in figure 3.3. The economic layer is represented by the Business Model Canvas of Osterwalder and Pigneur. The social and environmental layers each receive a replica of the BMC, but with a focus on their own 'P' (people and planet, respectively) [49]. The stacked layers so create new dynamics for analysis: both horizontal and vertical coherence [49]. This allows for a more active role for value creation within the social and environ-

mental aspects than within the Business Model Canvas or Extended Business Model Canvas. In addition, this framework draws more attention to management via the component of 'governance' and introduces the opportunity for circularity via the component 'End-of-life'. The authors state that the TLBMC is a more robust and holistic tool for developing sustainable businesses [49]. It allows for the identification of information gaps and possible negative externalities that can be addressed right away or solved creatively [49]. However, it should be noted that the tlbmc has been criticized for over-simplifying the complexity of sustainability [49]. Meanwhile, the model's more extended canvas has also been considered "complex" [47] and "overwhelming" at first sight [49]; an interesting contradiction that should be considered when choosing/developing a business model framework in later stages of this research. To remove part of the issue of 'lack of complexity', a Life Cycle Analysis (LCA) can be applied in the environmental layer [49] and entrepreneurs and business-owners can consider integrating more circularity. Despite the criticisms, the authors find their approach and framework being used implicitly and explicitly within many businesses. However, the paper does not mention the use of their framework in developing nations specifically. A Google Scholar search on *'triple layer business model canvas AND developing nations'* resulted in one relevant match on the first page. The paper in question applies the triple layer business model canvas to a project of rural electrification in French Guiana [55]. The TLBMC was said to be appropriate in addressing "all aspects of sustainability in the sketching phase" [55]. However, what the business model did not address was how to deal with the complex local social collaborations, the weak industrial capacity and the unclarity of the government's ambitions [55]. Then again, the TLBMC is meant as a tool and cannot tell the entrepreneur how to solve these barriers [49].

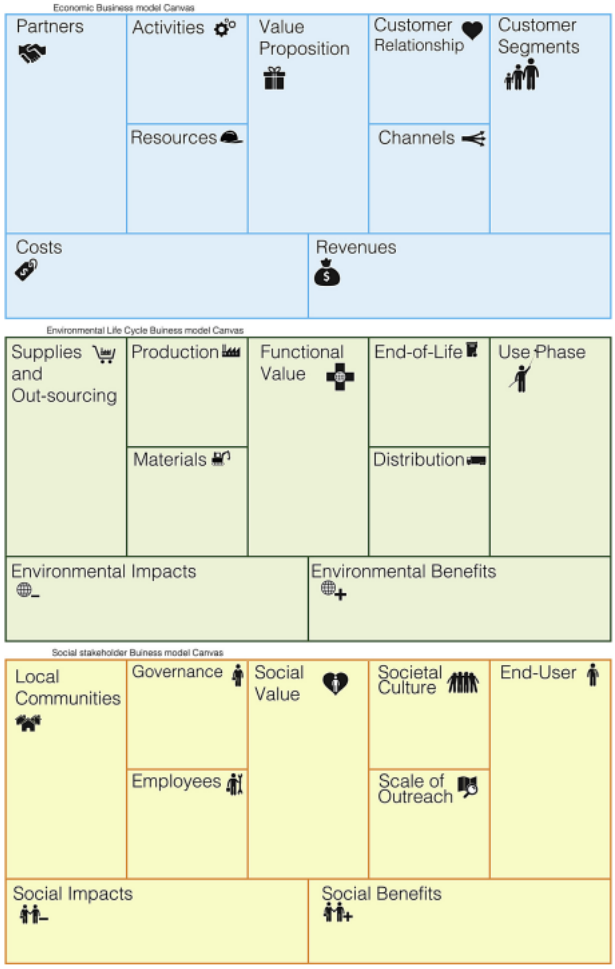

Figure 3.3: The Triple Layer Business Model Canvas (TLBMC) as proposed by A. Joyce and R.L. Paquin in 2016 [49]. The top layer represents the Economic Business Model Canvas. The middle layer represents the Environmental Life Cycle Business Model Canvas. The bottom layer represents the Social Stakeholder Business Model Canvas. Together they allow for horizontal and vertical coherence to create value for the triple bottom line [49].

In the Triple Layer Business Model Canvas, the *End-of-Life* component introduces the opportunity to in-

corporate circularity. Many researchers have made an attempt to create circular frameworks or approaches to circularity [47, 50, 56], as circularity is considered a desirable future for its financial savings and environmental benefits [47, 57]. To transition from a 'linear' to a 'circular' economy, it is key to slow, close, and narrow resource loops [47, 56]. Most attempts can be categorized to have based their work on the ReSOLVE framework, the Business Model Canvas (BMC) by Osterwalder and Pigneur, and hybrid models that try to combine the two [47, 50]. The ReSOLVE framework is rather an approach that "shows how the principles of the circular economy are translated into business actions implementing CE [circular economy]" [47]. As such, it will be discussed within the next section.

3.1.4. The Circular Business Model Canvas by M. Lewandowski 2016

One researcher, M. Lewandowski (2016), reviewed 92 pieces of literature to create an overview on the subject to determine whether a comprehensive business model framework can be created for any circular business[47]. The motivation lies within the notion that business models and business model frameworks lack transferability, and that there has not yet been a truly circular business model established [47]. As a base model, the business model canvas by Osterwalder and Pigneur was chosen again, "due to the ease of its practical application, complexity of components, worldwide recognition, and previous contributions to the development of circular business models" [47]. Lewandowski argues that the Business Model Canvas by Osterwalder and Pigneur can be used to create both linear and circular businesses to a certain extent because each business is linear and circular to a certain extent; however, he criticizes that the principles of, or actions related to, the circular economy and how they are related to the individual components is lacking. The Circular Business Model Canvas (CBMC) tries to combine all these elements [47]. Lewandowski created an overview of how each business model canvas component can be made more circular and what additional framework components are needed. The resulting model framework is as illustrated below with two new components *take-back system* and *adoption-factors*. For detailed information, review [47].

<table>
<tr>
<td rowspan="2">Partners
• Cooperative networks
• Types of collaboration</td>
<td>Activities
• Optimising performance
• Product Design
• Lobbying
• Remanufacturing, recycling
• Technology exchange</td>
<td rowspan="2">Value Proposition
• PSS
• Circular Product
• Virtual service
• Incentives for customers in Take-Back System</td>
<td>Customer Relations
• Produce on order
• Customer vote (design)
• Social-marketing strategies and relationships with community partners in Recycling 2.0</td>
<td rowspan="2">Customer Segments
• Customer types</td>
</tr>
<tr>
<td>Key Resources
• Better-performing materials
• Regeneration and restoring of natural capital
• Virtualization of materials
• Retrieved Resources (products, components, materials)</td>
<td>Channels
• Virtualization

Take-Back System
• Take-back management
• Channels
• Customer relations</td>
</tr>
<tr>
<td colspan="3">Cost Structure
• Evaluation criteria
• Value of incentives for customers
• Guidelines to account the costs of material flow</td>
<td colspan="2">Revenue Streams
• Input-based
• Availability-based
• Usage-based
• Performance-based
• Value of retrieved resources</td>
</tr>
<tr>
<td colspan="5">Adoption Factors
• Organizational capabilities
• PEST factors</td>
</tr>
</table>

Figure 3.4: The *transferable* Circular Business Model Canvas (CBMC) as proposed by M. Lewandowski in 2016. Each component can be made circular. Social aspects and influences are not a main focus and embedded in the adoption factors via the PEST factors. [47]

Lewandowski argues that this framework is an easier and more user-friendly practical tool than the triple-layer business model canvas (TLBMC), but still more complex than the BMC. Yet, he says this while also admitting that its "real usability in designing processes has yet to be empirically verified" [47]. In addition, although at least two models were reviewed that mention social and/or cultural aspects as an important contributor to business model success (Stubbs and Cocklin see [58] and Dewulf see [59]), and another was listed as its equal (TLBMC), the CBMC barely acknowledges the impact of socio-cultural aspects. Some social

aspects are integrated into the framework to a certain extent via the PEST factors (Political, Economic, Social, and Technological [60]) in the *adoption factors* component, but this is not mentioned explicitly within the text, making it easy to miss and downplaying its importance. Then again, Lewandowski's model is clearer on circularity, contributing to the overall sustainability. An additional search for 'Circular Business Model Canvas AND developing nation' and 'Circular Business Model Canvas AND case' on Google Scholar came up with no relevant results. Another review on circular business models by P. Rosa et al. (2019) mentions Lewandowski's approach, but also that the most commonly used business models are the Product-Service System (PSS) [1] and Reuse, Remanufacturing and Recycling (3R)[2] based Circular Business Model [50]. Furthermore, the most diffused framework is still the BMC by Osterwalder and Pigneur (2010) [50]. From these two reviews, the triple fit challenge [47] and the ReSOLVE framework [47, 50] are identified as enablers for the transition towards a circular business model. As both are approaches, rather than frameworks, they are discussed within the next section.

3.1.5. The Sustainable Circular Business Model Innovation Framework by M. Antikainen and K. Valkokari 2016

The "sustainable and circular business model framework" proposed by M. Antikainan and K. Valkokari (2016) builds similarly to the Triple Layer Business Model Canvas (TLBMC), but provides additional focus for circularity [64]. Like the TLBMC, there are three layers or 'levels'. The economic layer, as in the TLBMC, is a replica of the Business Model Canvas by Osterwalder and Pigneur. In this framework, it is called *The Business Level*. The *Business Ecosystem Level* with components *trends and drivers* and *stakeholder involvement* represents the social layer. The *Sustainability Impact Level* with *sustainability requirements* and *sustainability benefits* represents the environmental layer. This layer looks similar to the proposal of Vastbinder et al. [8] where the components of *social costs* and *social benefits* were added. Within the case study that was applied, the authors mention that "the value proposition for the various stakeholders took the most time during discussions" [64]. The steps of understanding 'end user needs' and 'value creation for consumers' were key to the entrepreneur involved [64], restating the importance of the social aspect in successful sustainable and circular businesses. The final piece of this framework is the vertical pillar *Sustainability and circularity evaluation of the business model* with bi-directional arrows to the three layers as an indication that a change in one can and will affect the others [64]. A visual can be found below (see figure 3.5). The authors try to reflect that innovation in a circular economy is a multidisciplinary and iterative effort that needs to combine "views of foresight, business, consumers and sustainability" [64]. The authors state that the framework needs to be tested several more times before proving its use. A Google Scholar search for 'sustainable circular business model innovation AND developing nation' and 'sustainable circular business model innovation AND case' and 'Antikainan AND developing nation' produced no relevant results. For now the assumption is made that the framework has not been used in developing nations, or at least not in a published / academic setting. The authors conclude that the key stages of business model innovation processes should be straightened out as a support tool to entrepreneurs. This relates to approaches which are discussed in the next subsection.

3.1.6. The Ecocanvas by A. Daou et al. 2020

The Ecocanvas is a tool backed by a methodology that allows businesses to "coherently formulate unique circular value propositions" [65]. It is one of the most recent in a long line of tries, and like some others, it has been adopted amongst businesses and academics. The main focus areas have been tourism, fashion industry, agro-food, winery, waste management, water supply and energy from waste [65], making this an interesting canvas to review. Like most others, the Ecocanvas is based on Osterwalder and Pigneur's Business Model Canvas (BMC) [65]. Based on the general critique of previous models - that they lack proper integration of the required social and environmental aspects that constitute the values of the circular economy - the authors of this tool have tried to overcome this by adding a new set of elements [65]. The elements (economic and legal, environmental, and social forces) have been added in a visual way that allows for creative exploration of circular value creation for a broad range of stakeholders [65]. Applying the Ecocanvas means to investigate economic and legal, environmental, and social foresight along with the general building blocks of the BMC, making the three added elements part of the core business [65]. The main differences with other circular business model frameworks is that the building blocks consider foresight, rather than only consider-

[1] Product-Service System (PSS) is based on the vision that consumer demands can be met by services, rather than physcial objects, allowing to reduce the amount of materials and energy required [61, 62]. The PSS is considered as one of the simplest strategies to move towards circularity among several authors [50].

[2] The 3 'Rs' stand for *Reuse, Remanufacturing, and Recycling* which represents the cycle of a circular economy [50, 63]

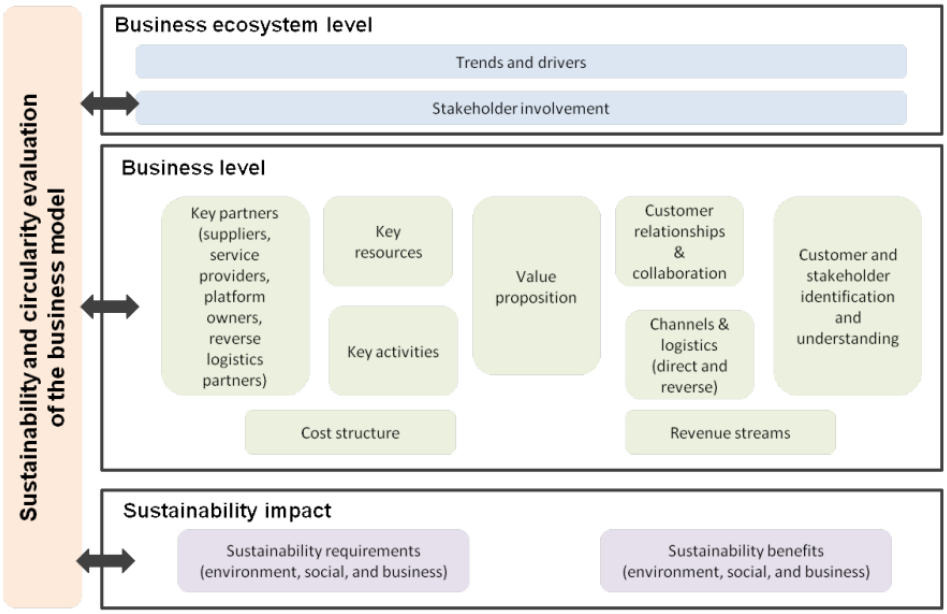

Figure 3.5: The Sustainable Circular Business Model Innovation Framework as proposed by M. Antikainen and K. Valkokari in 2016. This model tries to combine the essence of the Triple Layer Business Model Canvas (TLBMC) while integrating circularity to create value for the triple bottom line. Figure from [64].

ing movements in the past and now, and that the canvas can be used with 15 tools related to specific blocks of the Ecocanvas. When reading through the tools, (see Appendix A of [65] for specifics), it becomes clear that these tools can also be used as guiding steps in filling in the Ecocanvas, hinting to all the aspects that can be considered per building block. The tool had been used, tested, and adapted for 7 years before the publication of [65], but still has certain limitations. Because the canvas integrates many tools, proper use of the Ecocanvas can be time-consuming. In addition, mapping the foresight elements and including the positive and negative impacts of the added elements need to be improved. During an additional search for specific applications of the Ecocanvas with search terms 'energy from waste AND ecocanvas', 'energy AND ecocanvas', and 'case study AND ecocanvas', unfortunately, no relevant matches were found.

3.1.7. The Frugal Business Model Canvas by G. Perangin Angin 2019

A final search for 'business model frameworks AND developing nations' and 'business model framework AND transitioning economies' resulted in little relevant papers. However, there was a mention of frugal business innovation and frugal business models.

The frugal business model is a business model that combines aspects of sustainability and circularity. This business model is meant for products and innovation for the Bottom of Pyramid (BOP). This approach is especially interesting as the BOP are directly related to resource-constrained and often rural areas [66, 67]. This means that this approach is applicable to undeveloped or developing regions. In some ways this business model may seem traditional, as the leading criteria is to save as many costs as possible without compromising the necessary functionality of the product or service and so allow for a profitable and sustainable business [66, 67]; however, it uses the constraints and values of sustainability and circularity to achieve this. Frugal innovation aims to create social, environmental, and economic value in resource-constrained regions or communities by providing high value and affordable solutions [66, 67]. This is known as the 'frugal mindset' [66]. Winterhalter distinguishes two main approaches: "first, the transfer of a new but established technology from another context and second, the decomposition of multi-purpose machines into focused single-purpose devices" [66]. The model works for both product and service oriented initiatives, such as portable medical devices [66], sustainable household energy solutions [68], or telecommunication services [67].The methods applied to achieve successful frugal innovation or frugal business models include creating durable, portable and sturdy goods that can last in harsher environments; designing for speed and not overall efficiency; design for use by unskilled labor; design for a specific and unique BOP need; start design with a zero-environment mindset; keep supply chain, operations, and management local (benefits of market proximity); partner with local NGO's; employ women specifically; reduce resource consumption through the use of used material and

Figure 3.6: The Ecocanvas as proposed by A. Daou in 2020. Figure from [65].

/ or waste; and include education and traineeships within the business model. It is also important to keep in mind that with small (profit) margins, large scale operations are required [67]. However, however good the intentions of the business model are, and even though frugal innovation is based on sustainability values, frugal business models and initiatives are not inherently sustainable [66, 67]. Rosca argues that more focus should be given to sufficiency of products to avoid the effects of mass consumption that follow their new affordability [67].

Frugal business models are unique in the sense that they compete with non-consumption, rather than the traditional low-cost competitor. In addition, they generally add to the overall prosperity and standard of living (e.g. via female empowerment, improved infrastructure, increased health or medical opportunities, etc.), which endorses one of the UN development goals [66, 67]. Additionally, through these businesses, the consumer is introduced to the formal global economy by perceiving them as potential customers [66].

Of course this type of business does not come without challenges. There are various legal, social, and physical barriers to overcome [66]. Examples include the difficulty to obtain permits in such regions, lack of laws to protect intellectual property, cultural differences, unskilled labor, bad infrastructure, incomplete local supply chains, etc.[66, 67]. Upon her findings of frugal (energy) innovation and the frugal business model, G. Perangin Angin (2019) built the Frugal Business Model Canvas (FBMC) as a tool for setting up frugal business initiatives [68]. She proposes the use of the Business Model Canvas by Osterwalder and Pigneur with five new components: *adoption factors*, *mission values*, *objectives*, *impact measure*, and *output measure* [68] (see figure 3.7). During her case studies, she found support for the adjusted business model, as the additional components realistically portray what needs to be kept in mind at all times [68]. Since this business model framework is the only one that has specifically been developed for developing regions, it is worth understanding what has been altered from the Business Model Canvas by Osterwalder and Pigneur. Therefore, a short description of the additional components has been provided.

Mission Values: *What are the long-term goals of the company to support and improve the life of Bottom of Pyramid (BOP) citizens?* This building block connects the business' long-term goals to needs and wants of people belonging to the BOP. The values should connect to improvements in quality of life based on the aspects of the economy, environment, and society. [68]

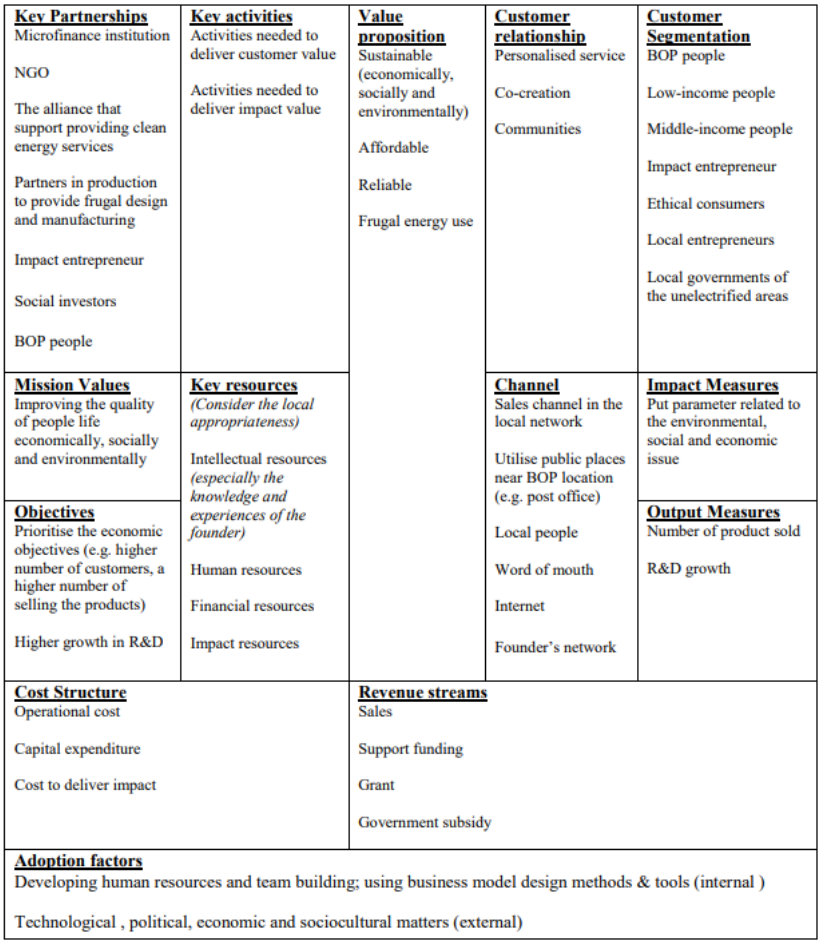

Figure 3.7: The Frugal Business Model Canvas as proposed by G. Perangin Angin in 2019. This business model canvas was specifically developed for innovation and entrepreneurship at the Bottom of Pyramid (BOP) and has been applied to various case studies with supportive outcome. Figure from [68].

Objective Values: *What are the short-term, for-profit goals in the mission?* This building block asks to determine the short-term, for-profit goals of the firm. Often these targets are defined within the commercial aspects of the company. They related the quantitative targets that are necessary to create value for the mission. Here it is important to prioritize the economic objectives. [68]

Impact Measures: *How can I measure the mission values of the company?* This building block asks for techniques / methods to measure whether the mission values have been reached. Preferably, a measurement is provided for each category / aspect; economy, environment, and society. [68]

Output Measures: *How can I measure the short-term, for-profit goals of the company?* This building block asks for a quantitative measurement of the short-term, for-profit goals. This can be in the form of a product quota, sales increase, sales rate increase, overall revenue, etc. [68]

Adoption Factors: *How can I include native capabilities to adapt my business model so that it is accepted into BOP markets?* This building block asks for the capacity to include native capabilities to make the technology more accessible to the user [68].

3.2. Business Model Approaches

Besides specific canvases and frameworks that can be used to set up a business model, there are also other tools that are here distinguished as 'Business Model Approaches'. Examples of tools that are being developed

for sustainable and circular business models include serious games, case databases, typologies, check-lists, analytical tools, diagrams, computer-based tools, approaches, etc. [56]. As there are thousands of approaches available, making a selection is required. Most approaches that are reviewed here below have been mentioned or referred to in the literature of the business model frameworks. Based on those references, additional papers have been searched, sometimes leading to additional approaches (snowballing). This means that the review, in which the various (dis)advantages are summarized, is completed mainly through literature review and desk study.

As with the business model frameworks, many approaches and tools have been developed, but lack actual application, meaning that their value is unknown [56]. To avoid reviewing too much unproven potential, the review paper of Bocken et al. (2019) is consulted as a starting point, snowballing from there. Bocken et al. (2019) review various tools for circular and sustainable business development, apply a screening of 'empirical testing', targeted user groups, guidance on use, and validation of the tool, and select those that have valid potential [56]. In addition, the triple bottom line and the ReSOLVE framework have often been mentioned directly or indirectly in the papers reviewed in the previous section [47, 49, 50, 53, 54, 64]. Although the latter is called a framework, it is more of a method and/or approach to work towards creating a viable and circular business model [52], which is why it is reviewed in this section.

This section, like the previous section, answers the first two sub-questions of this thesis project. They are: *SQ 1: What sustainable and/or circular business model frameworks and approaches exist and are there any that focus specifically on developing nations?* and *SQ 2: What are the advantages and limitations of the reviewed business model frameworks and approaches?*

3.2.1. The Triple Bottom Line

The triple bottom line is in effect representative of the core of both the sustainable and circular frameworks as it represents the idea that value is assigned or created not only for the economics of the business model, but also for the social and environmental aspects of business initiatives [47, 52, 53]. In some papers, they are referred to as the 3 P's (people, profit, planet) [52]. The idea was brought forward by John Elkington in the 1990s, but with its growing popularity and "anecdotal evidence of greater long-term profitability" [52], the demand for measurable results began to grow [52]. T. Slaper has developed a proposal on how the results of the implemented triple bottom line can be measured [52]. The method is based on an indexing system, as none of the 3P's have the same measuring unit or no measuring unit at all - as Slaper justly points out: "What is social capital measured in? What about environmental or ecological health?" [52]. If the indexing based on the 'measurable' points presented by Slaper are universally accepted, it would allow for comparison between businesses, states, policies, design proposals, etc. [52]. Besides the issue of measurement, it is often also difficult to find applicable data. However, when successful, the triple bottom line allows for the identification of points of improvement from a long-run perspective [52]. Unfortunately, although the school of thought of the triple bottom line has been widely accepted, the indexing system proposed by Slaper (2011) is rarely mentioned. Considering that frameworks often work under the notion of keeping it simple, one can understand why this indexing system may not have become widely applicable. The values of the triple bottom line, however, have proven to become extremely valuable when setting up a sustainable and circular business.

3.2.2. The ReSOLVE Framework

The ReSOLVE framework, although developed by McKinsey [69, 70], is often associated with the Ellen MacArthur Foundation which is considered a leader of the circular economy 'movement' in Europe [50, 70]. The framework is composed of a set of principles / actions that help companies and governments transition their business towards a circular economy by increasing (physical) asset utilization, prolonging asset life time, and shifting towards renewable resources [69, 70]. The framework identifies the following six ways to be circular: regenerate, share, optimize, loop, virtualize, and exchange [50, 69, 70]. The ReSOLVE framework has been at the basis for many other experts to develop classification models [50, 69], and although the framework demonstrates how the principles of the circular economy can be translated into business actions, and allows for the demonstration that each action affects another [70], Lewandowski criticizes that it does not do so "in relation to business model components [of the Business Model Canvas (BMC) of Osterwalder and Pigneur] and design process" [47]. Yet, it is an important foundation for circular business models and helps consider various ways in which businesses can make their operations circular. In addition, the ReSOLVE framework can arguably become invaluable for market development in developing nations [69], since introducing a circular economy could represent an opportunity for developing countries to do it 'right' first time round and catch up with the 'developed' world [71], perhaps even giving them a competitive advantage in the future.

Figure 3.8: The ReSOLVE framework with relevant points that can be addressed for each of the six actions. Figure from [69].

3.2.3. Slowing, Closing, and Narrowing Resource Loops

To achieve circularity, three 'methods' that have been cited several times in the reviewed literature above are 'slowing, closing, and narrowing resource loops' [47, 56, 72]. This approach extends on the *loop* section of the ReSOLVE framework. In the ReSOLVE framework, the *loop* refers mainly to closing the resource loop which is achieved mainly by recycling [72–74]. Jorgensen et al. (2018) argue that this only "has limited value for both businesses and society" [74]. Additionally, slowing resources by means of prolonging the lifetime of products, and narrowing resource flows by reducing the use of materials is necessary [56, 74]. To help achieve this, Jorgensen et al. have established three redesign processes: "redesign of services, redesign of value chain relations, and redesign of the internal business organization" [74]. Within these redesign processes, several business strategies and analysis methods are presented. One such method is the 'MECO-screening' which can be filled out in a table. The 'M' stands for (scarce) materials used; the 'E' stands for the amount of energy required and where it is sourced from; the 'C' stands for the chemicals used and their ecological and environmental toxicity; finally, the 'O' stands for other aspects, such as "land use, biodiversity, occupational health and safety (OHS), etc." [74]. Commonly, the MECO-screening covers all aspects and stages of the business and product's life; from resource acquisition to end-of-life. This can then be portrayed in a tabular form, as can be seen in figure 3.9.

Another method is 'environmental mapping' that looks at the expected characteristics of resource flows and compares them to the actual user practices (for more detailed information, view Jorgensen et al. 2018) [74]. Some of these methods and strategies are already being used successfully [74]. Bocken et al. (2016) created a visual for closing, slowing and narrowing resource loops, and connected it to Life Cycle Analysis (LCA) and Mass Flow Analysis (MFA) to create the Rapid Environmental Assessment (REA). The REA has been visualized in a table where the rows include categories *Closing effects, Slowing effects, Life cycle effects,* and *Systems effects*, and the columns include *Flows* and *Stocks*. For each remaining box in the table, key questions have been included to estimate the environmental impact reduction and determine the confidence in the current business strategy [72]. Figure 3.10 gives a short visual. An example application of the REA can be found in [72] (p. 10). At a closer look to the figure, it seems that the REA essentially includes the MECO-screening within the life-cycle effects row, but does so for both new flows and existing stocks.

Bocken et al. (2019) also review various tools that can be used to slow, narrow, and/or close the (resource) loop. They warn the reader that many tools are designed for one specific field and fail to learn from interdisciplinary experiences. In addition, many tools are overly complex and lack proper instruction or guidance, they are too time-consuming, or they only focus on one phase of the innovation process. Furthermore, they are also almost always only qualitative and without measurable or quantifiable results [56]. In other words, there is room for improvement. To help navigate the large amount of tools developed, Bocken et al. (2019) de-

MECO-screening

	Resources	Manufacture	Transport	Use	End-of-Life
Materials, including whether the materials are scarce, non-renewable or renewable.					
Energy, including whether the energy sources are fossil or renewable.					
Chemicals, including aspects of environmental toxicology (e.g. risks related to persistence and bio-accumulation.					
Other aspects, like land use, biodiversity, occupational health and safety (OHS), etc.					

Figure 3.9: The MECO-screening approach for assessing how to slow, close, and narrow resource loops. Figure based on information from [74].

veloped a checklist to help determine whether a tool is appropriate for use. For details, please review Bocken et al. (2019) [56].

3.2.4. SWOT Analysis

The SWOT analysis is a tool to determine the strengths, weaknesses, opportunities and threats of a business model, policy, idea, design, strategy, etc. [75] and is often represented in a 2x2 matrix (see figure 3.11). It is applicable to almost anything, even oneself. Osterwalder and Pigneur introduce the possibility of using a SWOT analysis when setting up the value proposition of a business model, but have not actively integrated it in the Business Model Canvas (BMC) [45]. For a tool that is so often applied in strategic planning and strategic management [75], it is interesting to note that SWOT analysis is not mentioned in most of the literature reviewed so far.

The advantages of SWOT are that it can help make plans or a decision. With its general perspective, general solutions can be found. In addition, the focus can easily be shifted between positive and negative aspects, and since the tool is interactional, changing one aspect (e.g. a weakness) can be evaluated by how value shifts between the other components. Another advantage is that by actively listing weaknesses or threats, the actor has the opportunity to examine them more closely, develop a strategy, and change these into opportunities or strengths [75, 76]. Furthermore, the SWOT analysis can be depicted in a clear 2x2 matrix, providing a good overview for anyone who needs to be informed quickly. Disadvantages include that, according to Gürel, SWOT is less useful/applicable for detailed problems [75]. In addition, the SWOT analysis is on paper and should therefore be tested in 'reality' (real decision making, daily operations, etc.). Furthermore, some argue that using the tool correctly / systematically takes some practice, and that even though many points can be identified, there is no official way to indicate which points are qualitatively more important to the company / idea / policy / etc. Also, categorization of variables into one of the four quadrants can be difficult. Using a consultancy to help with this also often means a loss of time and additional costs [75].

Nevertheless, the use of the SWOT analysis to set up a business model has been integrated in the entrepreneurship training provided by PUM[3] in Mek'ele, Ethiopia [76]. The training uses the SWOT analysis as a tool to analyse the business idea internally (strengths and weaknesses) and externally (opportunities and threats) before moving on to form a business strategy [76]. To clarify how each of the four components can be used strategically - matching capabilities with market possibilities - they have arranged the 2x2 matrix slightly different (see figure 3.12) [76]. The trainer, Ton van Kampen, notes that a large part of setting up a successful business as an entrepreneur in a developing nation such as Ethiopia is validating your assumptions (via lean start-up) and continuously reassessing your business model by analyzing your own capabilities and the

[3] PUM is a Dutch volunteer organization that provides entrepreneurs with advice for the sustainable development of their businesses.

Rapid Environmental Assessment (REA)

	Flows	Stocks
Closing effects *(Recycling)*	Key Questions: - *Can you increase overall recyclability of the new product?* - *Can recycle rates be improved?* **Estimated impact:** xxx reduction in waste **Confidence:** low, medium, high	Key Questions: - *Does it increase recyclability of existing products?* - *Is it able to reverse current trends?* **Estimated impact:** xxx reduction in waste **Confidence:** low, medium, high
Slowing effects *(Long lasting products and extending product life)*	Key Questions: - ... **Estimated impact:** xxx reduction in waste **Confidence:** low, medium, high	Key Questions: - ... **Estimated impact:** xxx reduction in waste **Confidence:** low, medium, high
Life cycle effects *(Effects across raw material sourcing, production, transport, use and disposal – not yet captured)*	Key Questions: - ... **Estimated impact:** xxx reduction in waste & other environmental categories **Confidence:** low, medium, high	Key Questions: - ... **Estimated impact:** xxx reduction in waste & other environmental categories **Confidence:** low, medium, high
Systems effects *(Wider impacts of the innovation)*	Key Questions: - *Does it lead to negative rebound effects?* - *Are there unintended consequences?* - *What is the impact on society?*	**Estimated impact:** xxx reduction in waste & other sustainability categories; other positive and negative impacts **Confidence:** low, medium, high

Figure 3.10: A visual representation of the Rapid Environmental Assessment (REA) as described by Bocken et al. (2016). Figure created based on example in [72].

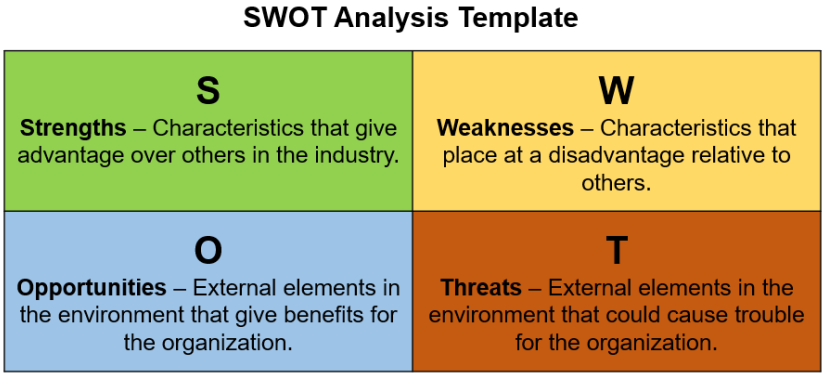

Figure 3.11: The SWOT analysis template as described in [75].

market and culture around you [77]. In the training handbook, several questions are provided to help the entrepreneurs in training practice this step and link it to strategies (p. 29-31) [78]. Additional lists of characteristics for the various four components can be found in [75] (p. 996, 998, 999).

3.2.5. PEST(LE) Analysis

A PEST analysis is a management method or strategic planning approach that assesses major external factors affecting the operations of a business. The goal of completing this analysis is to identify opportunities that will make the business more competitive within its field of business. PEST stands for political, economic, social and technological and can be extended to PESTLE, which includes legal and environmental [79–81]. Although the focus of this analysis is not specifically on sustainable innovation, it is a method to assess how to gain advantages in an ever-developing and growing market where sustainability is a major focus and goal for both consumers and producers. It is therefore also often done in conjunction with a SWOT analysis [81]. The PESTLE factors are often set up as a table, but the real value lies in how, or in which area, the factors can affect the business model and its strategy, as depicted in figure 3.13 below.

M. Lewandowski includes the PEST factors in the *adoption factors* component of his developed Circular Business Model Canvas (CBMC). Although he does not refer to the PEST factors specifically, he does argue that properly adopting a circular business model will lead to competitive advantages and benefit both the market, the environment, and the consumer. In addition, he highlights that the adaptation/adoption factors - established through changes in the (market) environment - change in time, which then "impact the evolu-

	Opportunities	Threats
Strengths	Use your strengths to grab opportunities.	Use your strengths to make threats less dangerous.
Weaknesses	Try to let your weaknesses not stand in the way of new opportunities.	Try to take away weaknesses to make threats less severe.

Figure 3.12: The SWOT analysis matrix as used in the Entrepreneurship training provided by PUM at the Nicolas Robinson School in Mek'ele, Ethiopia. Figure based on [76].

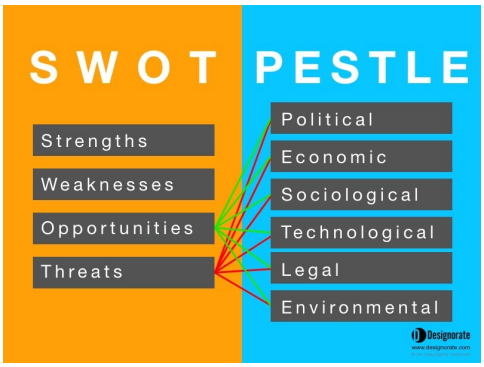

Figure 3.13: The relationship between PESTLE factors and the SWOT analysis. Each factor relates to the external analysis (opportunities and threats) of the business model and can create opportunities or present itself as a threat. Figure from [82].

tion of business models" [47], demonstrating the usefulness of PEST within circular and sustainable business models.

Additional benefits of a PEST analysis include: "a greater understanding of your company, more effective long-term strategic planning, heightened attention to potential threats and dangers, [and] insight for valuable business opportunities" [79]. However, there are some limitations. Generally, PEST is more effective in larger businesses that are strongly affected by macro events [81]. In addition, because the analysis focuses on the present and the past, it can be rendered useless within hours, days or weeks, or last more than a year, depending on the stability of the market or political environment [79]. A suggestion by *Business News Daily - Small Business Solutions & Inspiration* to make PEST more effective and valuable, is to use it "in conjunction with SWOT (strengths, weaknesses, opportunities and threats), MOST (mission, objective, strategies, tactics) or SCRS (strategy, current state, requirements, solution) analyses" [79]. This paper will not cover MOST and SCRS in detail, but they are recommended to consider if building or adjusting a business model. In the section about the SWOT analysis, the criticism included that there was no official way to mark urgency. As the PEST analysis lacks this also, J. Post suggests to measure each of the factors against the following grid [79]:

- Potential impact: low - high
- Time frame: immediate - long-term
- Type: positive or negative
- Direction of impact: increasing or decreasing
- Relative importance: high - low

With this grid, strategic planning can be aided as more urgent matters can be attended to first.

3.2.6. RESTART

RESTART is a process model that acts as a guide for business models that are redesigning and changing to accommodate and exploit the comprehensive sustainability problem [83], meaning that it is potentially less

applicable for new entrepreneurs. The process is divided into four phases: *recognize, rethink, reinvent,* and *reorganize*. The authors of this process, S. Jorgensen and L.J.T. Pedersen, have included a visual representation of the process (see figure 3.14), where the central 'create, capture, and deliver value' portion represents the business model and the circular flow enclosure represents the steps of change to the business model. For

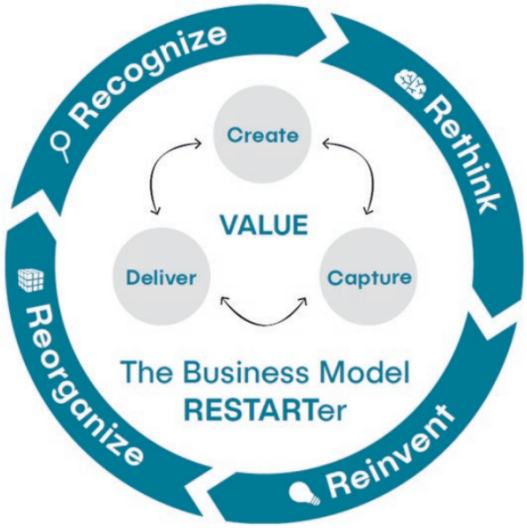

Figure 3.14: The business model RESTARTer process for sustainable business model innovation. Figure retrieved from [83] (p.185)

each of the four phases, guiding questions have been established. Some of the questions are directly related to parts of the business model, such as: "Who are you target customers, what problems do they have, ...?", but some also ask the developer to think beyond the borders or the internal business itself: "What are the main negative and positive externalities of your business model?" [83], which is also one of the key questions in the Rapid Environmental Assessment (REA) under System effects. This latter type of questioning creates awareness for the developer surrounding the various aspects of sustainability (social, economic, and environmental). All of the guiding questions are listed in table 14.1 of [83]. The authors indicate that in order to use this tool successfully, it is not only a question of knowing the company's business model, its threats and opportunities (i.e. completing a SWOT analysis), but more importantly, being able to analyze the company's entire ecosystem. Within this analysis, it is also important to establish whether there even is a supportive culture to RESTART amongst all levels of the business [83]. If this is the case, the process of RESTART can begin. However, in some cases, the authors argue that the reverse ordered approach TRATSER can be more beneficial to a company, as it forces the consideration of 'three-dimensionality' (finance, society, and environment - profit, people, planet) from the beginning of the change process [83]. In a sense this approach incorporates various approaches discussed above (SWOT, triple bottom line, REA) and links it back to the business model. However, because these specific elements are more hidden in this approach, it only becomes clear when the other approaches are known, meaning that the approach can only be used with very clear and detailed instruction. Again, the balance between simple clarity and complex depth seems difficult to find.

3.2.7. SURE Approach

The **SURE approach** stands for Sustainable Rural Development and is therefore a method that is specific to developing regions and focuses on rural development [42]. This thesis report does not address a rural business specifically, considering the case study area will be a city, but since the resources for biogas must come from the land and farmers, rural development is adjacent and vital to this project, as the two are linked via resource supply chains. In addition, this is the only method so far focusing on underdeveloped regions; therefore, within the approach itself, much can be learnt. Furthermore, the authors address that the SURE approach can be used in any area where new skills and knowledge, and a changing mindset is required [42]. Being focused on rural development, the authors of the method point out that, although opportunities may exist, one should not overestimate the capacities of the business owner in these settings [42]. This means that simple and small steps are needed to get to the bigger picture or new opportunity. Things often taken for granted, like bookkeeping and time management, are not guaranteed, and anything 'new' may be re-

jected due to the unknown and long-standing traditions. Also, besides all local social conventions, values and mindset will play a crucial role. This can mean that traditional classroom learning may be unsuccessful, and 'learning on the job' may prove fruitful [42]. To aid with these new difficulties, the SURE approach defines three steps (taken directly from [42]):

1. *Step-by-step improvement of the production*
2. *Cooperatives and small enterprises*
3. *Chain management, infrastructure and regulation*

The first step should have low financial demands (small investments and small risk), a high level of professionalism and immediate results. In this step, the owner can also grow by learning new skills and expertise, and start developing an entrepreneurial mindset to learn to deal with the innovations effectively [42]. The second step focuses on building trust and setting up partnerships. The authors suggest to keep these cooperations small at first, to create a good basis of trust amongst one another [42]. The third and final step 'ups the game'. The cooperation must start to function on a high level of professionalism (towards the customer) and become consistent in its relationships, as well as with the product or service delivered [42]. As many in rural areas have always 'learnt by doing', the authors impress on the reader that these processes are likely to take time and will only become successful when the new way of doing things has become habit and routine [42].

This approach focuses more strongly on the social impact on a business' success. It does not speak specifically of the triple bottom line - profit, people, planet. Profit is obviously incorporated because without, there would be no business. The focus on people is clear, as the approach highlights the effects on how they can make or break a business and develop as a result of this. However, within the approach itself, there is little mention of the environment, or 3rd 'P', planet. The authors state: "It is the explicit objective of this approach to empower their [rural farmers / workers] capacity and promote the development of the countryside on that basis." [42]. The environmental aspect of the triple bottom line is assumingly more implicit in this approach, as it is called *Sustainable* Rural Development. Of course a business can be sustainable in the sense that it may last long while creating a profit, but there is a growing consensus that when referring to a 'sustainable business', it is in reference to long-term profitability within the framework of a balance with its surrounding ecosystem and preventing additional externalities adversely affecting climate change. The reason I make a point here is because the authors do speak of "empowering their capacity" and "increasing production". While an increase in efficiency is often a key signal for improved sustainability, if it is done through the excessive use of chemical fertilizers (with high greenhouse gas emissions), leading to soil erosion, one should consider if this is the right type of development that is being promoted. Therefore, this approach should be used in combination with the morals of the triple bottom line, or extended to include attention to its effects on the environment.

As a counterargument, one could argue that taking care of the environment is not a luxury these entrepreneurs have when they are still working on a daily basis for their next meal, but as an approach developed by Westerners for enterprises in developing nations, we do not have the luxury to let such an important opportunity slide. In addition, although incorporating aspects of the environment may make it more complex, in the end, adopting the mentality of the triple bottom line sooner rather than later will likely aid these countries to level the playing field with the West faster and become a part of the global economy.

3.2.8. Lean Start-up Method

Similar to what was described in the previous paragraph with the 'step-by-step', the lean start-up approach is based on the idea that the first step of a new enterprise should cost little and test the validity and potential success of the business model [42, 77]. This validation process is a vital step to complete in order to revise the business model before making any investments to scale up or officially found the business [77]. Lean thinking is not a new concept and was first addressed by Henry Ford in 1926 [84, 85]. It is closely related to frugality, a concept known to almost everyone - especially amongst previous generations - in one way or another. In 2013, J.T. Scott defined the lean thinking business philosophy as demanding "the total and systematic elimination of waste from every process, every department and every aspect of an organization" [84], where waste is defined as "the use or loss of any resource that does not lead directly to what it is that customers want - and what customers want, ..., is value" [84]. Basically, he argues that anything that can be eliminated without the customer noticing, should be eliminated [84]. In the entrepreneurship training of PUM in Mekelle, they teach similarly that adding a special feature to a product and founding a business around this only works if that feature is considered valuable by the consumer, which is exactly why the validation step is so important

[76, 85]. Once the business is founded and larger funds need to be borrowed, making the entrepreneur or business owner vulnerable to any threat (change in demand, political unrest, insufficient supply of resources, etc.), you want to be absolutely sure that the business concept will sell once production starts [84]. J.T. Scott even argues that removing this type of vulnerability will directly increase productivity and reduce delays and accidents because the employees are more assured in their job; the job they are doing is essential to the company and the company itself is on stable ground [84]. Common areas in which 'waste' can be found are over-production, waiting, moving items needlessly, over-processing, inventory, unnecessary motion, defects, employee resistance and under-utilizing people [84].

How one should exactly approach the lean startup method is described in *The Lean StartUp - How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses* by E. Ries 2011. Ries's model is visualized as in figure 3.15. The steps of the Lean start-up method are:

1. Vision: Set up "Leap-of-Faith" assumptions for testing
2. Build: a minimum viable product to test the assumptions
3. Measure: Create an accounting system that allows for the evaluation of progress
4. Decide: Create a method that will help decide whether to pivot (go back and adjust) or persevere with the original idea

The related motto's are: "Eliminate uncertainty", "Work smarter not harder", "Develop an MVP" (minimal viable product), and "Validated Learning" [85].

The four steps above are not a one-time walk-through. Ideally, entrepreneurs create a mindset of continuous improvement and re-evaluation that will allow them to grow and become successful. In addition, they will learn to accelerate and complete this process more efficiently each time [85]. The book describes several techniques to do so; they are not discussed in this report. Steps 1 and 2 and the mentality of being open to continuous improvement is also what is taught at the entrepreneurship program in Ethiopia. The last two points are not strongly emphasized, likely because they tip the scale to a more complex and scientific approach [85] that is not likely to resonate with entrepreneurs that are used to a 'hands-on learning' setting [16, 42, 77]. Although it may not be applicable in full in developing nations, the frugality aspect and minimization of risk through this approach are important to consider in future endeavors and case study development later in this report.

3.3. Summary, Critical Reflection and Criteria for the Business Model Framework for Developing Nations

The two previous sections have summarized the findings from literature review and desk study to answer the questions:*What sustainable and/or circular business model frameworks and approaches exist and are there any that focus specifically on developing nations?* and *What are the advantages and limitations of the reviewed business model frameworks and approaches?* In this section, sub-question 3 is answered: *Based on the advantages and limitations of the reviewed business model frameworks, what criteria can be established for the design of a business model framework for developing nations that incorporates the principles of sustainability and circularity?* An overview of the reviewed business model frameworks has been provided in table 3.1. The resulting criteria that have been determined based on the advantages and limitations of the frameworks are listed in table 3.2.

From the various papers, the trend that is observed, is that most authors try to create one framework that suits all: the ideal business model canvas that will work in any application. However, most authors have only looked at business models in the developed / Western world and considered their personal or field of research's values to create their frameworks. They then include the environment and societal aspects to develop circular and sustainable business model frameworks / methods and argue that all three - profit, people, planet - should play an equally important role. However, with that logic, these models can never be 'one-fits-all', since society, the environment, and the way business is done vary per location over the globe and the focus and values per location are different. No one can fault these authors for trying because it would be ideal if every business could be placed or created in one canvas. It would make comparing businesses and analyzing them a lot easier. However, doesn't the fact that most authors build their canvases/frameworks based on the Business Model Canvas (BMC) of A. Osterwalder and Y. Pigneur or the ReSOLVE framework developed by McKinsey (see table 3.1), and the resulting critique often being that their work is too complex, too time-consuming, too specific, lacking a methodological approach, lacking insight from multi-disciplinary

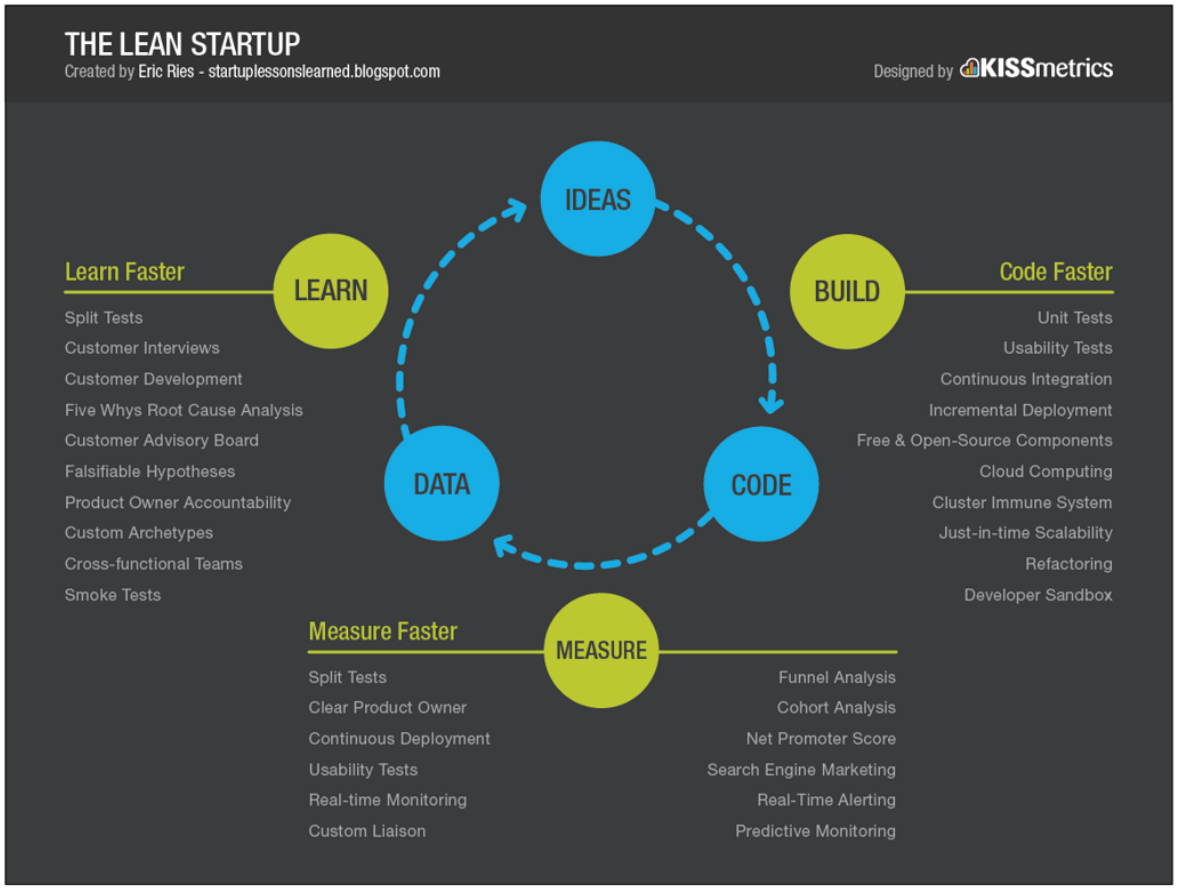

Figure 3.15: The Lean StartUp Method by Eric Ries. One should minimize the total time to go through the loop and create a mindset of continuous improvement. Figure from [86].

applications, or even proof of functionality [56], mean that there already is a 'one-fits-all' type of framework? After all, A. Osterwalder and Y. Pigneur's Business Model Canvas was created based on the insights of 470 practitioners in 45 countries [45]. Of course the BMC alone might not be perfect in each situation, and yes, at the moment, the focus on circularity and effects on the environment should likely receive more attention with the societal 'green' movement being prevalent, but perhaps it is not another 'one-fits-all' canvas that is required, but rather a modular BMC approach based on which goals one wants to achieve. Creating such modules for specific goals would be a work in itself and therefore not possible to create within this thesis project. However, creating modules to create value for the triple bottom line (social, economic, environmental) and integrate frugality to make a framework that works for developing nations, can be attempted.

Table 3.1: Overview of the Business Model Frameworks reviewed in Section 3.1.

Framework	**Author**	**Based on**	**Added components**	**Suggestions**
Business Model Canvas (BMC)	A. Osterwalder & Y. Pigneur - 2010	470 professionals in the field		
Extended Business Model Canvas (EBMC)	B. Vastbinder, O. Kroesen, E. Blom & R. Ortt - 2011	A. Osterwalder & Y. Pigneur Low-income economy restrictions	Social costs Ecological costs Social revenues Ecological revenues	Research in the social environment (infrastructure) in which these businesses need to succeed

Continuation of Table 3.1

Framework	Author	Based on	Added components	Suggestions
Triple Layer Business Model Canvas (TLBMC)	A. Joyce & R.L. Paquin - 2016	BMC A. Osterwalder & Y. Pigneur The triple bottom line	BMC layer for environmental life cycle BMC layer for social stakeholder business model canvas	Incorporate circularity via the End-of-Life component
Circular Business Model Canvas (CBMC)	M. Lewandowski - 2016	BMC A. Osterwalder & Y. Pigneur Literature on circular business models	Take-back system Adoption-factors	Incorporate the suggested circularity in each component to ensure circular economies
Sustainable Circular Business Model Innovation Framework (SCBMIF)	M. Antikainen & K. Valkokari - 2016	BMC A. Osterwalder & Y. Pigneur TLBMC A. Joyce & R.L. Paquin Circular economy values	The Business Ecosystem level with 'trends and drivers' and 'stakeholder involvement' The Sustainability impact level with 'sustainability requirements' and 'sustainability benefits' The Sustainability and Circularity Evaluation of the Business Model Pillar	The key stages of business model innovation processes should be straightened out as a support tool to entrepreneurs
Ecocanvas	A. Daou et al. - 2020	BMC A. Osterwalder & Y. Pigneur Circular economy values	Economic and legal forces in circular business model Environmental Foresight & Impact Social Foresight & Impact	Make the three added components (triple bottom line) part of the core business Use the tools described in Appendix A of [65]
Frugal Business Model Canvas (FBMC)	G. Perangin Angin - 2019	BMC A. Osterwalder & Y. Pigneur Frugal innovation of S. Winterhalter et al. [66] and E. Rosca et al. [67] for serving BOP	Adoption factors Mission values Objectives Impact measure Output measure	Beware of sufficiency of products to avoid the effects of mass consumption due to affordability

Within the Frugal Business Model Canvas (FBMC) created by G. Perangin Angin - the only business model framework developed specifically for developing nations - the focus of the added components seems to be on creating awareness for the economic, environmental, and societal value that is created by the mission for the Bottom of Pyramid (BOP) citizens, and setting up methods to analyse whether this value is truly created. Summarizing these goals make the canvas sound like an integration of the SURE approach and the lean start-up method, as well as the values of the triple bottom line. However, not in as much detail or guidance to truly achieve the individual goals of these methods. If the literature by O. Kroesen, R. Darson and D.J. Ndegwah [42], and the experiences of T. Van Kampen at PUM [77], K. Robinson and M. Robinson [16] are considered, a business model for an entrepreneur in a developing nation - whether with initial foreign guidance or not - will need a clear and simple instruction manual to be successful, with small steps and oftentimes hands-on learning. In addition, one thing all authors of frameworks for circularity and/or sustainability agreed on was:

the triple bottom line must be served. Therefore, to create a sustainable and circular business model framework for developing nations - or a BMC with modules social/culture, environment, circularity and frugality - this canvas needs adjustment.

Reshuffling, remodeling, and adjusting the canvas leads to a common issue of the field of business model framework development: simplicity and clear structure versus complexity and in-depth guidance. Finding the right balance is incredibly difficult, as can be seen by the critique on the various business model frameworks. Hence a clear modular structure might be a good compromise. Based on the reviewed criticism and strengths of each framework and approach in the literature review above, several criteria can be formulated that must be integrated in any business model framework that will be designed for developing nations. Some, such as creating value for the triple bottom line are common and true for most business model frameworks, but some are specific to developing nations. Both have been listed. For a comprehensive sustainable, circular business model framework for developing nations to be created, the criteria are as listed in table 3.2.

Table 3.2: The criteria for a sustainable and circular business model framework for developing nations based on the reviewed Business Model Framework (BMF) and Business Model Approach (BMA), their advantages and their limitations; specifically in relation to developing nations.

	Preliminary criteria for a sustainable and circular business model framework for developing nations.
1	**Develop a clear and practical, yet detailed and guiding tool** - The tool should be able to be used and understood by individuals with limited entrepreneurship experience. Guidance is especially important for setting up the value proposition. Validating the assumptions of a consumer need on which the value proposition is based, is a step that is often skipped but crucial to success and long-term sustainability of the business. An overall balance between a clarity and depth needs to be found.
2	**Slow, close, and narrow resource loops to stimulate circularity and implement where-ever possible** - Financial and environmental benefits can be obtained due to direct cost-savings, minimized resources and increased efficiency.
3	**Stimulate fore-sight and constant re-evaluation and improvements** - Being aware of changes in your environment can allow potential arising barriers to be removed ahead of time. Foresight should be applied to various areas including socio-cultural aspects, politics and legislation, market developments, environmental changes, positive and negative externalities, etc. Re-evaluation stimulates innovation and optimization, as well as expansion and advancement which leads to cost savings, increased efficiency, increased income and success.
4	**Create a clear link to strategy development** - "Work smarter not harder" is the motto to follow. A strategy for long-term sustainability of the core business' operations as well as of internal management must be set up.
5	**Include local culture/cultural habits as part of the business plan and strategy** - Identify long-standing traditions or habits that will be affected by the business plan and address the potential barrier they may form within the business model and/or strategy.
6	**Ensure mutual value creation** - The stimulation of equality between supplier, entrepreneur and customer by creating value for and between all parties within the business model allows all parties to benefit from the business, stimulating lasting relationships and business success. For example, by including education and training in the business model. It increases employee knowledge and awareness and allows for insight in the contribution the employee is making. This stimulates loyalty that benefits the entrepreneur and the stability of his/her business, which benefits the supplier in his/her business.
7	**Make the triple bottom line part of the core business** - The environment and society should be considered as stakeholders like the consumer and supplier in the previous criteria. Mutual value creation over the triple bottom line allows sustainability to be achieved.

	Table 3.2 continued.
8	**Adopt a frugal mindset** - Minimize resources, minimize costs and minimize risk. Follow the lean start-up principles to create high value and affordable solutions. Consider the local resource constraints and (rural) conditions to create durable goods that last in harsh environments. Design for use by unskilled labor. Design for a specific need and assume a zero-environment mindset. Keep supply and operations local for market proximity benefits. Remember that competition is often with non-consumption and that profit margins need to remain slim. Be aware of stimulating mass consumption.
9	**Create a clear balance and role division between for-profit and non-profit stakeholders with a formulated exit plan of the latter over time** - For businesses to be established and successful in a developing region, working with a local non-profit organization can prove fruitful, but the business should not rely on it long-term. A clear exit strategy should allow the business to survive this transition.
10	**Stimulate female empowerment** - Hire females specifically. Their employment will increase the community's productivity and stimulate economic development, which adds value to society.

The reviewed literature and these resulting criteria for the development of a business model framework for developing nations make it clear that besides theory on business model frameworks and methods, the culture of the case study area needs to be understood. This is necessary to understand and properly integrate modules for the socio-cultural values, determine opportunities and barriers in supply chains, develop strategic and culture-value fitting mindsets and proper management of the business. Most of the criteria above are related to socio-cultural values one way or another, as well as the local economic situation. Understanding a country and culture is difficult when not experienced first hand, but in the following sections, the drivers and barriers of biogas initiatives in Ethiopia are discussed, which will reveal parts of the local mindset. In addition, locals now abroad, and foreigners working in Ethiopia are interviewed to better understand the local culture and how it may affect the working of the business modules.

4

Drivers and Barriers of Business Endeavors in Developing Nations

This chapter reviews drivers and barriers that are commonly experienced by entrepreneurs in developing nations and translates them into criteria for a business model framework that preemptively addresses these barriers to enable entrepreneurs to set up successful businesses in such regions. Because literature on this subject in an overview or review type of manner is limited, a specific business endeavor is chosen to complete a more in-depth analysis. The chosen business endeavor should be both relevant to and reflect the main research question, as well as be relevant to the case study. Therefore, the National Biogas Programme Ethiopia (NBPE) is chosen to be reviewed. It is a business endeavor that has a foreign partner and introduces a sustainable and circular technology to meet the Millennium Development Goals (MDGs) (discussed in section 1.1.1) and stimulate national development. In addition, the NBPE prepares relevant knowledge for the case study of biogas in Mek'ele, Ethiopia because of the corresponding technology, location, and goals. To recap why only one nation is reviewed specifically and why that nation is Ethiopia, recall section 1.2.4.

The first section of the chapter focuses on reviewing the National Biogas Programme Ethiopia (NBPE) and its drivers and barriers, after which a preliminary list of criteria is developed. Next, the chapter discusses commonly determined barriers of entrepreneur in developing nations based on the limited 'general' literature found. Again a list of preliminary criteria is formulated. Based on the common criteria that local culture must be taken into account, the chapter continues with a section including an elaboration on local Ethiopian culture, cultural differences between Ethiopia and Europe / the United States of America, and how it affects business. This section is concluded with a list of insights and recommendations for entrepreneurs active in Ethiopia. Finally, all three lists in this chapter, including the list of criteria from the previous chapter are cross-referenced in the next chapter to create a final list of criteria for a business model framework that preemptively addresses common barriers and integrates aspects of sustainability and circularity. Per section, the addressed sub-questions of the main research question are noted.

4.1. The National Biogas Programme Ethiopia (NBPE) and its Drivers & Barriers

In this section, the business model of the National Biogas Programme Ethiopia (NBPE) is presented, followed by an analysis of technical, political, economic, social and environmental drivers and barriers that were encountered during the development and implementation of the NBPE. The drivers and barriers of the NBPE are based on literature review, desk study and any additional information provided during the interviews from section 4.3. As many factors are involved, they have been bundled and are discussed per category. The categories are technical, political & institutional, economic, social and environmental. The aim of this section is to identify what parts of the NBPE worked or made a positive impact, and what the main barriers were. From this, criteria can be formulated to determine what advantageous aspects should be reused and which barriers need to be addressed in the business model framework for developing nations. Integrating these criteria will allow for proactive solutions to be developed by entrepreneurs in developing nations and for the case study of biogas in Mek'ele, Ethiopia. To ensure that the established criteria are applicable beyond Ethiopia, the findings will be cross-matched with literature from other developing countries in the next section. The

sub-question that is addressed in this section is: *SQ 4 - What are the drivers and barriers of a business in a developing nation with a foreign partner or owner, such as the National Biogas Programme Ethiopia (NBPE)?*

4.1.1. National Biogas Programme Ethiopia (NBPE) - Description, Goals, Targets and Initial Insights

The National Biogas Programme Ethiopia (NBPE) was developed after a formal partnership between the Stichting Nederlandse Vrijwilligers (SNV) and Ethiopian Rural Energy Promotion and Development Centre (EREDPC) had been established. The main motivations to set up the NBPE were the vast deforestation and consequent increase in the use of dung and charcoal for cooking, along with the related negative health impacts due to indoor air pollution [41, 87]. Biogas presented itself as a viable solution as many (ca. 77% (2016) [44]) rural Ethiopian families that are affected strongly by diminishing biomass resources - more time, effort and money spent on retrieving burning wood or charcoal from further away - own cattle that produce dung. In addition, biogas promised improved decentralized rural access to energy, the development of a commercially viable biogas and bio-slurry market, an improved private sector, a reduction in poverty and increase in overall welfare [41, 44, 87, 88]. The program closely resembled the goals and principles of the Energy Policy and Environmental Protection Strategy and Plan for Accelerated and Sustained Development to End Poverty (PASDEP) and therefore found enough support to be implemented [34, 35]. The goals of the program were to install 14,000 biogas plants, develop a commercially viable biogas sector, reduce carbon emissions, and improve health, decentralized access to energy, opportunities for females and general welfare [41, 44, 87, 88]. A detailed list of informal and formal benefits in the micro, meso and macro level have been summarized in the business proposal of the NBPE (pg. 7) [41]. To ensure proper operational management of the program, the lead institutions at the national and regional level became the EREDPC and the Mines and Energy Agencies (MEA) / Energy Department, respectively. In addition, the National Biogas Programme Coordination Offices (NBPCO) and Regional Biogas Programme Coordination Offices (RBPCO) were established for the operational management of the program on a national and regional level [41]. For the specific roles and targets of the various institutions and coordination offices, please consult [41] (pg. 8) and [88].

The National Biogas Programme Ethiopia included help to "install and manage biogas digester plants through promotion and marketing, providing demand subsidies, training, quality management, research and development, monitoring and evaluation, and institutional support" [87], as well as gender mainstreaming [41, 88]. In addition, awareness campaigns were held to inform potential producers and consumers of the physical and financial benefits [87, 88]. Financially, the program provided support by setting up microfinancing opportunities for long-term, low interest credit, and making a subsidy available for up-front costs [87]. To support the development of the biogas market sector and stimulate the use and attractiveness of the new technology, private suppliers on the competitive market were set up, along with the certification of installers [41, 87]. The use of the competitive market should keep prices low and provide incentive for improvements and sustainable business practices [41]. To certify installers, tailored training was provided through the establishment of training and resource centres in the four participating regions: Oromiya, Amhara, Tigray and the The Southern Nations, Nationalities and People's region (SNNP) [41, 87]. Furthermore, additional services by SNV-Ethiopia and other local capacity builders included providing technical assistance, "advisory services, resource mobilisation and knowledge brokering" [87].

The target of the first phase (NBPE-I 2008-2012) was to install 14,000 biogas digesters with 7,000 domestic sanitation facilities connected to the plants, followed by an upscaling to 100,000 bio-digesters [41] (other sources indicate respective targets of 14,500 and 20,000 [44], and 14,000 and 18,000 [88]). How many have actually been installed also varies per source, with numbers varying: 8,000 (2015) [43], 12,884 (*2015) [44], 13,000 (2019) [87], 23,802 (2019) [89], 18,534 (*2020) [44], and perhaps the most reliable source, but outlier value: 30,000 (2020) [90]. The varying numbers may be explained by varying and sometimes unknown / not explicitly stated (indicated by *) publication dates of information sources, varying starting dates of counting, and also because the plan was modified several times during implementation. What sources do agree on is that after phase I, only ca. 60% of the bio-digesters were working [43, 91]. Furthermore, the program also included plans to fund several research papers to analyse effect and progress of the program [41]. The key implementation strategies of the included a multi-actor approach and public-private partnership for the promotion and dissemination of the NBPE in addition to the market-oriented / commercial approach of using the competitive market where the consumer pays. For details see [44] and [41].

Phase II of the NBPE (NBPE-II 2012-2017) was a 5-year follow-up plan that included the further development of a commercially viable, market oriented biogas-sector with the benefits of reduced carbon emissions and creating access to efficient domestic energy [37, 92]. The SNV acted as a main supporter again

and helped at national and regional level to support program management, leadership, sector development and participation, entrepreneurship, quality management, change management, capacity building of coordination units, promotion of biogas and bio-slurry, technical support, and female empowerment [88]. The organization also aided in the development of a national framework and financial opportunities for farmers [88]. The target was to introduce another 20,000 bio-digesters [92]. On April 11, 2019, 23,802 bio-digesters were constructed under NBPE-I, NBPE-II and NBPE+ which was launched in 2017 [89]. Of these 23,802 bio-digesters, on average, 79% of the bio-digesters work without problems [89], meaning that functionality has increased over time, which was confirmed by a contact at the SNV [90]. This may be because of the increased amount of trained maintenance workers, the improved after-sales service, the proper instruction of use and operation, and a one year guarantee [89].

NBPE+ followed phase II of the NBPE as the next 5-year plan (2017-2022) [89, 93]. This project progresses beyond its initial borders as the backing is not only by the Dutch Government through the SNV, but it is also backed by the European Union. Furthermore, targets include bringing bio-digesters to 36,000 households - reaching 180,000 rural people, expansion into the regions of Afar, Benishangul-Gumuz, Gambella and Somali, and piloting 40 larger bio-digesters for businesses and institutions [90, 93]. Under NBPE+, use of toilets has improved. For the 94% of bio-digester using households that own a toilet, 84% have been connected to the bio-digester [89]. This has improved the use of toilets, reducing open defecation and flies, while also acting as a major time-saver since new toilets/latrines do not need to be dug every few months [93]. There are also reports that bio-digester construction is becoming a lucrative business, attracting young people to engage in the business [93] which is necessary to create a healthy support base for market sector development and sustainability [90]. Under the NBPE+, the country also received its first UN certified emissions reduction payment for the reduction of 34,380 tons of $CO_{2,eq}$ [94]. Part of the revenue from this payment is reinvested in the NBPE+ in support of households trying to purchase bio-digesters and increasing maintenance on existing bio-digesters [94]. The next sub-sections focus on drivers and barriers that were encountered during the various phases of the National Biogas Programme Ethiopia (NBPE).

4.1.2. Technical Drivers & Barriers

One of the main drivers of the bio-digester as a technology was the fact that it was multi-purpose [95]. It was not only a technical means to an end (clean cooking), but also provided opportunities and involved many positive externalities. For example, clean cooking does not only bring comfort [37], but also improves health [20, 37]. The biogas can also be used for lighting, saving electricity costs and reducing dependence on the electricity grid. In addition, the by-product, bio-slurry, can be sold off as an additional source of income or used as an organic fertilizer, meaning that the original purpose of the cow dung, that is used as feed in the bio-digester, can now function as both an energy source and fertilizer, instead of just one of the two. In fact, many argue that using bio-slurry as a fertilizer has resulted in better crop yields, quality and taste [37] than dung alone or agro-chemical pesticides which often come with other health and environmental risks and additional costs that can now be saved. Furthermore, the dissemination of the technology allows for the development of the private sector and use of a competitive market [41, 88], along with the creation of new jobs at various levels, especially amongst youth [96]. And besides all this, the technology also contributes to carbon emission reductions [32, 94], helping solve one of the largest global challenges to date, climate change. When looking at this summary, one would believe that this technology is the answer to many local problems, but one should not forget that the system in which it is has been placed is not ideal. There are many factors that stimulate or hinder the expected results from this technology. This sub-section discusses the technological drivers and barriers in more detail.

All the promises this technology makes and the hopes it represents are a major driver to implement bio-digesters. On a purely technical aspect, the technology is also suited for its application and region because it is sturdy and will hopefully last for 30-40 years [37, 90], which is an important factor for innovation success in developing regions [43, 66, 67]. A further driver was that building the bio-digesters became simple and faster once the design had been standardised [95]. However, for a long time, the lack of a standardised design was a barrier [41]. Also, once the production of bio-digesters began to increase and speed up, shortages in material led to an increase in costs [97], which cover about half of the construction costs [89], hindering dissemination. Additional technical problems were that there were issues of water condense, blockage of pipes, corrosion, cracks in the digester dome, broken pipes and gas/water drain valves, unidentified leaks or disturbances in gas transport, the lack of a manual, and the lack of measuring tools to interpret production status and help with problem solving [89, 91, 95]. This became especially important because there is a lack of monitoring, follow-up, and maintenance mentality [36, 91, 95], which made bio-digesters unreliable [36]. Towards the

end of NBPE-I and NBPE-II, this resulted in the fact that almost 60% of the installed bio-digesters were not functional [43, 91, 95] and that there was a trend of moving back towards the use of traditional fuels [36, 89].

A disadvantage is that the bio-digesters require farmers that have minimum amount of cattle and access to water to run the digester [89, 91, 95]. With water shortages being common in Ethiopia [16, 38, 43, 91, 95] and some farmers only having a couple of cows [41] or being nomadic [36], this is a barriers to widespread dissemination of bio-digesters. For example, a nomadic farmers can neither own a bio-digester or act as part of the supply chain. A final barrier that affected widespread dissemination was that there is a deep-rooted practice of eating injera, a staple food made from fermented teff four dough [36, 43, 89]. For this type of food, a specific stove is needed. Interestingly, the need for an injera-biogas-stove was identified in the NBPE business plan in 2007, but is consistently mentioned as 'undeveloped' throughout the years ((2015) [95], (2016) [43], (2017) [36], (2018) [98]), even though there was a stove designed in 2014 [99]). In [98] (2018) the arrival of an injera stove is promised, and a paper from last year (2019) discusses another new design [100], but mentions it needs further development before distribution. What hinders the proper development of the injera stove is not stated clearly. A potential issue is that the baking of injera is not very efficient and uses a lot of fuel, whether biomass or biogas is used [89].

4.1.3. Political/Institutional Drivers & Barriers

The political and/or institutional drivers and barriers are too complex to analyse properly without understanding the country as a whole, including the national, regional, and even international politics. Analysing the country's politics in detail goes beyond the scope of this paper. Therefore, this sub-section will limit itself to summarizing the drivers and barriers that have been found in the reviewed literature.

The National Biogas Programme Ethiopia (NBPE) is in line with and supported by the United Nations Sustainable Development Goals [101], Ethiopia's Energy Policy and Environmental Protection Strategy, and Ethiopia's Plan for Accelerated and Sustained Development to End Poverty (PASDEP) [34, 35, 41]. Together with the extensive and suitable sectoral policy, an almost complete network of (regime) actors [43], and the support and backing from a foreign government (the Netherlands) and the European Union since NBPE+, the NBPE was set up to be a large and successful program. First order learning among this network of actors and governmental institutions also seemed to be present and help the project progress [43]. However, during phase I of the NBPE, it became clear that the institutional structure that had been planned to be used (phase I structure) was not adequate or meeting expectation with regards to the set targets and goals [95]. Improvements in institutional structure made dissemination of bio-digester better [95], but was not enough to meet the targets. In fact, L. Kamp and E. Forn argue that the diffusion process was "not designed for the context of the receiving country" [43], and report "poor alignment in network of actors - many mismatches between governmental bodies and levels" [43] as one of the main barriers. An additional barrier that may have been underestimated at first, is the amount of "lock-in regime of firewood" [43]. The widespread use of biomass for cooking was one of the largest drivers for the various governmental actors and Stichting Nederlandse Vrijwilligers (SNV) to set up the NBPE [41, 89]; however, it was not perceived as a driver amongst potential consumers. The consequence of the lock-in regime of firewood - a direct lag in acceptance of the new technology - is easily explained via the Dutch proverb *'onbekend is onbemind'*, which roughly translates to 'unknown is unloved'. Many farmers or farming communities that come in contact with the technology for the first time are hesitant to invest in the 'unknown' before it has been tested and proven. Even with testimonials and the achievements of the NBPE, they are hesitant to believe what they hear about the benefits of bio-slurry, for example [93]. A biogas expert from the Water and Energy office in Were Ilu testifies that the only way to overcome this is to improve stakeholder commitment, keep the systems affordable, and promoting the project more broadly [93]. For example, if the Office of Health can promote the benefits of a toilet connected to bio-digesters, or if the Office of Agriculture can testify to the increased productivity of land through the use of bio-slurry and compost, or if micro-finance institutes are allied to the project, it can make a significant difference [93][89]. Even better would be if these things are promoted on national TV or via radio [89], as national TV and radio are a part of the culture and a main source of information [102].

Final barriers include the political tension and (economic) instability that have been ongoing in Ethiopia [43, 102, 103]. Especially in the region of Tigray - where Mek'ele is the capital - this situation is enhanced [102]. Trust in the government is not strong because since the election of the new prime minister in 2018, Tigrayans have been repressed as a minority after years of leadership [39, 103]. This means that although the benefits of biogas are recognized, partaking in the NBPE means accepting that the government will come through on its promises of a subsidy and that the technology will be available for use (spare parts, promised cost savings, etc.) during the next few decades. With the political situation now escalated in Ethiopia, citizens in Mek'ele

have first-hand proof that their mistrust was placed correctly. Please note: the previous sentence bares no judgement, but rather tries to show how a certain status quo can reinforce itself, whether it was based on correct assumptions and truth or not. For more information on the current situation in Tigray, please review section 1.1.2 and the Foreword.

4.1.4. Economic Drivers & Barriers

The implementation of bio-digesters in rural farming communities has seen increased rural development [36, 93]. The availability of an organic fertilizer (bio-slurry) that has improved agricultural yield and quality [34, 37, 41, 44], improved soil fertility [35], and acts as a pesticide [93], has additional economic benefits such as the reduced costs for chemical fertilizers and pesticides [37, 89, 93], as well as increased income for selling part of the bio-slurry and compost [44] and the development of a biogas sector [90]. The additional income creates increased buying power which benefits the economy as a whole [36], but also allows for creating employment stations for the activities of, for example, bio-digester management (regular feed input, management of bio-slurry, etc.) [37]. New employment is not only found on farms, but also as masons for bio-digesters and after-sales service and maintenance workers [89, 93, 96]. Furthermore, bio-digesters and the business sector surrounding it are inspiring entrepreneurship and attracting youth, which is vital to the sector's development [37, 89, 93, 96]. One bio-digester user reports that he plans to use his land so that he and his family can become self-sufficient. In addition, he has planned for his 7 children to become 'farmer investors', so they can invest in high value crops and market to improve their income and welfare [37]. Other areas of entrepreneurship can be found in the niche markets and export of bio-slurry [36]. Another driver supporting both the bio-digester dissemination, but also the economy as a whole through supporting entrepreneurship is the availability of micro-credit [36, 88, 93] and some regulatory mechanisms that maintain ceiling prices for biogas installations [92].

However, micro-credit is not available everywhere [44, 104], which means that it acts as a barrier in some regions because wide-spread poverty hinders many farmers to invest in a biogas plant [43, 89]. In addition, unclear payment schedules, lack of money, and expecting debt cancellation has led to loans not being paid, especially in the regions of Tigray and SNNP [89], which does not cause positive stimulation of providing additional loans. Under NBPE+, there is hope to improve financial support [89, 90, 93]. In addition, even though the entrepreneurial drive is increasing and the business sector for biogas is developing, the private sector is still weak [43, 44, 90, 103] and a complete network of actors has not yet been established [43, 44], or commitments are lacking, although it has improved over time [93]. The issue of commitment is partially a social one [90] and is discussed more in the next sub-section. Shortages of materials and their rising costs have also not been supportive of general economic development or the construction of bio-digesters [44, 97]. In some cases, it has lead to using lesser quality materials, influencing construction and long-term functionality [93]. Another economic barrier, that is closely linked to social barriers, is the lack of sense of ownership for many of the bio-digesters [44, 93], and if no one feels or is responsible, functionality over time cannot be guaranteed. These type of economic / social barriers, together with the other barriers mentioned here, make for a non-supportive environment for enterprises and innovation [43]. The next sub-section will elaborate on the social drivers and barriers. Often, they are closely linked to trends in the economy because the economy is a direct reflection of human actions, which are based on cultural values.

4.1.5. Social Drivers & Barriers

As mentioned in the previous sub-section, some drivers and barriers are closely linked to and shaped by social aspects. This makes sense because it is human's way of thinking and doing that drives opinions and actions and shapes politics and the economy. This is not a complete one-way street, of course. The environment and other external (political/economic) factors can create push-back, creating a balance over time. Generally, however, humans are driven by anything that will improve their welfare or overall happiness. The bio-digester promises a large amount of improved welfare on various aspects including health, cost-savings, income generation, energy and food security, reduction of labor, and gender equality. However, built-in culture and mindsets can often hinder the speed at which the new developments are embraced, creating push-back on the speed of development. For the dissemination of the bio-digester, it is no different.

Social drivers include that the bio-digesters improve health and save time for all family members [37]. Fixed toilets can be connected directly to the bio-digester, improving overall sanitation and hygiene levels [34, 44, 89, 93]. The amount of toilets that have been connected to bio-digesters has also increased over time: 63% in 2016 [44] to 84% in 2019 [89]. Drivers for this increase are improved health through hygiene, more consistent feed into the bio-digester, and saved time since no new latrines need to be dug [93]. Connecting

a large household or community toilet to the bio-digester improves the reach of the bio-digesters, as families with fewer cattle can also become users/owners. The use of biogas instead of burning biomass, leads to the elimination of indoor smoke and air pollution by which females, children and the elderly are strongly affected [20, 34, 36, 95, 101]. Indoor air pollution is a major cause of premature death among females and children [20]. Removing this improves quality of life aspects and helps achieve Millenium Development Goals 4 and 5 (reducing child mortality and improving maternal health, respectively) [34]. Improved overall health means fewer missed days at work and reduced medical costs [101], leading to better quality of life, stability at work and increased buying power. One user even describes the bio-digester as "a source of comfort and relief" and her very own "health insurance" [37]. Using biogas as a cooking fuel saves large amounts of time because the gathering of wood or dung, or the buying of charcoal is eliminated, as well as the time necessary to prepare a fire for cooking [36, 101, 102]. This directly beneficially influences female productivity and gender equality, as they now have more time to explore or act out new professions [41, 102]. Using electric stoves has the same advantage in terms of saving time, but is often less reliable because energy shortages can occur several times a day [38, 105], and sometimes even unsafe, as safety standards are low [16].

Female productivity itself can be an important driver, whether out of necessity or for improved income. Female family heads need to find a way to balance household activities with work to provide for their children. The same counts for families where the male head of the family cannot provide due to, for example, disabilities, which is very common in Tigray due to the civil and Eritrean wars. With limited to no possibilities to work, many females suddenly become the main provider [16, 102]. In a European setting, this usually means that the 'traditional' roles of male and female are reversed: the woman goes to work and becomes the financial provider and the man takes up household work to the best of his ability, which often solves the problem. However, this needs to be put into perspective. In Ethiopia, culturally, it is still not commonly accepted that the man partakes in household activities (cleaning, cooking, etc.). All six interviewees (see appendix C) agreed that for a man to cook, for example, is generally a taboo. A man living on his own does not cook, but employs a maid or eats somewhere in the community. To Europeans it may seem odd, but this perspective is not purely male-driven; even women consider this to be something only females can do properly [38, 102, 103, 105–107]. One of the interviewees [106] even had the common maid from his campus residence in Oromia complain to him that he did not let her cook because he enjoyed cooking himself, which was "abnormal". Another interviewee [102] shared that her father cannot find work due to a physical disability from the war, meaning that her mother needs to work to provide for the finances. To increase productivity, she invested in an electric stove because the household still falls to her and her daughters. Besides a heavy workload at home, females are also limited in the type of work they do and are often payed less [102], making productivity even more important. In this case, increased productivity is a necessity, but for some it comes as a luxury that allows for improved overall family income, making it an important driver. However, it should be noted that this only works as a driver if there is trust by the potential consumer in what the bio-digester promises (saving time, additional income, etc.).

Increased buying power is a strong driver as it increases overall welfare of the individual and the nation (via stimulation of economic development) and has already been mentioned due to the reduced medical costs. Additional reduced costs, such as for the purchase of chemical fertilizers, pesticides and cooking fuel have been discussed in the economic section, as well as the additional income from selling of the bio-slurry and biogas. Also previously discussed, and discussed in the next sub-section, is how crop yield, quality and taste, and soil fertility improve through the use of bio-slurry.

A social driver that is deeply rooted in Ethiopian culture is the strong social ties. All interviewees noted it as one of the major strengths of Ethiopians [38, 102, 103, 105–107] and literature identifies it as a common value in developing nations [42]. Everyone helps everyone. This also extends to the use of bio-digesters. Strong social ties enforce constant contact with each other. It is time consuming, but also useful. For example, in the case of biodigesters, when one farmer experiences difficulties with his bio-digester, he calls upon his community to help him solve it. Other bio-digester owners can help solve the problem, but also make sure that it is prevented in their own digesters [37]. This hands-on experience learning style is very beneficial for the dissemination of the bio-digesters, as the reputation of the technology increases because expertise amongst the community increases and functionality and reliability is positively influenced [89, 93] making the technology more trustworthy and attractive on a wider scale [16]. This is an example of the first-order learning that was referred to in previous sub-sections.

However, amongst all these social drivers, there are also barriers. It has been mentioned before that there is a stable lock-in regime for the use of fire-wood [43]. There is also a very stable lock-in regime in the baking of *injera* [36, 43, 89, 90], a staple food made of fermented teff flower. Without a proper biogas stove that

allows women to bake their *injera*, the technology is only moderately attractive [37, 89, 90]. Also, although the strong social ties stimulate learning from each other and spreading awareness, a high rate of illiteracy [16, 43], the use of different languages in different regions [43, 103, 106], and a lack of monitoring and follow-up [43, 88, 90, 101] have made first and second order learning slow and difficult [43, 101]. With the start of NBPE+, the focus on spreading awareness and experiences from other farmers and users is increased and has already seen improvements [93].

Additional barriers that often find their origin in deeply bedded cultural values and customs include power hierarchies in the working field (lack of delegation, and male-female hierarchy), the existence of vertical networks and related 'corrupt' behavior, lack of (anonymous) trust - as discussed in some examples above, lack of individual drive and loss of interest, lack of sense of responsibility, lack of commitment, and a consequent lack of management and follow up [42, 44, 89, 91]. It is important that these barriers are not discarded as laziness or simple stupidity. For example, the issue of commitment, which was already referred to in the previous sub-section does not always literally mean that the actor is not committed. This may appear so to the Western viewer / actor because the local actor never specifically or clearly stated that he / she is perhaps not interested, has no time, or simply does not even know what is expected of him / her. In Ethiopian culture, hospitality stands as a high priority, especially in relation to foreigners. An average employee (government staff, teacher, mason, etc.) will not likely contradict you in what you ask or say, and you will be none the wiser, thinking that he / she agreed to something, until you realize that it has only been done once or twice or not at all. Disagreeing, speaking out, or admitting that they lack the skills they need to complete the task is rarely done, and if it is done, only within a very small circle between individuals that have known each other for a long time and have already established trust [16, 90, 102]. The next sub-section goes into more detail on the findings of Ethiopian culture. These type of barriers are not singular to Ethiopia. O. Kroesen, R. Darson and D.J. Ndegwah published thei book *Cross-cultural Entrepreneurship and Social Transformation - Innovative Capacity in the Global South* this year (2020) [42] on how these social factors influence entrepreneurship and the social transformations in developing nations, focusing on the Global South. These characteristic barriers are also not singular to developing or transitioning nations, but are also still present in second-world countries. Although they are less prevalent, they still have the ability to influence international business when one is not aware of them [108]. To determine how extreme some of these factors are in Ethiopia and to determine other cultural difference that could affect business with Ethiopians, six people were interviewed on socio-cultural differences (see appendix C). The results are discussed in sub-section 4.3.

4.1.6. Environmental Drivers & Barriers

Most of the environmental drivers and barriers have already been mentioned, but in this sub-section, they are repeated and the effect they have on the dissemination of the bio-digester and the nation's welfare are included. One of the main drivers almost any report mentions is the reduction of deforestation that can be achieved with the National Biogas Programme Ethiopia (NBPE) [34–36, 41, 43, 44, 87, 88, 95]. The reason this is a driver is because the impacts related to deforestation - droughts, floods, land degradation, reduced crop yields, loss of soil nutrients, reduced feed for livestock, etc. - can be drastically reduced through the use of bio-digesters [35, 36]. In addition, since biogas is made from renewable resources, it reduces the burden of fossil fuel imports [34].

The use of bio-slurry as an organic fertilizer [36] has seen improved soil fertility [35] and agricultural production (quality, yield and taste) [34, 37, 41, 44]. Water and soil pollution due to the mis- and overuse of agrochemicals can also be reduced [34, 35]. This is important for the environment, increasing income opportunities, but also because it will help improve food security for the fast-growing population [34, 35] and reduce the percentage of undernourishment (35.3% in 2007, 27.5% in 2013 [109]) [34]. An elaboration on this follows in section 7.1.

Biogas is perhaps one of the greenest forms of biomass-sourced energy. The argument of whether biomass is truly a net-zero emissions energy form is ongoing; however, for biogas produced and used correctly, one could argue that it is even emission reducing. Animal manure is polluting to the environment due to its large ammonia content. Using it as fertilizer on the fields means releasing it to the environment. However, when used in a bio-digester which does not require additional energy input, the manure becomes biogas and bio-slurry [32]. The first can be used for cooking and lighting, saving large amounts of air pollution like soot because of the elimination of fire wood and charcoal use, and the latter can be used as a fertilizer on the land with improved results [20, 35, 89]. It has additionally been observed to act as a natural pesticide also [93]. This means that another two pollution sources can (in part) be removed: chemical fertilizers and chemical pesticides [89]. This has warranted Ethiopia its first Certificate for the Emission Reductions (CERs) and UN

certified emissions reduction payment this January (2020) for the reduction of 34,480 tons CO2 equivalent for 4,112 digesters [94]. The revenue from this payment will be used to support households in their purchase of bio-digesters and to provide maintenance of the digester [94]. In the coming years, with the spread and increased use of the biogas *injera* stove (*mitad*), the NBPE+ team expects these numbers to go up due to a further reduction in the use of fire wood, which will hopefully also result in a reduced rate of deforestation.

However, amongst all these major drivers is an environmental barrier that proves difficult to solve: water. The bio-digester requires the animal manure to be mixed at a 1:1 ratio with water before entering the bio-digester for optimal use [89, 92]. However, droughts and water shortages are common in Ethiopia [16, 38, 41, 91, 106]. This is not only a problem for the bio-digesters, but also affects livestock feed [35]. Proper and consistent monitoring of the environment and water, soil and air quality and resources has been lacking [34]. This needs to improve and solutions need to be found for the better use of water resources because with a growing amount of bio-digesters, there is also a growing demand for water. This barrier could majorly affect the functionality and spread of the bio-digesters, as well as the nation as a whole [110]. Ethiopia is an unfortunate country when it comes to water. It is an arid climate with a scarcity of water, but also still battles with a shortage of safe drinking water (infrastructure). In addition, with the 'wild card' of climate change, droughts are becoming longer and more severe, which affects food production [110]. However food production is necessary to meet growing population demand. The common approach is to use groundwater aquifers and dig wells, but it is only a temporary solution, as is seen in India, China and Pakistan [110]. A closer elaboration on how the use of bio-digesters - indirect through the use of water or direct via the production of biogas and bio-slurry - affects Ethiopia as a developing nation follows in section 7.1.

4.1.7. Criteria

The reviewed barriers and drivers above were specific to the National Biogas Programme Ethiopia (NBPE). Enabling entrepreneurs to address these barriers preemptively, would provide better chances for long-term successful business endeavors. The current list of resulting criteria is specific to this example. In the next section, general barriers of entrepreneurs in developing nations will be reviewed, resulting in another list of preemptive criteria in table 4.2. A cross-referenced and final list of criteria can be found in table 5.1 in chapter 5. The criteria based on the above literature reviewed are:

Table 4.1: The summary of the criteria based on drivers and barriers of the National Biogas Programme Ethiopia (NBPE). Enabling entrepreneurs to address them preemptively, gives them a better chance at long-term successful businesses.

	Preliminary criteria for a business model framework that preemptively addresses barriers and integrates drivers of (biogas) business endeavors in developing nations.
1	**Validate the customer's need and check for lock-in regimes** - Sometimes a specific need is tied to another criteria. Identifying this from the start allows the entrepreneur to set up a value proposition that truly serves a specific need or want. For example, in the case of the bio-digester, the biogas allows cooking to become a healthier activity; however, because there is no biogas-powered injera stove (*mitad*) available on the market, consumers revert back to traditional biomass burning, making the bio-digester less attractive. In addition, the use of firewood and charcoal is a lock-in regime, just like the consumption of injera is 'non-negotiable'. Knowing this from the start can help adapt the business plan to overcome these types of barriers.
2	**The product/service must fit local conditions and include simple assessment/measuring tools** - The product or service must be sturdy, simple, and satisfy a specific need. Resource constraints must be considered during design. And a standardized design (if possible) should be created. In addition, simple assessment/measuring tools should be designed for production, installation, and after-sale use to help with simple trouble-shooting and problem solving.
3	**The product or service must include a manual/process guide** - The product or service is often constructed or delivered by unskilled labor. They require specific guidance in how to assess and fix certain problems. Including a manual or process guide may help prevent issues like the use of unsatisfactory material leading to additional technical issues or reduced life-span. The manual must include instructions, or even checklists, for follow-up, monitoring and maintenance. To create understanding and incentive, the manual may also indicate the consequences to the product or service, as well as the business. If these guides are successful, they can act as first-hand data from which one can learn for further improvements (stimulate second order learning).

	Continuation of table 4.1.
4	**Consider all externalities** - Considering all externalities, both positive and negative can help identify points by which the company will be judged (weakness) or points that the company can use as an opportunity for improvement (strength). This analysis will help the company create long-term sustainability and influence its own reputation in its community.
5	**Consider the customers, resources, networks, etc. you want to reach, but can't** - In the case of biogas initiatives, nomadic farmers are difficult to include. Farmers with a limited amount of cattle, however, also cannot participate. If they could work in cooperations with other farmers, they could be included. This would require additional work and stimulation from the entrepreneur and his stakeholders, but could be an extension of the business in the future. In addition, considering alternative customer approaches may also lead to an improved business model now. Considering what you want, but can't have, forces the entrepreneur to carefully review what is available to him/her and what not and how this may affect the business or how he/she can get it after all.
6	**Use your networks wisely** - In countries like Ethiopia, social ties are strong and one of the main information sources available. Engaging in these social networks and valuing the worth of this cultural habit will enable to understand behavior and trends. For example, talking to potential consumers can tell you the level of trust they have with certain stakeholders (e.g. government officials). This level of trust (positive or negative) may extend to your business through interaction with such parties. This can help determine who will be strategic and who will be counterproductive partners for business success.
7	**Stimulate, create and improve stakeholder commitment and alignment** - Being successful in this criteria will result in easier acceptance and dissemination of the technology. Being successful means that stakeholders are clear on the expectations, role division and targets that should be achieved. This can require large amounts of networking and potential negotiating to and create incentives and buy-in. This clarity should also extend to payment agreements and consequences for failure to meet expectations. How this is implemented will largely depend on local culture and finding a balance with ones own culture.
8	**Create clear role division and incentivize employees (and stakeholders)** - Commonly mentioned issues like lack of individual drive, lack of delegation, hierarchical structures, loss of interest, lack of sense of responsibility can often be solved by making clear what each individual's role and targets are and what they contribute to the company or business. If necessary, additional incentives can be created to ensure that the roles are completed as expected (e.g. education for themselves or their children, bonus payments based on performance or targets reached, career path evaluations, etc.). The same holds true for stakeholders, as is discussed in the previous criteria.
9	**Include the use of awareness campaigns** - Awareness campaigns spread knowledge and represent an opportunity to stimulate the introduction of renewable and/or waste-reducing technologies. The campaigns can be set up as a 'lead by example' (convention) event and even have demonstrations, testimonials, tester product, etc. Digital campaigns are best led via television and national radio, as they are the two main media for spreading information.
10	**Employ youth and stimulate gender equality** - Integrating the younger generations will help stimulate economic/sector development, but also improve the acceptance of new technologies and stimulate their integration. This may also inspire entrepreneurship amongst the new generations. Employing females increases female and thus community productivity which will enhance economic development and community welfare. In both cases the business then acts as a 'lead by example' function.

4.2. Common Drivers and Barriers of Entrepreneurs in other Developing Nations

The above criteria are specific to a business endeavor in Ethiopia. It is already interesting to note that some of the criteria overlap with the criteria established from the literature review on the theory of business model frameworks. To create a framework for developing nations in general, the barriers and related criteria must be relevant to developing nations in general. Therefore, this sections focuses on literature discussing barriers and drivers commonly encountered by entrepreneurs in various developing nation. To this end, the book *Cross-cultural Entrepreneurship and Social Transformations - Innovative Capacity in the Global South* by J. O. Kroesen, R. Darson and D.J. Ndegwah is used as a reference. The main common drivers and barrier are

translated into another list of preemptive criteria. In the next chapter, the various lists from sections 3.3, 4.1.7, and 4.2.1 down below are cross-referenced to create a final list of criteria. This section contributes to answering sub-question 4: *SQ 4 - What are the drivers and barriers of a business in a developing nation with a foreign partner or owner, such as the National Biogas Programme Ethiopia (NBPE)?*

The authors determine that there are many common barriers amongst developing nations. Some of the main and commonly mentioned barriers are a non-ideal institutional setting, a lack of both competition and cooperation between companies, a lack of anonymous trust, an disadvantageous balance between individuality and community and the common presentation of not hiring based on merit, but based on ones own networks. In addition, it is common in such nations to avoid uncertainty and follow hierarchical structures. Other barriers include a lack of equality and equal rights, tribal-based conflict and tensions, high rates of illiteracy and subsequent unskilled labor. Further barriers specific to the work place include a lack of proper time management, low levels of commitment and bad communication skills, as well as other culture-specific work ethics. Each of these barriers is explained in some more detail in the paragraphs below.

Non-ideal institutional setting - The institutional setting of these nations is a root cause for slow or lacking development. Institutions that do not foster overall prosperity and stimulate growth and initiative directly affect how the economy is shaped. This then often affects culture and levels of trust which then again influence the economy and reinforce the political institutions; a cycle that is not easily broken [111]. The authors of *Why Nations Fail* 2012 concur and state this as one of the main reasons why nations fail. They state that to become prosperous, inclusive economic institutions are needed. "To be inclusive, economic institutions must feature secure private property, an unbiased system of law, and a provision of public services that provide a level playing field in which people can exchange and contract; it also must permit the entry of new businesses and allow people to choose their careers" [111]. This sentence in itself combines various criteria for a nation to develop. Unfortunately, most of these, except for stimulating education, equality and free career choices, fall beyond the possibilities of a business plan.

Lack of both competition and cooperation between companies - There is a tradition of closed in-groups resulting in compartmentalization of civil society instead of an open civil society where individuals are free to change coalition and membership. This barrier is a direct result from the previous barrier and part of the cycle and lack of inclusive economic institutions described above.

Lack of anonymous trust - Anonymous trust is built by constant cooperation, learning and communication and is the basis for competition. Anonymous trust is key in how the 'developed' world works. Establishing anonymous trust takes time and work and needs to reinforce itself if it is to last.

Individuality versus community - The strong social ties of the community (horizontal networks) are strong as they are a means of survival and protection of those belonging to the group / network. This can stimulate trust - that is heavily reliant on constant contact - which leads to some form of productivity and business. However, standing out in such a strong community is often not rewarded with support [102] and so it can cause unintended lock-in regimes that prevent progress.

Hiring based on merit versus based on vertical networks - On the discourse of corruption in developing nations, this is a common barrier in setting up successful businesses because the hired employee is often not qualified if hired due to his/her vertical social network (nepotism). This also stimulates mistrust because of uncertainty and reinforces the need for vertical (and horizontal) networks to ensure a 'safety net'. This constant building and relying on safety nets prevents incentives for initiative and consequent growth and development.

Uncertainty avoidance - When benefactors or NGO's set up a business in a developing nation, they often do so with the intention to leave and hand over leadership to local parties and stakeholders. However, by then, they have become part of the community and its (vertical) network. The authors describe the NGO or benefactor's position and function as an umbrella: once the umbrella disappears, there is uncertainty and local stakeholders look for certainty elsewhere.

Hierarchy structures - Hierarchy in the form of a clear management and responsibility structure within a large firm or government is not a problem and often necessary. However, hierarchy in the form that results in a lack of delegation or stimulates inequality in the work force and influences productivity negatively is a barrier to success. Hierarchy structures in communities also enable vertical networks and acts of nepotism or other 'corruption', resulting in distrust, little cooperation, little competition, exclusive economies, and non-ideal (political) institutions.

Lack of equality and equal rights - Equality between seniors and junior, tribe A and tribe B, male and female is not always guaranteed. Inequality of rights in the work space will always influence productivity

negatively and hinder the effectiveness of introduced incentives.

Tribal-based conflict or tension - African countries, specifically, are often made up of many tribes with various ethnicities and religious backgrounds. Even though the tribes all belong to the same state, they first and foremost belong to their tribe. So if tribes are not 'at peace', this can lead to tension or even conflict in the work space and hinder productivity. This is not as strong in every country or tribe.

Illiteracy and unskilled labor - The lack of proper education results in a missing minimal basic skill-set that is often expected from a grown-up. This often goes paired with minimal planning, discipline and precise labor. The authors suggest that the capacity of labor should therefore not be overestimated.

Lack of time management - This point is mentioned separately as the effective utilization of time is a concept that is not deeply integrated into most cultures of developing nations. The extent of this depends per country. In Kuwait, it is still common to arrive hours after the time of the appointment; in Mexico, arriving up to an hour late is fine [personal experience]. In South Africa, the term 'Africa time' explains the late arrival to an appointment [112]. The prompt appearance at meetings, managing an agenda and utilizing update meetings is uncommon and has a direct effect on productivity.

Commitment and Communication - Similarly to the analysis of drivers and barriers in Ethiopia, communication forms a barrier on various levels. This barrier can be purely linguistic, but also cultural. In certain cultures, for example, saying 'no' is not done. Cultural linguistic barriers can lead to misplaced understanding, trust and expectations, and have direct effects on productivity, technological dissemination, etc.

Culture-specific work ethics - The three previous barriers could also be integrated under this point. Often there is a misunderstanding between cultures. First, it is hard to distinguish strengths and weaknesses of one's own culture. In addition, we may have misconceptions of other people's culture. Both of these points may cause conflict when different cultures work together. Open communication can help overcome this, but open communication in itself is a cultural property and value. In the end, it is important to value other culture's values and remain flexible and integrate local cultural practices. Not only is it a sign of respect, but it will also stimulate trust and an egalitarian workspace that will help the business to succeed long-term with a motivated and productive workforce. Finding a balance between the various cultures may need some trial and error, but will prove beneficial. Be aware: applying this in a culture that does not value compromise might require potentially adopting more local culture, additional communication and patience.

4.2.1. Criteria

When reviewing the above-mentioned barriers, it becomes clear that many of them are interrelated; causing and re-enforcing one another. It also becomes clear that there are some larger structural / institutional barriers that hinder development and are possibly not possible to address within a business plan. In addition, because distinguishing cause and effect is difficult, setting up criteria becomes difficult also. The authors distinguish six main criteria that set a country up for successful development. They call them "conceptual distinctions and generalizations of a much more fluid and diverse, and detailed pattern of human relationships and interaction" [42]. This is another way of stating that they try to create clarity within a complex network of interrelated actions, laws, trends, values, policies, etc. that are common in (developing) nations. In addition, because they are concepts, they are unlikely to be achieved directly within a single business, but can be stimulated and grow over time. In addition, many of the above barriers and drivers can be reformulated into goals that are sub-categorized in these six criteria. They are summarized below.

Table 4.2: The summary of the criteria based on commonly-faced drivers and barriers of entrepreneurs in developing nations. Enabling entrepreneurs to address these barriers preemptively, gives them a better chance at long-term successful businesses.

	Preliminary criteria for a business model framework that preemptively addresses barriers and integrates drivers of business endeavors in developing nations.

Continuation of table 4.2.

1	**Individualism (vs. Collectivism)** - Individualism allows for free enterprise, free beliefs and a free pursuit of profit versus being subordinate to a certain community, state, belief or other collective group. The interests and rights of the individual are valued. • Stimulate cooperation and trust amongst individuals from different backgrounds (or religion or tribes). • Treat all equal, provide equal opportunity, apply a standard set of rules. • Initiate open communication. • Find the value within each other's cultural values and habits and be flexible to integrate them.
2	**Egalitarianism (vs. Hierarchy)** - Equality between parties, age, gender, beliefs stimulates open cooperation and will allow competition and a stimulated economy. • Stimulate education, equality and free career choices. • Set up consequences or misuse of power.
3	**Initiative (vs. Uncertainty avoidance)** - Uncertainty avoidance ironically often creates uncertainty. There must be an environment that stimulates and rewards initiative, which will lead to growth. • Create incentives and stimulate and reward initiative. • Formulate an exit strategy for benefactors and NGO's to avoid uncertainty.
4	**Planning (vs. Synchronic management)** - Thinking ahead and using foresight instead of waiting for things to happen and only fix them then (e.g. preventative maintenance, product adaptation for upcoming law changes). • Train employees and stakeholders in time management and highlight the benefits and potential pitfalls.
5	**Status based on achievement (vs. Status based on position)** - Reduced vertical networks that endorse nepotism and other 'corrupt' behavior for social protection. • Initiate a clear hiring protocol. • Reward achievements and punish misuse of position.
6	**Universalism (vs. Particularism)** - Letting go of closed in-groups. Loyalty and trust can be created between parties without judgement based on ethnicity, religion, etc. • Stimulate equality to build trust and common goals.

Finally, when comparing the criteria distinguished from the general literature with those from the barriers and drivers specific to Ethiopia, there are few differences. The main difference lies within the fact that there are additional criteria within the Ethiopian drivers and barriers section relating to the environment (and circularity). This makes sense considering that the National Biogas Programme Ethiopia (NBPE) is a business that was set up and evaluated based on goals of circularity and environmental benefits, whereas the book of J.O. Kroesen, R. Darson and D.J. Ndegwah only considers general structural and institutional criteria for developing nations to become successful in entrepreneurship and growth, although some of the specific cases in the book have included aspects of environmental concern.

One of the barriers and criteria above relates to integrating cultural values into the business and finding a balance in customs and values. That understanding local culture plays a significant role in an entrepreneur's success was also already determined at the end of chapter 3. This is important to consider, but very country - and sometimes even region - specific. Therefore, as preparation for the business model of biogas in Mek'ele,

Ethiopia, an elaboration on Ethiopian culture is completed in chapter 4.3. Within the chapter, the commonly mentioned barriers from case studies in [42] and the literature reviewing the NBPE is tested during interviews with Ethiopian nationals. In addition, a small evaluation based on the same topics follows on how it has influenced doing business in Ethiopia as a foreigner. See section 4.3 for more detail.

After the completion of that section and in the next chapter, chapter 5, all the criteria and goals for the sustainable and circular business model framework for developing nations are cross-referenced, combined and summarized in table 5.1.

4.3. A Critical Barrier: Cultural Differences - An Elaboration on Ethiopian Culture and How it Affects Doing Business Locally

Understanding the culture and social institutions of the country you are trying to do business in or with is very important, as was determined at the end of chapter 3 and from the preliminary criteria of sections 4.1.7 and 4.2.1. When looking closely at the barriers and drivers of the previous sections, it becomes clear that culture has a strong influence on many, or maybe even most, of the drivers and barriers. The beauty and difficulty of this lies in that the cultural aspects are well hidden and interrelated with the local economics and politics, making it hard to identify cause and effect, which would enable entrepreneurs to proactively address causes. For example, the example that was discussed within the social drivers and barriers (section 4.1.5): lack of commitment. Is it truly a lack of commitment? Or is it a lack of social acceptability to speak up and/or ask for help? Taking it a step further: why is speaking up not accepted? Or why are people afraid to speak up? If the fundamental cause is known, the entrepreneur can try to address these issues proactively or at least understand why certain behavior is exhibited; both can benefit the future business. This section elaborates on Ethiopian culture and how it affects the working environment as an exemplary culture related to this thesis project that answers the sub-question: *SQ 6 - To what extent does culture play a role in the success or failure of such initiatives?*

4.3.1. Transitioning from System I to System II

Businesses that fail due to a lack of understanding cultural differences and social institutions is not only an issue for inexperienced entrepreneurs and certainly not only an issue for cultures commonly associated with the Bottom of Pyramid. An example is the KDow joint venture between state-run Kuwait Petroleum Company's (KPC) subsidiary Petroleum Industries Company (PIC) and the American-based Dow Chemical Company (Dow) in 2008. This $17 billion endeavor between KPC and Dow to establish joint venture KDOW was almost complete, when Kuwait's parliament pulled out of the deal last-minute, almost forcing Dow into bankruptcy [108, 113]. The official reason stated by the Kuwaiti government was that the project "was not economically viable in light of the global financial crisis and slumping petrochemical sales" and that "the necessary measures to cancel the contract" should be taken "within a sound legal framework while safeguarding the state's rights and interests" [113]. Although it was a difficult time for petrochemical companies economically [113], Dow did not anticipate this move. In hindsight, some of the parties involved speculate that the negotiators on both sides had not ensured that all direct and indirect stakeholders of the merger had enough 'buy-in' in the project - especially amongst the Kuwaitis - and feared that their interests were not included or addressed in the joint venture [108]. Whether this was a contributing factor or not, this indicates a general lack of understanding of each other's social institutions. In this case it led to opposing forces and growing traction within congress and parliament, resulting in the deal being shut down, despite the financial consequences [108, 113]. Because there is no open proof on the subject, it can only be discussed hypothetically. Therefore, if buy-in did play a role to ensure a successful deal, this is because of what O. Kroesen et al. define as nations belonging to *System I* and *System II*, which both have their own characteristic social institutions.

System I is the traditional system with patrimonial and family-based institutions and values in obedience, group-conforming behavior, etc. [42]. This is what is commonly associated with underdeveloped countries and the Bottom of Pyramid. System II is the system of 'developed' nations with equal rights and protecting rule of law and values in individualism and open and adaptable attitudes [42]. Typical characteristics of System I and System II are listed in table 4.3. To transition from System I to System II, values and institutions in individualism, egalitarianism, initiative, planning, status based on achievement, and universalism are generally required (see section 4.2.1). The discussion considers both values and institutions because even though they most often go hand in hand and reflect on another, during times of transition, this is not necessarily the case. For example, introducing a System II type institution in a predominantly System I nation, may be 'ac-

cepted' by the public, but not yet internalised in their values and traditions. Together, values and institutions show a balance between the subjective and objective values of a nation, but because they are not always in line with each other, both must be considered.

Most countries are somewhere between System I and System II, which sometimes makes it more difficult to understand which system is dominant in various aspects of the culture and its institutions. For example, going back to the example of KDow, if 'buy-in' played a role in Kuwait's decision to withdraw - again hypothetical - this would be System I behavior. Behavior that Dow (almost completely System-II) likely would not have anticipated. 'Buy-in' and 'greasing up' are all too often directly linked to 'corruption' under a System II mindset. Corruption is considered illegal and unethical in System II, but it is part of daily life and an (essential) part of a functioning social system in nations where other (System I) institutions are dominant. For a more elaborate discussion on 'corruption' as a valid social institution, see [42]. A possible explanation as to why Kuwait may still exhibit some System I behavior is because the nation has only been in possession of its wealth for a relatively short while. Due to the businesses it has drawn and its rapid growth and industrialisation, it has gone through a fast transition towards System II and integrated many of its institutions. However, the subjective integration of these institutions into the values of the culture is slower. This results in a sort of mask that hides valued institutions from System I.

Note that this example and analysis are based on speculation and a hypothetical situation that only considers a very linear train of thought. It does not consider cultural transformations and the impact of the Gulf War on the nation's transition. It is merely meant as an example to portray that this is not only an issue associated with nations truly considered at the Bottom of Pyramid (BOP). Further, it must be noted that this analysis makes it seem as though System I behavior is always to blame, but assuming a similar situation as described above does occur, it is characteristic System II behavior to look the other way, even if 'corrupt' behavior is being displayed openly because it is not 'correct' in System II values (and can be persecuted by its own institutions). However, this way, if each others differences are not acknowledged, the two parties will be like ships passing in the night.

Talking about these differences, or even recognizing them, is difficult. Every child is raised by the values and institutions of his/her country and bases categorizations of 'right' and 'wrong' on these. This realization is important because it opens the mind to accepting and understanding other cultures. This is a vital step when doing business in a foreign country because it allows the two parties to meet in the middle. In relation to this thesis project, the listed criteria so far have regularly also noted the importance of including local cultural and associated institutions in one's business endeavors. To prepare for the case study, the next two sections elaborate on Ethiopian culture and some associated institutions in relation to the characteristics of System I and System II, as well as how cultural differences are noticeable in the working environment. To gather the relevant data, interviews have been completed.

Table 4.3: Institutions and Values of System I and System II as defined by O. Kroesen, R. Darson and D.J. Ndegwah in [42]. Table based on Table 2 section 2.5 in [42].

	System I		System II	
	Institutions	**Values**	**Institutions**	**Values**
State	-Patrimonialism at the top -Granting favors and privileges in return for services	-Obedience -Loyalty -Hierarchy -Status -Personalized relationships -Particularism	-Rule of Law -Equal access -Strong but accountable state institutions -Poperty protection -Contract enforcement	-Universalism -Equal access -Justice -Transparency
Civil Society	-Closed in-groups -Vertical networks -Little cooperation	-Lifelong solidarity -Adaptation to the group -Traditionalism -Uncertainty avoidance	-Civil society -Open cooperation at the bottom -Changing coalitions (apart from family loyalty and state authority)	-Open attitude -Mutural adaptation -Multiple memberships -Pluralism of opinions

Continuation of Table 4.3

	System I		System II	
	Institutions	**Values**	**Institutions**	**Values**
Individual enterprises	-Family based -Distributed activities -Dependent on positions and opportunities in the vertical network	-Command and control -Status through position -Closed in-group ethos -Loyalty counts more than efficiency -Synchronic time management -Privileged treatment of in-group members	-Open labor market -Contracts -Instrumental working relations -Both competition and cooperation between competitors	-Individual judgement -Professional attitude -Initiative -Status by achievement -Planning and innovation -Cooperative attitude -Equal treatment -Teambuilding

4.3.2. Ethiopian Culture Tested on the Parameters of System I - Interview Results

To help improve collaboration, progress and success, general criteria for businesses in developing nations have been established. However, one of these criteria is to integrate and respect values from both cultures. This requires understanding one another and being able to openly communicate. The best way to understand Ethiopian culture would be to live in Ethiopia for many (3+) years. Since this is not an option, the next best thing is to talk to Ethiopians that have been confronted with their own culture by living abroad and foreigners that have worked with Ethiopians in Ethiopia. In appendices C and A, the list of interviewees and questions, as well as an interview protocol can be found, respectively. The interview questions are based on the literature reviewing barriers and drivers of the biogas installations and the National Biogas Programme Ethiopia (NBPE), and from the literature on cross-cultural entrepreneurship (e.g. the list of values from table 4.3). Specific topics that were discussed to determine socio-cultural differences are: (educational / work) background, strengths and weaknesses of Ethiopians, cultural differences between regions, first impressions when going abroad (cultural shocks), unmet expectations when abroad, time management, commitment to agreements, anonymous trust, equal rights, hierarchical structures, and horizontal and vertical networks. The results of each topic are discussed here below. The next section elaborates on the experiences of working with Ethiopians in Ethiopia.

To begin, it is important to note that all of the Ethiopians that were interviewed have enjoyed university education. 5 of the 6 Ethiopian interviewees have scientific majors and 5 out of 6 are working on doctorate degrees. Their backgrounds are very different, however. This has several benefits. First, with a scientific degree, they have learnt to think structured and critically and are likely to be able to discuss about culture in a rational and non-emotional manner, making an open conversation easier. The fact that they are from various regions allows regional culture to influence their thoughts and opinions and perhaps will allow to establish some region-specific trends, while at the same time portraying Ethiopian culture more widely. However, when looking at the background map (figure 4.1), the West of the country and the very South are underrepresented. Most are from Northern regions which is also the case study region of chapter 7. 5 out of 6 have also been abroad for more than 3 years, allowing them to better understand the culture they are confronted with now. This may additionally allow for a more open conversation. However, if this is the case, this may be an indication that they are adapting to a 'middle ground' culture which might make insights about their own culture (because they speak about themselves) milder and less distinctive. In addition, Ton van Kampen, who organized the entrepreneurship training in Mek'ele, was briefly asked for some insights, but did not complete the interview as described in the appendices, since the conversation with him took place at the very beginning of this thesis project, although similar topics were discussed. His insights have been included in the text. Furthermore, only 7 people were interviewed. From these 7, some general trends can be established, but to truly elaborate and understand the culture in depth, larger studies are recommended along with extended local field studies in various regions. These are points to keep in mind when reviewing the results from the interviews below.

Educational / Work Background As already mentioned, all six Ethiopian interviewees have enjoyed university education. Five of them have a scientific degree and five of them are working on post-master degrees.

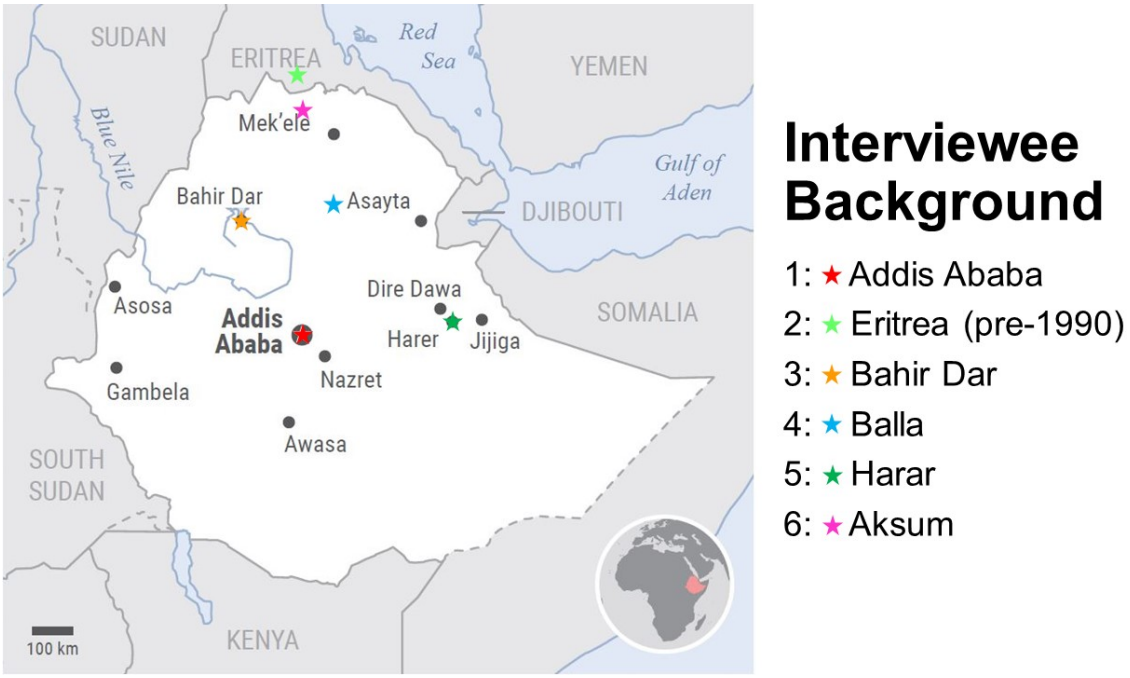

Figure 4.1: The various geographical backgrounds of interviewees 1-6.

Four out of six have worked in various regions of Ethiopia. An overview is provided in table 4.4[1].

General Strengths and Weaknesses of Ethiopians From the six interviews, all six agreed that Ethiopians are open, friendly, and hospitable - especially towards foreigners, and that there is a strong sense of community. They look out for each other, no matter the background. Ethiopia is culturally and religiously diverse and yet one unified nation, which is a common area of pride [38, 103, 106, 107], although this has been decreasing with the rising tension in Tigray [103, 106]. Looking at their history, they have found strength in this unification and fought to retain their freedom as a nation. Now they are one of two African nations that was never colonized. Besides their diversity, they are also proud of their uniqueness. Ethiopia has its own calendar(s), way of counting time, and also a unique skin tone which they call 'habesha color' [38, 102], although the term *habesha* applies mainly to the North and means 'of mixed blood'. The alternative way of counting time (7am is 1:00 o'clock daylight Ethiopian time) is a good example of why it is important to understand each other's culture. If you have a meeting at 3:00, you better double check whether your meeting is at 3pm (what you likely thought) or 10am (3:00 daylight time Ethiopia). The same applies to dates. There are various calendars circulating, one with a 7 year gap to ours; however, most calendars overlap correctly. Since these unique traits are sources of pride, respecting and participating in them can allow for trust and good relations to be established.

Additional strengths that were mentioned included that the farmers are hard-working and have a good work ethic [106, 107] and that Ethiopians are good listeners [102, 107]. In the literature reviewed, the work ethic was almost constantly portrayed as weak or insufficient when referring to biogas installation users (mostly farmers). However, the interviewees distinguish between the two. The farmers are considered hard and steadfast workers under the face of constant pressure and little governmental support [38, 103], whereas urban workers are considered to be lazy [38], unskilled or under-qualified [105], and have an overall bad work ethic [38, 106]. Whether this is true or not, it shows an appreciation for those that work on the land and that generally the skills should not be overestimated before proven; something the founders of the Nicolas Robinson School in Mek'ele, and the literature on Cross-cultural entrepreneurship agree with [16, 42]. In terms of being good listeners, which won't be disputed as a strength in certain cases, the origin of this sentiment is more interesting to an entrepreneur than it might seem at first. The interviewee that mentioned that Ethiopians are good listeners also mentioned that they have little self-initiation [107]. This is also tied to communication, which was generally described as extremely poor, and speaking up, which is rarely done

[1] Interviewee 7 also enjoyed university education, but he has been left out of this table.

Interviewee (#)	Gender	Home town	Degree(s)	Work experience
1	Female	Addis Ababa	BSc Computer Science, MSc Computer Science, PdEng Data Science (in progress)	8 years
2	Male	Eritrea (pre-1990)	BSc Physics, MSc Physics, PhD Computational Physics & Material Science, PdEng Computer Science (in progress)	5 years
3	Male	Bahir Dar	BSc Computer Science, MSc Computer Science, PdEng Computer Science (in progress)	-
4	Male	Balla	BSc Statistics, MSc Applied Statistics, PhD Mathematical statistics, PdEng Data Science (in progress)	5 years
5	Male	Harer	BA Architecture & Urban Planning, MAS Urban Design, PhD Architecture & the Built Environment (in progress)	8 years
6	Female	Aksum	BSc Biology (in progress)	-

Table 4.4: Overview of personal and educational background of the interviewees for socio-cultural differences. Interviewees have been given a number for privacy reasons: [38, 102, 103, 105–107], respectively.

[38, 103, 105–107]. Central and Northern Ethiopia are mainly Christian Orthodox and within that culture / religion, it is not valued to speak up. For example, in stricter communities, children may not speak when there are guests; and a priest that does not talk, is respected for it. This influences children when growing up because it teaches them that not speaking is good [38]. The interviewee fears that this hinders the development of proper communication skills and that it will be a difficult thing to change because the elderly are very set in their ways. Several interviewees agree on this last point [38, 102, 106]. An additional consequence of not speaking up and taking initiative is that is stimulates a fear of failure [107]. Initiating something - especially something new - goes against everything you were taught was 'good'. If it then doesn't work out, you have failed the community, so best not even try. This is closely related to the desire of two of the interviewees that individuality be valued more [102, 105]. This hope was expressed by the two female interviewees, which may indicate that they feel (subconsciously or consciously) more pressured and/or limited by the expectations within their own culture and communities. This claim may be supported by one female mentioning that she went abroad to live independently without the influence of her family [105] and the second female mentioning that there is a constant pressure to be at your best in the eyes of the community (similar to what was expressed by [107]) for fear of disciplining [102]. She explains that this is not only bad because you cannot express yourself, but also because girls act based on the notion of "what will others think", rather than truly understanding the value of what they are doing or not doing[102]. This does not take away from the fact that both women value their culture, but it may indicate an inequality between gender. One of the interviewees does indicate an exception to the *do not speak up* trend. She explains that in school, when certain tasks or group work had not been completed, peers would be quick to cover for the group-mate that had failed to complete the task and share the blame amongst all of them [102]. This display of solidarity comes from the strong sense of community. And although the gesture is appreciated, the interviewee indicates that it is protecting a status quo often not recognized and certainly not discussed [102]. More on this below in the paragraph on equal rights.

Additional changes that the interviewees would like to see in their own culture are a better work-life balance [107], more commitment to the quality of work delivered [105, 107], better linguistic communication in English and general communication [38, 102, 103, 105–107], more flexibility amongst those looking for work [38, 106, 107], more respect for each other's time [38], and improved work ethics (taking responsibility, commit to quality work, less corruption, etc.) [38, 103, 106, 107].

Cultural Differences Between Regions All interviewees agreed that there are major cultural differences between the various regions of Ethiopia, but that they do not know the details. This is not unexpected considering that travel is not a luxury most have and the country is so large that it is more like a union between nations than one nation. However, it does indicate that little is learnt about other regions in school and that there is little contact between the various regions. Especially the province of The Southern Nations, Nationalities and People's region (SNNP) (except for the city of Awassa, which borders the Oromia region), the Western-most borders, and Somali were not mentioned often, but this could be because the interviewees are mainly from the Northern half of the nation. This means that an entrepreneur wishing to do business anywhere in Ethiopia should get more region-specific information before planning his/her business. The map in figure 4.2 below indicates the states/provinces of Ethiopia.

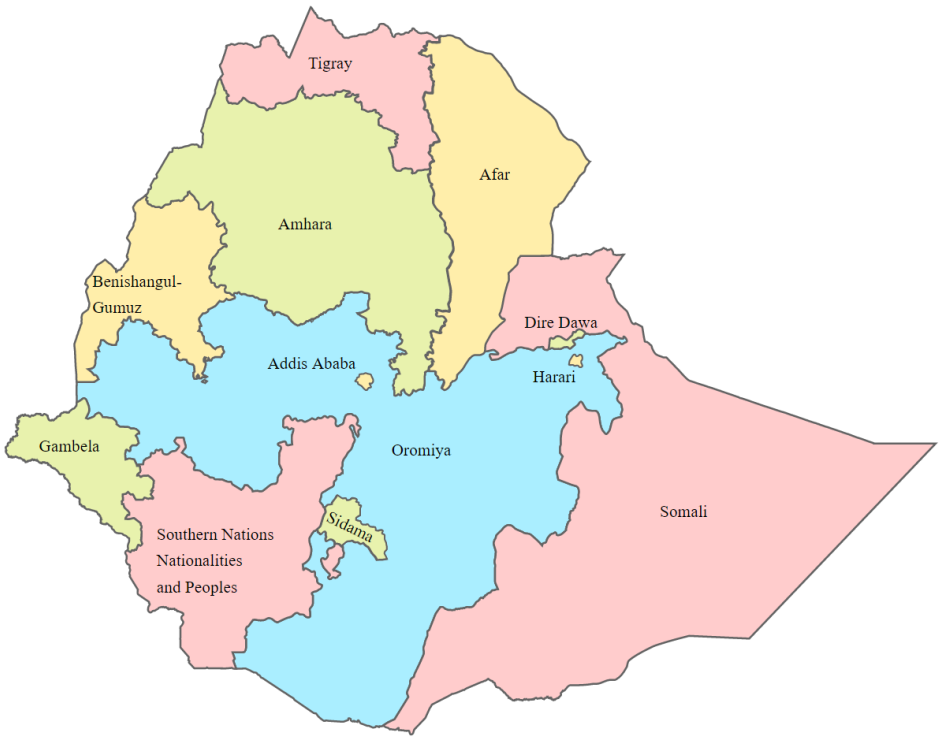

Figure 4.2: The provinces, a.k.a states, of Ethiopia.

Some generalities that were mentioned include that the North is more religious and conservative in dress (e.g. no skirts above the knee) [38, 102, 105, 107], where the capital allows for more revealing clothing. Certain other areas, on the other hand, still wear tribal dress where the bosom is revealed [105]. Different regions also have different infrastructure and jobs, leading to different types of preferred transportation. One interviewee explains that you will not find any bicycles in the capital while it is the main form of transportation in Awassa (Oromia-SNNP border) [105]. In the North (e.g. Mek'ele), donkey-, horse- and ox-drawn carts are not uncommon. You can even find camels on the streets. Families that own a car are considered wealthy. The main way of getting around is with the local bus, a *bajaj*, or on foot. Within the city, streets are made of cobble stone or asphalt, but beyond the city, with the exception of a few major routes, roads are dirt tracks (status 2014). From the conversations, it also seems that hospitality is stronger beyond the borders of the capital. Other differences are geographic and climatic. Where the mean temperature in Mek'ele, Tigray is 19 degrees Celsius and average precipitation is 46.2 mm, the mean temperature in Gode, Somali is 28 degrees Celsius and precipitation averages 27 mm [114]. This leads to differences in landscapes, land fertility and life style [102]. Since this project focuses on the North, no additional research will be done for the Southern regions.

First Impressions of Going Abroad | Cultural Shocks [2] The list of first impressions amongst the interviewees is quite long. One thing that sprang out and was mentioned by several of the interviewees was that Europeans and Americans are more individualistic, have looser social ties, and that there is a certain lack of

[2] From hereon, *there* represents Ethiopia and *here* represents Europe / the Netherlands.

common values [38, 102, 103, 105]. In Ethiopia, social ties and the focus on family, community, and religious values is very strong [38, 102, 105, 107]. In terms of social values, Italy most resembles Ethiopian family culture [106]. Some have mentioned that this individualism has made it difficult to make friends [38, 103, 107], but it also has benefits like being able to express your opinion, needs and feelings, and it allows you to act upon the values that you have and connect freely with others who share those values (e.g. by starting a petition) [102, 106]. This is a type of freedom and equality that was unknown to some of the interviewees, which is only possible because of the legal institutions, individualism and equal rights common in Europe and the United States of America. It also results in dependable and trustworthy institutions that don't require large amount of strong personal connections [103]. In addition, there is also a larger patience to abiding rules in Europe than in Ethiopia. For example, when it comes to getting in and out of a train, no one needs to regulate the process because people wait patiently [105].

This equality and freedom extends into their daily experiences of their studies: you can openly approach and communicate with your professors. This includes giving feedback [102, 106, 107]. In Ethiopia it is not common for a teacher to interact on a personal level with their students. From the six interviewees, only one mentioned that they could approach their teachers, and this was at the Nicolas Robinson School, which is influenced by foreign culture and values. However, giving a teacher feedback directly was not possible there either [102], and like with the others, if you see your teacher or professors on the street or in a cafe, you make sure to make yourself scarce out of respect towards them [102, 106]. Besides all this, children in Europe and the USA have equal access to education and levels of knowledge and insight are higher than back in Ethiopia, according to [107]. Unfortunately, this is known in the West as a stereotype and expresses itself negatively in certain situations. For example, one of the interviewees was openly confronted with racial stereotypes during her International Baccalaureate (IB) studies [102]. Because of the *habesha color* of her skin, people questioned her African heritage. There were also other instances where entitled students would remind her of 'her place' at that school based on the fact that she was there on a scholarship. Receiving this feedback should remind and warn us that stereotypes still exist and that children are cruel. Fortunately, the interviewee looks back at that time as an overall positive experience.

In terms of working in Europe / the Netherlands / the USA, there is an appreciation by most interviewees for the commitment to one's work and the quality thereof, the use of an agenda and the respect everyone has for each other's time, the better work-life balance, and the open communication amongst peers and superiors [38, 106, 107]. However, it does mean that some spontaneity is lost because everything, even social gatherings between two people, needs to be arranged [103]. Then again, it is possible to refuse a meeting here, which you would never do in Ethiopia because it is offensive [106]. In addition, people can work part time. One interviewee found this especially astounding because it is often younger people that still go to school who have a part time job in stores and still manage to be successful in their studies [106]. The interviewee was appreciative of this and said he thought it "one of the greatest strengths of the West" because it gave young people the opportunity to be independent early on in life within a safe and regulated environment [106]. In Ethiopia this would never be allowed by parents, even if it were a possibility, because it would be bad for the family's reputation; it would indicate they can't afford it [106]. The same type of avoidance is seen with odd jobs. In Europe it is okay and even appreciated or valued to an extent to do odd jobs (e.g. janitor, construction worker, etc.) and there is little social discrimination noticeable, whereas in Ethiopia, you avoid these types of 'degrading' jobs as long as possible [38]. In general, in Ethiopia, people are less flexible about their careers. If they finish a BSc in physics, for example, they feel like they *must* work in physics and they cannot choose or look for any alternative career paths [38, 106]. According to one of the interviewees, this is actually a main barrier to economic growth and likely plays a part in the high unemployment rates amongst youth [38].

Additional culture shocks that were mentioned by more than one interviewee are that there are no issues of energy fluctuations or water shortages, which can happen several times a day back home [38, 107] or be shut off by the government when it is beneficial to them [16]. Also, the general infrastructure in Europe is very good and well-thought out, including public transportation and the cleanliness of the streets [38, 103, 107]. Furthermore, most interviewees were somewhat shocked by the liberal clothing in public. For those with a stricter background, wearing trousers as a women was already new [38], but even for those coming from the capital, hot pants were a new sight, and bikini's in public were shocking and sometimes even uncomfortable [38, 102, 105, 106]. Traditional dress is still commonly used; in Mek'ele, for example, the split of traditional vs. modern dress is still ca. 50/50 [16]. In terms of liberality, the interviewees were also amazed by the relaxedness around, and easy access to, the use of weed [105] and the amounts of alcoholic consumption and partying, which is mostly reserved for special occasions in Ethiopia [38, 107]. Another thing that is different here is that you do not necessarily share your food and if you offer to cook, you should not expect that favor to be

returned. Of course this depends on the type of roommate, but in Ethiopia, if you want to eat, you need to offer whatever you have to the people around you out of respect and because it is a communal value [106]. That is not the case in the Netherlands.

Some final funnier remarks were the open curtain windows of Dutch homes which some people find odd - sharing such an intimate part of life - and others find heartwarming [105], and the amount of bikes that are used by all sorts of people, including businessmen [105]. In Addis Ababa, bikes are generally only exclusively used by messengers [105]. Furthermore, several interviewees mentioned that they were not used to the temperature swings from summer to winter [38, 102, 105] and that they found it odd that people complained about rain [102]. Both interviewees were from the North of Ethiopia where temperatures vary very little between seasons and night and day. In addition, in the North, people generally pray for rain and appreciate it once it comes [102]. One of the interviewees was also shocked to see that cars could remain parked outside on the street at night. He had not realized that theft rates could be so low [107]. Also, the large amounts of tourism were interesting to see, the difference in counting time led to some initial confusion, and European, Asian, and American trees are impressively large [102].

Unmet Expectations and New Insights Amongst the interviewees, expectations varied. One said he was quite content because his expectations had been met in terms of public transport, access to energy and work ethics. Only the restaurants and bars were smaller than he had expected, especially along the beaches [107]. Interviewee 6 also mentioned that she had little expectations because she knew very little of the countries in Europe, the Americas and Asia [102]. Another mentioned that he had low or little expectations when he arrived in Europe because the decision to come was made fairly fast and there was no real time to form opinions, but because they watched American movies back home, he had expected that the buildings would be higher and also newer [38]. Interviewee 1 also mentioned housing to be smaller than expected [105]. In addition, she was surprised at the exactness and efficiency of public transport. At each station you could find the departure time of the trains and buses, including their stops. While underway, the stops are announced and you are even informed of potential delays [105]. Interviewee 2 was also positively surprised by the clarity and punctuality in public transport systems [106]. However, as much as public transportation impressed, healthcare disappointed. Healthcare in Ethiopia is more direct. If you believe you need a specialist, you go. In the Netherlands, you have to consult with your general practitioner first and only then might be eligible for specialist care and your choices in hospital are limited also, whereas in Ethiopia you have the option to choose between private and government hospitals [105]. This was somewhat disappointing to her. The reason for this structure is of course because of the inclusive and fairly socialist structure of the Dutch health care system, but having known an alternative, it is clearly not considered flawless. Then again, the interviewee was fascination with the train of thought here.

In her eyes, people don't strive for luxury, but for simplicity, which is exactly the opposite of what she had expected [105]. Instead of luxurious resorts and far-away destinations, the Dutch (especially younger people) choose to spend their vacation hiking and camping, which would never be done voluntarily as a vacation in Ethiopia [105]. She believes that these are parallels that can be drawn to the energy transition. Europeans have the luxury to think past the 'simple' issue of energy access; they have the option to be concerned with ethical sourcing of materials and products, and consider other sustainability aspects [105]. Because of this, trends such as buying refurbished or second-hand goods have emerged and are considered 'good' and 'cool' or even 'hip'. In Ethiopia, buying second-hand is avoided and definitely not appreciated [105]. In the Netherlands, she believes that simplicity and creating a peaceful life is truly appreciated, which is a sharp contrast to the dreams of luxury and extravagance in Addis Ababa and sometimes still difficult to understand [105]. She may be right. When I hear the conversations amongst fellow students, vacation destinations and trips are sometimes planned based on avoiding long flights or wasteful activities, but as students of the master Sustainable Energy Technology, we might not be a representative group. Also, the Dutch have long been devoted campers, and although some might go looking to let go of daily life and find a peaceful spot, most camping sites are anything but peaceful or away from society. It was interesting to note that the stereotype of the Dutch being stingy was not mentioned once, which might be a stronger driver for trips with campers, although this is a personal and biased opinion as well. The reality, however, is that people of our age / (university) students still studying do not have an income and thus often do not have the funds to go on more luxurious trips. A simple and non-expensive way to have a nice time, see beautiful sights and experience adventure is to go hiking, biking, or camping.

A final and interesting unmet expectation was to that the promise of "When you go abroad, there are endless opportunities and doors that will open for you" had been disappointing and turned out to be not true

[102]. Requirements in paperwork, visas, qualifications etc. restrict the amount of opportunities available. This is a common problem amongst foreigners requiring a student visa for their studies. The visa does not allow them to work locally, or only on campus, which can limit their prospects for the next step, as is the case in the USA because often internships are a requirement for graduation or when applying for a job (which is done on a transitioning / extended student visa) [102]. It can be demotivating that a land promising *the American Dream* has so many technical and bureaucratic hurdles [102]. Again this is a result of the institutions the West has built, but it is interesting to hear how it affects outsiders nonetheless because we consider ourselves to be inclusive and providing equal rights and opportunities.

The most important lesson of the two final insights above is that, at least subconsciously, there are always stereotypes of other nations that one needs to consider when doing business. In both examples above it has to do with the misconception that prosperity and welfare in a nation stands equal to (financial) wealth and an 'easy' life. There is not yet the realization that, even though a European is extremely wealthy in Ethiopia, he/she is most likely merely average in his/her own country and needs to work just as hard to create his/her own opportunities. And perhaps something even more important: this applies to ourselves also. We too have (sub)conscious stereotypes and should try to remain aware of how they influence our behavior. Stereotypes are often based on some truth, but are often overly exaggerated or become irrelevant over time. Trying to avoid actions and thoughts based on (unproven) stereotypes is likely wise.

Horizontal and Vertical Social Networks In this thesis project, what is understood as a horizontal network is the connections and network one has amongst those with a similar 'ranking' or position to oneself. This can include family, friends, their families, and generally comes down to most people within the community. Vertical networks are the connections and network one has with those higher in social rank or with more influence [42]. This can include connections to bank or government officials or the local chief or even a family member who has enjoyed a better education or lives abroad. Of course it can happen that some of these overlap. Both horizontal and vertical networks can protect and enable you and they are important to build up and (carefully) partake in, when active in regions that rely on them strongly. One could visualize the two networks as a safety net for when things go wrong (horizontal network) and as a protective umbrella (vertical network) that protects you from unlawful characteristics and provides unique opportunities. It is not necessarily to say that this is a conscious division that the population strives towards - none of the interviewees seemed familiar with thinking about it this way - but it is an effective social construction that protects and enables in a situation where rule of law is limited and unequally distributed. It is similar to being in favor of a king or queen in European history or lobbying of larger companies in the government. Both enable one to accumulate wealth and be better protected from law changes. In a sense, these vertical networks are not limited to larger companies, but it isn't a necessity because there are equal rights, fair rule of law and inclusive institutions which enable someone with even the least advantageous background to become a successful business owner, politician, professor, doctor, etc.

The reason this distinction is presented, however, is because it is important to be aware of their roles and how they will affect oneself when visiting or doing business in countries where this still strongly prevails. As a (white) foreigner in Ethiopia, you will almost automatically become part of the vertical network. First of all, compared to them, you are lavishly wealthy and have access to greater funds. You also have your own complete network within other countries that represents thousands of opportunities. You can often also provide work, secure pay, or other benefits that they may not find locally. It is also important to understand these networks because the social interaction amongst various social network 'levels' becomes different, as explained by one of the interviewees [105]. She explains that the direct horizontal social layer that everyone has, can be represented by what they call *ithir* - the circle of neighbors, or the community. These social ties are strong and should, if possible, never be broken because they form the fundamental basis of trust [38, 102, 103, 105–107]. One interviewee explains additionally that you are also often addressed with your role in the community: aunt, uncle, sister, brother, mother, father, ..., and, as mentioned earlier, that you may be disciplined by almost anyone belonging to that community if you do not adhere to the values and expectations [102]. Because everyone is one piece of the community and so has a certain 'value' with which you do not want to break, you will need to invite all of them for important feasts, such as a wedding. A wedding of 800 people in the capital is considered 'small' and people will go into debt to avoid offense [105]. This all comes back down to your community being your safety net. Should you ever find yourself in hardship, and your relationships are stable, you will be helped [102]. It should be noted, however, that this network is also upheld by gossip, and not only direct action [38] which results in at least females being constantly aware of their actions and reputation [102]. Therefore, these horizontal networks may have some down-

sides, but generally, the community is experienced as home, an extended family [38, 102], or even "a source of happiness" [107].

The interaction amongst vertical networks is somewhat different. First of all, for some, it is something one does not talk about because it is considered a weakness that they would rather not see in their culture [107]. One of the interviewees said that she had very little experience with such interactions because her family and community come from the 'lowest classes' [102]. However, one of the interviewees said that it was not uncommon for businesses to have connections with government officials to help them achieve their goals and grow [38]. Of course there is nothing directly wrong with these type of connections; we know and use them in Europe and the United States of America as well. They are also what lead to children of employees being offered internship positions more easily than others, or a connection receiving a job that he/she did not necessarily qualify for or earn, which is the lesser productive side to the story. In nations such as Ethiopia, both are common and unfortunately, are sometimes more severe. For example, one interviewee had applied for a job, gone through the official hiring process and received the job. Then, the day before starting, he heard that someone else would be filling the position. This person turned out to be the son of the school's dean [106]. That people are recommended and introduced for positions that they might not fully qualify for is not unusual, even in Europe, but giving the position to someone else after the position had already been promised to someone, would be highly unusual in Europe. A similar situation was mentioned by another interviewee: a cousin with very good grades had applied for nursing school, but she didn't get in. The girl that took her place had lesser grades, but a connection to the school [103]. These type of situations would easily be considered corrupt amongst Europeans and the main issue with this corruption is that it changes the (economic) playing field and reinforces extractive institutions, limiting the opportunities of the less fortunate, even if they might have more potential. According to one of the interviewees, if you would like to make a larger investment, for example, you need contacts with state officials and the process will likely be corrupt (e.g. bribes, protection, law changes, etc.) [38]. The book *Cross-Cultural Entrepreneurship and Social Transformation* [42] elaborates on how the negative connotation of 'corruption' needs to be relativated in these countries as it often forms an integral and vital part of a stable society [42]. However, as mentioned before, it also reinforces extractive economic institutions [111] and prevents anonymous trust to be established, which is necessary for inclusive institutions to form. Extractive economic institutions hinder development [111]. Another interviewee brings an unexpected and somewhat ironic issue to our attention. A few years back, there was a wide-spread anti-corruption campaign in Ethiopia. Public bribes etc. became taboo. But instead of resolving the issue of bribery and corrupt networks, the campaign mainly led to bribery being internalized within companies. It has made avoiding and managing them a lot more difficult and regularly misleads people because they think it is no longer practiced and suddenly are confronted with it [103]. This would also explain why most of the interviewees seemed unaware of the extent of corruption: it is now done in secret, rather than publicly. This means that entrepreneurs should be aware of vertical networks and potential corrupt schemes that they may encounter, and that determining the extent to which they exists in various regions is difficult to estimate, but important to find out.

Equal Rights The subject of equal rights[3] could be considered somewhat sensitive because it is often intertwined with long-standing traditions and beliefs; questioning them might be considered offensive. However, all of the interviewees responded openly and friendly to the subject. One interviewee informed that there have been several large campaigns stimulating equal rights and forbidding gender mutilation, but that the advancements were rather rhetorical / on paper than in practice [103]. Others agree that there is talk of change, but the mindset amongst both men and women is not yet changed [106, 107]. Historically, however, Ethiopia was quite progressive (15th and 16th century), but this has declined strongly [103]. Ethiopia has known queens and female war-leaders. They were considered strong and were respected [103]. Now, women are respected and valued for the work they do in their homes because without it, the communities would not work [106]. One of the interviewees explains that he comes from a very traditional and strict background [38]. The inequality at home is clearly visible, but not all of it was presented as necessarily negative, which is often the thought Westerners have when debating the topic. He explains that the situation and roles at home are dictated as stated in the bible: the man is the head of the family and therefore makes the relevant decisions. The woman is responsible for the household and has little to say; comments and feedback are generally not accepted [107]. Physically, while walking, the woman is also expected to walk at least half a step behind her husband [107]. Being silent as a woman, is to be respectable [107]. This is her role in the community; she

[3] The equal rights discussed here are about men and women. The conversation of equal rights for alternative sexual orientations is not covered as it is largely not accepted amongst the population and officially still illegal.

forms the backbone of the family. Without her work, there is no life. So far, the conversation portrays a sense of pride and respect towards both the man and the female. He continues to explain, however, that he does not find it just that the women need to work on the farm just as hard as the men do during the day and then also need to do all the housework and cooking while the men rest [107]. The conclusion from that conversation was that a clear role division with certain behavioral traits is fine, but the roles should be balanced in terms of physical labor and responsibility. There is an issue, however. This inequality is not only upheld by men, but also by women. A woman is proud of her work and will often believe a man to be incapable of cooking [106, 107] and in that way - when both parties are proud of their capabilities and role in the community - there is nothing 'wrong' with this way of life. However, there are other consequences of this situation that may not even be visible to the opposite gender.

Being wholly responsible can be a burden, but having no say can limit you in your accomplishments and be frustrating, especially because the community is an indirect enforcer that protects the status quo. For example, even if you were to have more progressive and less strict parents as a girl, the community is still strict and will discipline you based on the common and traditional values that form the status quo that still upholds gender inequality [102]. The interviewee concedes that there is some value in some of the traditions (e.g. not going out alone as a girl after dark) because they are based on experience and love, but she would prefer that there would be some change that would allow more respect towards females as individuals and that the reasoning of "because you are a woman, you cannot do this" would disappear [102].

On an educational level, this role division has its effects also. Since girls need to help at home with the house work and cooking when they get home, and there is often no time left at the end of the day, or even no light in the living quarters, finishing homework is a problem and sets girls behind in their studies [102]. Similarly, completing group work as girls is difficult because they are often not allowed to meet up with others and move around freely outside of school, even if there had been time. In addition, because most families do not own a phone, completion via telephone is also not an option [102]. Then in school, they stand up for one another in solidarity, but in the end it affects all their education and chances in the future [102].

In the work space, it is not standard, but very common for gender biased or cultural-values-based behavior to occur [103, 105]. It often starts with appearance. If you have dreadlocks, braces, or dress too revealing or too traditional, or even if you just aren't the most attractive, it can be enough to not be hired [103]. Then, if you are hired, a man can always be addressed with *ato*, no matter his marital status, but an unmarried woman will be addressed as *weyizerit* and a married women as *weyizero* [103]. Especially when a woman is *weyizerit*, this will be the only focus, no matter her skills [103]. Interviewee 1 was lucky never to encounter this in her work space, but she had heard of others who have [105].

Of course there are differences per region that one should be aware of. For example, in the capital Addis Ababa, it is not uncommon for men and women to be friends, but in other regions like Awassa, Oromia and Mek'ele, it is less accepted [106]. And as mentioned, there are some changes happening, but they are somewhat slow [106] and not yet integrated in daily life [103]. Some things may also be interpreted as equal rights - like women working construction and as street cleaners - but this is not a happy coincidence; they are hired because they are cheap labor and not because it is their right [103]. Then again, in 2011, the *Setawit* or Yellow Movement was initiated as a student initiative and is now an official club with both male and female participants fighting for female rights, female empowerment and against gender-based violence [103, 115]. In 2016 a sister chapter was established at Mek'ele university and plans were made to expand towards Adama University and Gondar University [115]. These clubs are a sign of hope for a brighter future for all Ethiopians, which is also why they chose the color yellow [115].

The above discussion on gender equality is only a small insight into the level at which it still carries value, how it affects daily life and how it can be masked, but there are also parties emerging to fight for gender equality. In addition, there is some awareness for the topic which is an important first step. This means that you may encounter gender inequalities when doing business in Ethiopia, but if you stimulate gender equality and equal rights, you will likely also meet supportive voices. In the end, equal rights lead to higher overall productivity, increased GDP and improved social conditions, which benefits any nation [116].

Hierarchical Structures Hierarchical structures are closely linked to cultural values based on network relations and rights and thus also to the paragraphs of Equal Rights and Horizontal and Vertical Social Networks. Some hierarchical characteristics have therefore already been mentioned, such as that you do not talk back at your teacher or superior out of respect, or your husband or father because of the cultural status quo [38, 102, 103, 105–107]. These two are born out of similar cultural traditions and represent hierarchical structures in both position / rank and gender (see the previous paragraphs). However, if you are in such a

position, there are also expectations one has to meet. For example, one of the interviewees explained that because of his doctorate title, he is expected to dress well. His family cannot understand why he would dare walk around in normal clothing; his status demands a certain type of dress [106]. In literature there are also references to certain expectations such societies have of people in a higher hierarchical position [42]. In some cases there are expectations or rights to a specific type of dress, in others it is how they live, the luxuries they have (e.g. cars) and the benefits they are expected to share with the community [42]. One additional source of hierarchy is age [103]. This 'ranking' is merely for a show of respect towards the achieved wisdom in age. The main difference the interviewees noticed between Europe / USA and Ethiopia is that hierarchical positions in Europe / USA are generally only on paper and rarely enforced unless absolutely necessary; most uttered a preference for this type of interaction [38, 102, 103, 105–107]. No other specific examples of hierarchy in the workplace were mentioned, but one should assume that they exist and may influence work. In section 4.3.3 below, additional insights into how business is affected by hierarchical structures is discussed.

Anonymous trust The concept of anonymous trust is that two parties can collaborate and do business with each other, without knowing the opposite party personally. The trust to conduct business this way is based on the reputation and integrity of the firm they work for. According to [42], this is one of the fundamental keys to establishing cooperation and thus free competition and prosperity. The statement the authors make is that this is fundamentally lacking in a System I nation. The reactions of the interviewees, however, show mixed results. For example, interviewee 1 mentioned that the job she had had, seldom required her to meet face to face with people and that the focus of both parties was to make a profit through business [105]. Interviewee 2, on the other hand, disagrees and explained that good social conduct is to interact face to face and that it is an absolute necessity to establish trust. It is part of their lifestyle and culture [106]. He also mentioned that he had been surprised while completing the application for Erasmus Mundus because there was no way to prove that the data submitted was truly his until it was 'too late'. Of course you sign that the information you have provided is true and correct, but yet he found it a little strange and surprising [106]. Interviewee 3 argues that it depends on the type of business. He works for a media company alongside 20 other guys, but some of them have never met, yet it works fine. However, if you would want to start a local business in his home town, you would definitely need to meet the people you would want to do business with and build a relationship and thus it depends on the type of business [38]. Interviewees 4 understands the value of anonymous trust and can attest that face time is important and often also motivating, but has limited experience or examples of this topic [107]. Interviewee 5 experienced it in a corrupt setting where people got into contact with him and built up trust only to try and coerce him into sabotaging an important project [103]. Finally, interviewee 6 has little work experience and has generally only been in situations where she knew who she was dealing with. However, now with the covid-19 pandemic, she notices that you often need to work with people online that you do not know. It takes some getting used to, but so far it has worked [102], indicating that trust habits are difficult to break. Naturally, even in Europe, sometimes it is simply better to work face to face, but it is not necessarily a requirement to form trust. The extent to which anonymous trust is a given in Europe, also depends somewhat on local culture; in some countries it is stronger than in others. The take-home message, however, is that personal relations in Ethiopia are a necessity when building relations to do business. Only in certain circumstances or businesses will it not be required, but even then it will never work against you and be valued by the second party.

Time Management In the reviewed literature in the previous chapters and in the paragraph on strengths and weaknesses above, the general consensus is that time management is not a strength of the Ethiopians. The interviewees agree that they have learnt a lot about time management in the Netherlands and the United States of America [38, 102, 103, 105–107]. In Ethiopia, being on time means arriving between the time of the meeting and an hour late [38, 102, 105, 106]. In Mek'ele, it is almost an unspoken rule that if your appointment is at 13:00 for example, both will arrive at 14:00 [102]. It is known as *habesha time* [102]. In Addis Ababa, the same is true; meetings will often be scheduled one hour before they actually start [105]. Adjusting to Western standards of punctuality takes some adjustment, but the interviewees all say that they value how time is used here. First of all, being on time shows that you respect and value someone else's time [107]. Having hard deadlines helps getting used to being punctual, but also improves time management skills [102]. The same counts for the use of an agenda, which is not used often in Ethiopia [106]. Also, the use of progress meetings is valued. Not only do they allow you to see what others are working on and consult on problems you encounter in your own work, it is also a way to stay on track with your tasks and determine ahead of time if you are going to meet the deadline or whether you need to work harder [107]. Lastly they enjoy the effect punctuality and

time management have on everyone's productivity [38, 102, 106, 107].

The Ethiopians abroad and in a Western setting clearly value the benefits time management has. However, it does not mean that if it is introduced in a firm in Ethiopia, punctuality will be adhered to. When asked how one could motivate employees / co-workers to be on time, no one could come up with a way because it is part of the culture. However, in terms of meeting deadlines, there are some businesses that are strict on meeting deadlines, especially when there are penalties that are enforced based on the law (e.g. cash registering systems, banks, etc.) [105]. Finally, one should not forget how time is counted in Ethiopia: 7 am = 1:00 in Ethiopian time and that culturally it is not acceptable to refuse a meeting [106] and that social calls should not be scheduled, but occur spontaneously [102].

Agreements This topic is often closely related to time management. In an interview with T. van Kampen, he mentioned that agreements are not always adhered to as we are used to [77]. Sometimes it is simply that the deadline is missed, but other times it is that something completely different than agreed upon has been done [77]. In literature, it is often referred to as a lack of commitment (see section 4.1.5). The potential reason and origin of this lack of commitment is discussed there also. More interestingly is to see what the Ethiopians think when confronted with this observation / accusation. One of the interviewees himself mentions a lack of commitment amongst workers and management to secure a standard quality and on-time product [107]. In addition, he explains that oftentimes, Ethiopians will not speak up to do or refuse a job, but might surprise you with a pragmatic solution after some time [107]. Generally, we should consider such actions to be done in good faith and because they mean to avoid offense, but because it does not match with our (European/American) cultural habits, we should try to remain aware of potential misinterpretation. Of course when the job is not done on time and deadlines are pushed without consultation, as can be the case in Ethiopian firms [105], it is more difficult to see the good faith. Interviewee 2 stated that poor communication skills are often at fault for this type of behavior [106], but perhaps it is also the fear of failure that lead to non-communication [107], or just general bad work ethics [38]. Whichever it is, one should remain aware of the possibility that changes in planning may not be communicated, nor changes in the type of task completed.

4.3.3. Doing Business in Ethiopia - Interview Results

The previous section discusses the socio-cultural differences between Ethiopia and Europe / the United States of America that were found when asking Ethiopians living abroad about values generally established as characteristic for developing nations. Because the interviewees are Ethiopians now living in Europe (5/6) and the USA (1/6), they are capable of comparing and contrasting the different cultures. The same is possible for people with a 'Western' or non-Ethiopian cultural background working in Ethiopia. Due to the social ties and culture of establishing trust from face to face visits, in addition to the fact that contact with Mek'ele came to a halt in November 2020 with the local military struggle, only two companies were interviewed: SNV Ethiopia and the Nicolas Robinson School (NRS). This means several things. First of all, the information obtained is limited to a very small representative group. This section, however, aims to provide an initial overview of how it can be to work with local Ethiopians and summarize what the interviewees have learnt during their endeavors. This may provide some insight into local practice and deduct recommendations or points of caution for ones own future endeavors. Before setting up a business, it is highly recommended to get into contact with more parties with relevant experiences. Second of all, both SNV Ethiopia and the NRS are influenced by international players, although many employees working at both companies are Ethiopian. Of course, if one were to set up a business as a foreigner in Ethiopia, or if one were to work at such a company, these influences would exist also, making these companies perhaps more relevant than fully local companies, as finding the balance between System I and System II values will be of importance. These two businesses have experience with this.

The list of interviewees and questions that were posed can be found in appendix D. The interviews were semi-structured and the interview protocol of appendix A applies. The topics that were to be covered during the interview were: funding opportunities, leadership style, entrepreneurial mindset / drive, adaptability / growth potential, prioritization / commitment, collaboration and (commitment to) operations. Within these topics / talking points, additional points were indirectly addressed, such as on what basis employees are hired (merit or through connection), what the employees prioritize and value, how independent and / or entrepreneurial the employees are, how much room there is to be entrepreneurial in relation to leadership style (supportive or authoritarian leadership) and what the observed effects have been. The results can help plan and prepare for future business plans in these regions. However, because only three people were interviewed, it is only meant as an indication of how you can approach business. It is not to say it will worked guaranteed.

For that, this study is too small.

Funding Opportunities This topic was addressed to determine the options of funding and the ease at which funding can be received. None of the interviewees was very knowledgeable in general funding opportunities, as can be expected, but some helpful tips were given, nonetheless.

For educational purposes or projects with a large training component, the Nicolas Robinson School (NRS) is allowed to get funds from overseas donations. The founders of the school have also found that they can set up projects / businesses in collaboration with the school that allow for revenue streams in the form of carbon credits. These type of projects allow for the employment of more locals and additional (environmental) benefits [117]. As a local or entrepreneur looking for financing, "Dedebit Bank is the primary lender of choice for micro-credit" [117]. They have a clear approach, strict rules, and encourage students to approach them. The bank considers individual credit history, but also allows for the support of an educational institution of good reputation or collateral to uphold the contract [117].

SNV Ethiopia is a non-profit organization that performs projects that are funded by governments and other organizations. Both interviewees 9 and 10 are working on the National Biogas Programme Ethiopia (NBPE) (NBPE-I, NBPE-II, and NBPE+), meaning that their funding comes from the Directorate-General for International Cooperation (DGIS) and the European Union [118]. They have little to do directly with funding, but do state the importance of the availability of micro-financing institutions for the development and dissemination of bio-digesters in Ethiopia, as well as the support from the local government and other public institutions to develop the private sector [90].

Leadership Style / Hiring Policy / Loyalty This topic was addressed to determine whether there are hierarchical characteristics within leadership and if so, how they are used; how leadership approaches achieving company targets and meeting deadlines; how employees are hired; and how loyalty is inspired.

At both SNV Ethiopia and the Nicolas Robinson School (NRS), leadership finds that the best results are achieved when they lead by example [90, 117]. A balance between various leadership styles is necessary to set a good example; you must be participatory (democratic) and a counselor, but sometimes also restrictive and demanding (authoritarian / autocratic characteristics) [90]. In the end, however, you want them to embody the values of the institution they work for. To achieve this, you must inspire them and lead by example. Then you must let them try on their own (delegative / laissez-faire). If necessary, you can redirect them [90]. Purely autocratic, has never worked for interviewee 9 [90]. Like interviewee 9, the leadership approach of interviewee 8 is a balance between different types of leadership and is applied towards his staff, as well as by his staff towards the students. It has proven to be effective so far [117]. At the Nicolas Robinson School, the goal is also to train and coach the staff to improve their skills and develop mentoring and coaching skills, based on the values of the school, for the students they work with [117]. For example, during conflict resolution, teachers learn to take an unbiased stand and give both parties a chance to explain what happened, then they should help guide the students in reflecting on the situation so that both parties are part of understanding and resolving the situation. If necessary, the teachers can ask suitable questions or help come up with solutions. Only in a couple of rare cases, judgement is passed to resolve issues [117]. Issues amongst colleagues is most often due to different work ethics and rumors that spread quickly through small communities [117]. Conflict resolution at SNV Ethiopia is described similarly by interviewee 10, although conflicts occur more often between clients and partners than between co-workers at the organization itself [118]. However, there are sometimes personal grievances (e.g. problem at home). When this occurs, interviewee 9 believes in the following approach: there is space for grievances, but they should be addressed and resolved as soon as possible because "we have a responsibility to perform". This can mean that, on occasion, the conflicted must be helped to put the situation into perspective and be reminded that they are all working towards a larger goal because "we are here to do something good for the people" [90].

During the interviews, there was little indication of typical hierarchical play. Both organisations seemed interested in and feel responsible for the well-being, development, and dedication of their co-workers / staff. How much hierarchy plays a role in other businesses is not known, but it is important to note that by leading by example, company values and a company culture can be established and reinforced, which will represent a balance between cultures and a fair and comfortable work place. However, this can only be achieved with a constant effort. Again, it is important to note that both organizations have international influences and values and that, even if hierarchy is not clearly noticeable at this level / amongst these interviewees, there can still be smaller plays of hierarchy at work that go unnoticed in the bigger picture. Interviewee 8 does openly

states that culturally there is some natural hierarchy based on positional (job) rank, age and experience [117]. However, since there is no further indication here, no more can be said about it.

In terms of meeting deadlines and discipline in time management, this seems more difficult to establish. As discussed several times before, it is customary for Ethiopians to be up to an hour late to meetings and being commitment to an agenda is not common amongst locals [106, 117]. Interviewee 8 says that his staff needs very regular reminding of (routine) tasks and their deadlines [117]. To manage this more effectively, there are regular meetings with the management team where they follow training to prioritize their work and that of their staff [117]. In addition, to stimulate time management and commitment to deadlines, it is important to understand what motivates the staff. Interviewee 8 explains that, as with most people, his staff performs best when their work seems relevant [117]. Therefore, the staff is regularly reminded of what their tasks contribute to and why completing tasks as agreed upon and on time is important [117]. The reward for punctuality, attendance and discipline is a progression in promotion and other rewards or benefits. For additional motivation, the staff gets together in the community twice a year to help build teamwork, friendships and common appreciation. On a smaller scale, the staff also have a monthly celebration and participate in coffee clubs and additional team work activities [117]. An additional important motivator is that the school is not only concerned with itself, but with improving the community as a whole, extending benefits to family and friends living in the community. For some staff, another motivator is that their children attend the school; their hard work directly affects the quality of education for their children [117]. Physical incentives include the salary, and an increased pay could stimulate loyalty, but is difficult to realize. For the head of the school there is a loyalty bonus. The idea is to extend this bonus to other staff members that prove to be irreplaceable and/or add significant value to the school [117]. However, sometimes it proves to be difficult to compete for a staff member's loyalty. Especially amongst men, marriage is a reason to leave the school. Usually under the pressure of the bride's family, he is expected to start his own business [117]. Women leaving the school after marriage is becoming less common, as well as leaving because of the status a teacher holds in the community (appreciation for elementary and middle school teaching staff used to be lower) [16].

At SNV Ethiopia, time management is also a known point of constant improvement [90]. Since the organization employs people from various backgrounds and cultures, there are various 'senses of time'. Some value time very much, others take it for granted. As an organization with international influence that wants to lead by example, achieving targets on time and improving time management amongst its employees is important; however, interviewee 9 explains that since there are only 3 expats amongst many locals, focusing on delivering on time has proven more effective than forcing time management in the sense that every minute should be planned [90]. He explains that he provides tips as to how time management can be improved (e.g. prioritize work, set personal targets per day/week/month, try to beat your own planning, then get to lower priority work, etc.). Whether they choose to apply the tips or not, if they do not have their work done on time, they are required to work over-time [90]. In addition, since they agree to the company culture and values when signing the employment contract, they may be (verbally) reprimanded for tardiness. For example, if five people have to wait for one person for 5 minutes, it is 25 minutes of work wasted; this is the mentality they try to achieve: value other people's time [90]. This approach again represents a balance of various leadership styles (autocratic, democratic, and laissez-faire). Interviewee 10 agrees that when tasks are distributed, communication on who does what and when it should be delivered is always very clear, so there should be no reason for delay [118]. As a manager and leader, interviewee 9 is responsible for delivering results on time, but he also relies on his employees to provide part of the work. When a deadline is about to pass, he transfers some of the pressure towards his co-workers to make sure the target is reached on time. Upon further elaboration, he explains that - similar to the NRS - the pressure is received well if they understand the 'why' and if he leads by example [90]. This means that he must also stay late and deliver results; a sign of mutual respect and collaboration [90]. However, there is an additional component to this final statement. Interviewee 9 explains that there is always a higher expectation in terms of work load and results of an expat because they are paid more. An expat must live up to the expectations or he/she will likely loose his/her job [90]. This is an interesting point that should be remembered when working in Ethiopia amongst locals. Interviewee 9 describes important motivators of his employees to be on the basis of personal gain (financially, physically and mentally secure), but balanced with the understanding of the larger goals and targets of the organization and how it helps the nation develop. These goals and motivations can be translated to personal performance objectives [90]. In addition, the organization provides training for soft and hard skill development which benefits employees in the long-term [90, 118]. Outside the organization, there are awards for best performing woreda (district), individual experts and Biogas Construction Enterprise (BCE). In addition, the biogas program follows result-

based financing and budget allocation. The parameters are based on quality control, biogas production rate per bio-digester, biogas promotion, number of bio-digesters constructed and in use, etc.[118]. As base preparation and to give them a fair shot, user and construction training, technical support, and regular supervision are provided [118].

How employees are managed and motivated has been discussed above, but how they are hired is also important. In some of the reviewed literature in the previous chapters, and even in the previous section, it was mentioned that sometimes people are hired due to their family or friend's connections, rather than based on their skill set. Both the NRS and SNV Ethiopia have a hiring protocol. Because they are both based on, or backed by, international organisations this is not surprising. Nonetheless, during the interviews, the interviewees were asked how they approached the situation when other employees of the organisation present a family member or friend as potential new hire. In the case of the NRS, family members or friends recommended by staff is not common, but when it happens, they enter the official hiring process. For teachers, the process includes having achieved the necessary qualifications and a rigorous face to face interview, as well as teaching a class to their future peers for evaluation. When passed, most enter a six week probation period. If there are some doubts, they can be hired based on a 1-year contract before becoming a full employee [117]. At SNV Ethiopia, there is a human resource department that handles new hires for SNV employees. Hires are based on qualifications and experience, but mainly also on characteristics such as relationship building, integrity, etc.. These characteristics are difficult to determine in one interview, so it is something that you need to work on continuously as a manager once they are hired because you want them to become SNV'ers and embody SNV values [90]. Within the National Biogas Programme Ethiopia, the hiring of the national and regional coordinators falls to the government, which has its own HR manual. The hiring of masons and BCE is organized through the National Biogas Programme Ethiopia under the supervision of SNV Ethiopia. Hire is based on skills and experience, but often hires (masons and BCE) are trained in their new job and receive programme certification [118]. To make sure that the quality of work fulfills at least minimal standards, there is a quality enforcement system based on construction quality control, along with after-sales services and other accountability systems [118]. To accommodate equal performance and equal pay, the masons and BCE are given a manual and refresher course whenever necessary and paid per job (with specific requirements), not based on time spent on the job [118]. Both employees at the Nicolas Robinson School and SNV Ethiopia are payed on a monthly basis into a bank account, indicating no foul play or direct issues of trust and loyalty.

Prioritization / Commitment / Trust Priorities and commitment have a lot to do with mindset, but also with loyalty. Loyalty has already been discussed to a certain extent in the previous paragraphs, as well as the commitment to time and deadlines. It is important to understand that for Ethiopians, the priority lies with their family and community, and rarely with their employer. The Nicolas Robinson School (NRS) uses various methods to inspire collaboration, team work, friendships and loyalty, but it is one overall theme that helps inspire loyalty: when the school becomes part of the family [117]. Through projects that help and benefit the community or even create additional employment, the school accepts its role as both part of the local community (horizontal), but also as provider and protector of the community (vertical). This inspires appreciation by the staff and so also loyalty [117]. Of course, however, when pressure from family to start their own business becomes stronger, it becomes difficult to compete, as discussed above. Loyalty and especially commitment to work is also inspired by good examples. Interviewee 8 often stays to work late. This is seen by the staff and often copied. These extra hours are valued by the community because it ensures good education and often allows for extracurricular activities for the students [16, 117]. In return, they are supported by the community in times of crisis and share in any celebrations [117]. This behavior attests to the strong support system that the horizontal networks / communities represent and shows that the school is considered a vital part of that network. Because of this, the school partakes in its role and provides lower paid workers with extra work whenever they volunteer [117]. Whether this is done consciously, or because it is culturally expected of them, was not specified. Nonetheless, it has had a positive impact and is recommendable to others. This is the ideal picture, however, it takes quite some effort to get to this point. Regular training about prioritizing work and improving communication skills have proven to be a necessity when wanting to achieve the situation described above. It is a new balance employees are not (culturally) used to. For some employees the training is not enough and the school requires to give fines for non-communicated tardiness and/or absence, or absence without a valid reason [117].

At SNV Ethiopia, they recognize too that it is sometimes difficult to keep employees loyal and committed [90]. However, as explained above, by leading by example and continuously acting upon the values of SNV

and holding their co-workers accountable to do the same and reminding them of the values when necessary, progress in this department can be made [90]. Within the National Biogas Programme Ethiopia, it is more about commitment and integrity. SNV Ethiopia tries to provide incentives for local actors to create the base of a private biogas sector, but regularly finds itself needing to intervene through dialogue facilitation or quality control and accountability systems [118]. The initial approach, however, is to set them up as best they can through training, certification, the provision of a manual and a subsidy for the material or the mason [118]. This indicates some initial trust towards the masons and Biogas Construction Enterprise, but not a fully independent and secure, laissez-faire type of trust. In the end, trust is one of the most important characteristics for a good business where employees are committed and prioritise their work.

In the previous section, anonymous trust was discussed and how it forms the basis for collaboration and competition. At the NRS, they have a policy of assuming trust as a starting point [117] similarly to the way Western law systems assume innocent until proven guilty. Considering the school is almost like a community, it seems issues of trust can often be resolved fairly easily. At SNV Ethiopia, generally, there is also trust amongst co-workers. However, now with the covid-19 pandemic and the requirement to work from home, interviewee 9 is noticing that the need for the traditional cultural values of having lots of face time to build personal bonds and trust is slowly returning, making virtual meetings increasingly more difficult [90]. They are used to greeting each other for several minutes per encounter. You ask about the family, hug and repeat the questions several times. Interviewee 9 finds it fascinating and understands that his co-workers value this, but it can sometimes be an obstacle [90]. These cultural habits and trust through contact extend their effects into daily work. Interviewee 9 explains that - as was discussed in the previous section also - Ethiopians do not speak up and will rarely voice their opinion or feelings verbally; especially not in a larger group. Also, the expression is often done through body language or facial expressions which can be hard to interpret and understand as a foreigner [90]. Because nobody voices an opinion and it is not customary to voice an opinion, it is difficult to voice an opinion yourself because you do not know who you are offending and the extent to which this will affect your relationship with that person, especially if your own background is different [90]. Interviewee 9 elaborates: the Dutch are very passionate and will sometimes have such heated debates that it looks like a fight; 5 minutes later they can be laughing and are the best of friends again. In Nepal (his home country), a discussion/fight like that would break any bond you had with that person. In Ethiopia, you will sometimes not even know if you have offended someone until later [90]. This uncertainty in the outcome or effect on a relationship is most commonly observed when sensitive topics arise during meetings and nobody wants to speak [90]. Being able to communicate openly and professionally with your peers is a sign of trust. Not being offended is a sign of respect. Both seem to be a work in progress in Ethiopia, something one should not forget, especially because hierarchical gender and seniority may also put you in a position where you are not expected to have an opinion, let alone voice it [102].

Entrepreneurial Drive / Adaptability / Collaboration The previous paragraph brings up an interesting point about collaboration. Collaboration is difficult if you cannot voice your opinion or ideas. Again, trust is essential to create a space in which open communication is valued and collaboration is possible. This is especially important because without such a space, you will never be able to present new ideas or points of improvement for fear of offense, which will inevitably lead to stagnation if visionary leadership is also not available. In the previous paragraphs, it is mentioned several times that the Nicolas Robinson School (NRS) works hard in regular trainings to improve communication and team work, which has proved beneficial over the years. The trainings help them feel welcome and relevant within their teams, and present a positive, helpful and inclusive environment, which they are expected to embrace and carry on [117]. The trainings also try to show that everyone has the same opportunities within the school, which is a legal requirement, but not always directly internalised by employees [117]. This feeds the base for an environment in which new ideas, innovation, and an entrepreneurial mindset is valued, which is traditionally counter-cultural [117]. Over the years there has been improvement and it has led to several after-school activity groups for students (e.g. STEM club), but also to some innovation and important initiatives [117]. For example, with the covid-19 pandemic, the students were not allowed to attend school anymore. Realizing the impact this virus could have on the city and community, the teachers offered their time to produce hand-sanitizer and other disinfectants in the school lab, which were distributed to the families of the students and surrounding community. Because of limited resources in internet etc., some classes were taught via local radio, allowing for continued teaching. Ethiopia also saw a desert locust plague this year (2020). One of the biology teachers developed a natural pesticide which he presented to interviewee 8, who was in support almost immediately and able to give the go-sign and allow the teacher to lead a team of volunteers. The project was such a success that a local

firm even provided production equipment and helped him patent the pesticide and method. Unfortunately, due to the war, the project came to a halt [117]. Initiatives like these are valued at the school, but it it clear that it is only due to continuous reminder and portrayal that it is valued. Interviewee 8 explains that there is an inherent 'shoot the messenger' fear, even for things as simple as informing senior staff that a light bulb has broken [117]. He also mentions some (culturally-based) hesitance by staff to accept or partake in new projects or processes. Generally, if you want people to participate, the way the project is presented is critical and they need enough buy-in and understanding as to what the benefits will be [117]. The school tries to support as many initiatives as possible to counter this kind of behavior. For example, if a teacher voices the wish to receive an additional qualification in a field of his/her interest, the school tries to support this financially and by adjusting their work at the school. However, as with any business, there is a balance. The teacher's new qualification must be relevant and add value to the school (i.e. buy-in). It is also important that the teacher scores well in his / her appraisals, otherwise you might send the wrong message to other staff members [117]. It is a give and take, like in any relationship.

Collabortion at SNV Ethiopia is more strongly affected by local culture, as explained above. Anonymous trust is weak. As a manager, interviewee 9 has explained that he tries to continuously work on the SNV values with his co-workers to integrate them in every day work. Some show more adaptability and willingness to learn than others [90]. He also explains that the introduction of new tools is important, but sometimes difficult. Sometimes it is purely because of capacity limitations (i.e. the employee does not know how to work with a new system or tool), but sometimes change is just generally not welcome [90]. Interviewee 9 explains that over the years he has learnt to first discuss with his colleagues and other parties to see whether there is a need for a new tool or process and whether they are open to trying it - here it is important to explain the benefits. Next, the tool is tested on a small scale after which feedback is given and the assessment can be made on whether or not the tool should be implemented on a large-scale [90]. Here too, it is very important that the co-workers have buy-in and understand the benefits in the larger picture. The introduction phase is therefore very important [90]. Generally it is hard to predict whether a tool or process will be accepted or not because it is very culture and context specific [90]. Whether initiatives ever come from co-workers was not specified, but considering the cultural influence, it seems less likely. In conclusion, it means that culturally, initiative and change is not naturally welcomed, but it can be inspired in a constant and reassuring environment that inspires trust and freedom to speak up; something worth considering for future entrepreneurs.

Operations All businesses have operations. These can be physical or digital, but often there are also general things like maintenance at the work place that need to be done. In Europe, this is usually not difficult to manage as most firms are reliable and can provide good and professional references. In Ethiopia, however, both interviewee 8 and 9 explain that it is difficult to come by good and reliable workers for even simple manual tasks [90, 117], as was also discussed as a main barrier for the National Biogas Programme Ethiopia in the literature review in chapter 3. Often before giving a job to a worker, interviewee 8 asks him/her to demonstrate his/her work to see if it will meet the requirements [117]. For plumbing and electrical work, the Nicolas Robinson School (NRS) now has contract workers, which is the best way to get quality workers in Mek'ele, Ethiopia [117]. But even if a qualified worker can be found, often material to complete the job is scarce, especially electricity, as it is often unreliable and fluctuating [16, 117]. Also, both the worker and material are often relatively expensive. The Nicolas Robinson School has a facilities director who is in charge of organizing regular maintenance work, but providing him with a well written manual is critical [117].

Interviewee 9 and 10 are not involved with maintenance work or related work at their own work place. Interviewee 10 also explains that within NBPE+ they are not influenced by material or financial shortages as they are financed by larger organisations (i.e. the European Union, the Ethiopian government and DGIS) [118]. Literature, however, suggests that there have been material shortages in the past which have potentially led to diminished quality constructions, and that obtaining enough finances or financial credit via an institution can be an obstacle for individuals looking to invest in a bio-digester (see chapter 3). Once construction has been completed, use and operation is directly transferred to the owner after a training. They are also given a manual, a warranty certificate and after-sales service [118]. Literature suggests that there are some gaps in the manual/training on proper maintenance and that after-sales service is inconsistent or inadequate for the problems encountered. According to interviewee 10, the bio-digesters should not require any maintenance for many years (20+ years) except for perhaps exchanging pumps, pipes and other heavily used accessories like the stove; the user is to organise this himself with the constructor [118]. This attitude and mis-match in information could potentially signal an area where some additional communication between users, constructors and the SNV could improve long-term working and functionality of the bio-digesters, which would

be in the interest of all parties under the goals of the National Biogas Programme Ethiopia. It may also be worthwhile asking whether the manual can be read and understood by most users, as well as the trainings, considering that illiteracy is still very high in the country.

Either way, it is important to note that operations in Ethiopia are dissimilar to operations in Europe. As an entrepreneur, it is probably wise to get into contact with more experienced business owners and ask for advice on how to approach obstacles commonly encountered during production.

From the interviews it is interesting to see that there is quite some overlap with the literature reviewed, but that there are also some mis-matches. It is motivating to see that when one is aware of, invested in and participatory in the local culture, it is possible, with a constant and positive effort to embed some more system II values into the working culture and find a balance that allows the beginning of a social transformation. Especially at the school where the school is part of the community, teachers are an example to many young students, and student take their experiences back home, slow improvements can be seen. While interviewing all the participants of this chapter, the question of how age affects these types of transformations comes to mind. At the school, most teachers are still fairly young and eager to learn, whereas as SNV Ethiopia, interviewee 9 described that the eagerness to learn is only found amongst some of his co-workers [90]. Perhaps a school is exactly the place where such transformations need to start. The influence of age on social transformations could be an interesting area for future research.

The next section summarizes all noteworthy points of interest and recommendations that have been established in this chapter. They can be used by entrepreneurs looking for tips and tricks in their business when working in Ethiopia, or similar nations. Of course the input came from a limited group with international influences, so tips are only meant as such and are not always guaranteed to work.

4.3.4. Insights and Recommendations Based on Socio-Cultural Differences and Business Leaders Operating in Ethiopia

Here the insights, recommendations and noteworthy points of interest or caution that have been discussed in the previous two sub-sections are summarized. To keep it short, they have been listed in the table below. These points are not specific criteria for the business model framework for developing nations because they are country specific. However, some of these points have been mentioned in the previously determined barriers and drivers from the previous sections. The overlapping points will be noted in the final list of criteria in chapter 5. Additionally, these noteworthy points of interest and insights are valuable for the case study, which is also in Ethiopia.

Table 4.5: Summary of the noteworthy points of interest and caution, insights and recommendations from the interviews on socio-cultural differences between Europe / the United States of America and the interviews with business leaders operating in Ethiopia.

	Noteworthy points of interest or caution, insights, and recommendations.
	Ethiopian Society...
1	Ethiopians are open, friendly and hospitable, and proud of their culture. Social ties are very strong. Partaking in their culture shows respect and builds relationships and trust.
2	Many elderly are very set in their ways and have seniority-based hierarchy on their side, which is often best respected.
3	Other hierarchy is based on job ranking, experience (age / seniority), and sometimes gender. It is generally not an easy topic to discuss as it is deeply embedded in tradition and culture.
4	Religious diversity is something they are proud of. Therefore, religious discrimination is generally not an issue. Note: Based on religious grounds, same-gender relations are illegal.
5	Abiding by rules and understanding your rights is uncommon amongst Ethiopians. Society creates the rules they live by. Gossip can be enough to tarnish ones reputation and limit ones opportunities.
6	Equal access to education, equal access to energy, and equal rights between males and females are not well-established / developed, but awareness campaigns and activist clubs are increasing.
7	(Linguistic) communication (in English) is poor.

	Continuation of noteworthy points of interest or caution, insights, and recommendations.
8	Ethiopians like to think of themselves as good listeners. In reality this reflects a culture where collectivism goes before individualism. Standing apart from the group or speaking up is not appreciated. (Verbally) voicing opinions and feelings is rarely done and may cause offense if done anyway. There is an inherent fear to initiate something new for fear of 'shoot the messenger' or general failure and repercussions in the community. This affects women more strongly than men as they need to worry about their reputation more. The only exception to speaking up is in solidarity to your friends or family.
9	There are quite some significant cultural differences between regions in Ethiopia, but only few know what they entail exactly. This is not taught at school. The North is known to be more conservative; along the Western-most borders there are tribe lands and in the East there are more Muslim communities. Addis Ababa is generally portrayed as the most progressive. This would need further research.
10	Do not take your meals alone. It is disrespectful / offensive. Share what you have, if necessary.
11	*Westerners* are generally considered wealthy (stereotype) and expected to live in luxury and extravagance. Note: What luxury and extravagance looks like may vary per region.
12	Try to remain aware of your own prejudices and avoid actions and thoughts based on (unproven) stereotypes.
	... and the concept of time.
13	Time in Ethiopia is counted different. 7:00 (7 am) is 1:00 Ethiopian daylight time, 8:00 is 2:00, etc., 18:00 (6 pm) is 12:00, 19:00 is 1:00 Ethiopian night time, etc.
14	There are various calendars in use. Some have a 7 year gap to the Gregorian calendar. Check to be sure you are talking about the same day.
15	Being an hour late to a meeting is part of the culture. Because you are a foreigner, however, they may show up 'early'. It is likely best to show up on time, but don't be surprised if they are 'late'.
16	Time management is weak and active use of an agenda is rare. Commitment to / prioritizing work is not common. The concept of a work-life balance is not commonly understood or even known. Generally, the commitment is always to family first. Changing time management and priority habits requires a constant and consequent approach. Often, regular training in time management, prioritizing work and improving communication skills are a necessity to achieve a positive and productive working environment.
	... in relation to business.
17	Horizontal and vertical social networks are still a strong basis of everyday life. As a foreigner you will likely automatically become part of the community's vertical network and will be expected to act as such (protective umbrella). This can also mean that you are expected to share in the benefits you have. To find support and protection yourself, make sure to build relations in the horizontal social network (safety net), as well as in the vertical network. It is highly likely that both will be needed to make your business sustainable and profitable over time. Be aware of in-transparent corrupt schemes when setting up your networks.
18	Anonymous trust is rarely a reality in Ethiopia, thus personal relations in Ethiopia are a necessity when building relations to do business. Note: refusing meetings is considered offensive.
19	Loyalty amongst employees can be stimulated by building personal relations and trust, by becoming part of the horizontal network, by sharing benefits, by creating additional employment, by demonstrating why their work is relevant, or by other things they value. Financial incentives (promotion / pay trajectories) often work also.

	Continuation of noteworthy points of interest or caution, insights, and recommendations.
20	Unprofitable or unsustainable characteristics in the work place can be changed. Ideally, your leadership style is a balance between democratic/participatory, delegative/laissez-faire and autocratic/authoritarian. You are a coach and mentor, a co-worker, but also the boss when necessary. This requires communicating clear boundaries and targets and holding everyone equally accountable, including yourself. Leading by example and engaging in team building activities to create a patient, open, inclusive, supportive and positive working environment works well. Note: if you are a foreigner, your employees will likely have high expectations of you. Younger generations are more open to change than older ones.
21	Communication skills are weak. There is a 'do not speak up' type of culture and an inherent fear to initiate something new for fear of 'shoot the messenger' or general failure. It is closely related to uncertainty avoidance within the community. Being able to communicate openly and professionally with your peers is a sign of trust; not being offended is a sign of respect. Both seem to be a work in progress in Ethiopia. This is important to remember because hierarchical traditions (gender, seniority, job ranking) may put you in a position where you are not expected to have an opinion, let alone voice it.
22	Remain aware of the possibility that changes in planning may not be communicated, nor changes in the type or extent of task completed.
23	For new projects / processes / tools to be accepted and integrated in the work space, initial presentation is critical and staff must be aware of the benefits and have enough buy-in. Sometimes a small-scale test phase is recommendable. Employees may come up with their own initiatives if there is an inclusive, open and supportive environment. This may take time to establish.
24	Even amongst Ethiopians, many workers are considered lazy or to have bad work ethic. Laborer quality is often poor and should be tested before hiring. Once good labor is found, it can be wise to set up long-term contracts.
25	Doing odd jobs is not appreciated and often considered degrading.
26	Younger people looking for work will often be inflexible in the type of job they want, especially if they have completed a specific education.
27	Establishing strict hiring policies and processes seem to resolve most issues of nepotism. Also make sure that issues like choices based on ethnicity, gender or appearance are resolved.
28	For any type of operation / activity, a clear manual is critical and hands-on supervised training is recommended. Make sure that the manual is understood and used. Regular reminding will likely be necessary. Be aware of potential illiteracy.
29	Be aware of gender inequality in the work space. Subtle sexual harassment, especially towards unmarried women, is not uncommon and can influence work output / productivity. Women are also often paid less than men. However, if you fight this status quo, you are likely to find both male and female support, especially amongst younger generations. The company could possibly even benefit by actively engaging and positioning itself with supportive groups (i.e. attract specific employees).
30	Water, electricity and material shortages are common.
31	Infrastructure and transportation options are limited. Keeping business and supply chains local can help with this problem.

5

Final List of Criteria for the Development of a Business Model Framework for Developing Nations

To develop a sustainable and circular business model framework for developing nations, criteria from existing sustainable and/or circular business model frameworks and those focusing specifically on developing nations have been established (see table 3.2. Additionally, two preemptive lists of criteria have been developed based on barriers and drivers commonly faced by entrepreneurs in developing nations. The first list (see table 4.1) is created by considering a specific business endeavor that relates to both the research question and the case study, the National Biogas Programme Ethiopia (NBPE). The second list (see table 4.2) is created based on literature considering various developing nations. Since there is quite some overlap between the various lists and the list based on the NBPE may consider barriers and drivers in more detail and/or related to only Ethiopia, it is important to cross-reference the lists to make sure the criteria are applicable for a business model framework for developing nations in general. By doing this, the sub-question *SQ 5 - How do the drivers and barriers from the NBPE differ or coincide with those found in literature from similar initiatives in developing nations?* is answered.

As already mentioned, there is quite some overlap between the two lists of criteria based on the drivers and barriers of the NBPE and general literature. Generally speaking, the criteria have only been listed in the final list in table 5.1 when there is overlap between the two lists. The only exception is criteria number 18 which was included because it was noted as a very effective way to motivate employees at SNV Ethiopia [90] and is not likely to cause any damage. If only those from table 4.2 are included, why then bother with the list of criteria from table 4.1? The criteria from the list based on the NBPE can help make the criteria from the general literature more specific. An example is criteria 19. The first part was mentioned in both. The second part is the result of the research on the NBPE which indicated that hiring youth can be beneficial because they are often relatively progressive thinkers and still open to adapting their ways, which is a useful tip when cultural differences are large. In addition, due to the similarity between the NBPE and the topic of the case study in chapter 7, knowing the information from that list can help build the business model in the case study. Finally, the list of noteworthy points of interest and caution has been cross-referenced. Any overlapping points have been noted in the table below also. All the criteria represent the following: they are minimizing resources, optimizing costs, maximizing efficiency and maximizing productivity in a dynamic manner in which the economic, natural and social environment is constantly considered and reevaluated. Essentially, this means that the criteria allow for the integration of sustainable and circular aspects while considering any current issues or potential issues in the future on any level of people, planet, and profit.

Table 5.1: The summary of the criteria for a sustainable and circular business model framework for developing nations. Each criteria is followed by the section from which it is originated. Details on the criteria, ideas for implementation and the background can be found in those sections. Criteria with overlap in two or more sections have all relevant sections mentioned.

	Criteria for a sustainable and circular business model (framework) for developing nations.
	General Criteria
1	Develop a clear and practical, yet detailed and guiding tool / handbook. (3.3)
2	Pay special attention to the value proposition. Validating the assumptions under which it was formulated (e.g. customer's need and want, existing or potential competition, potential lock-in regimes, etc.) (3.3 & 4.1.7)
3	The product/service must fit local conditions and include simple assessment/measuring tools. A standardized design is advisable. (4.1.7)
4	Include a manual for products and services for employees to consult and for users to keep. (4.1.7)
5	Slow, close, and narrow resource loops to stimulate circularity. Implement this where-ever possible. (3.3)
6	Make the triple bottom line (profit, people, planet) part of the core business. Consider the economy, society and the environment as stakeholders. (3.3)
7	Adopt a frugal mindset. (3.3)
	Planning and Strategy
8	Stimulate fore-sight, constant re-evaluation and improvements. Consider all externalities, both positive and negative. Consider goals, customers, resources, networks, etc. you want to reach, but can't. Turn weaknesses into strengths. Implement this where-ever possible. (3.3 & 4.1.7)
9	Create a clear link from business to strategy development. (3.3)
10	Include a clear management strategy (3.3 & 4.3.4)
11	Respect local culture/cultural habits and include valuable / strategic values as part of the business plan and strategy. (3.3)
12	Include training for unsustainable / unprofitable / non-strategic behavioral characteristics (e.g. training for improved time management). (4.1.7 & 4.3.4)
13	Ensure mutual value creation and buy-in for all stake- and shareholders. (3.3)
14	Include the use of awareness campaigns, if applicable. Use commonly used local media and advertising channels. (4.1.7)
15	Use your social networks (horizontal and vertical) wisely when establishing relations and building trust. (4.1.7)
	Management: Individualism - Initiative - Universalism - Reduced Uncertainty Avoidance
16	Stimulate, create and improve stakeholder commitment and alignment by establishing a clear role division, communicating expectations, and incentivizing employees and stakeholders. If applicable, formulate a sound exit strategy / plan for non-profit benefactors / stake- / shareholders over time. (4.1.7 & 4.3.4)
17	Stimulate cooperation, open communication and team work between employees (with various backgrounds). (4.1 & 4.3.4)
18	Help employees understand the larger company goals and strategy, along with the benefits and risks, and set up personal performance targets (4.3.4)
19	Establish a clear hiring protocol. Hiring youth can prove beneficial. (4.1.7 & 4.3.4)
20	Provide equal treatment and opportunity. (4.1.7 & 4.3.4)
21	Stimulate and reward cooperation, initiative and achievements. (4.1.7 & 4.3.4)
22	Stimulate (gender) equality and female empowerment. (3.3, 4.1.7 & 4.3.4)
23	Hold all equally accountable to represent company values, and adhere to company policies. (4.1.7 & 4.3.4)

Part II

6

Outset Business Model Framework Concept for Developing Nations

This chapter introduces the developed business model framework for developing nations based on the list of criteria presented in table 5.1 in chapter 5. The framework aims to preemptively address commonly-faced barriers by entrepreneurs in developing nations and include aspects of sustainability and circularity. This chapter answers the sub-question: *SQ 8 - How does a business model framework for developing nations look based on the established criteria?*. The framework that is presented has a modular form. This idea is already mentioned in the critical reflection of chapter 3. Why this idea is still considered best is discussed in the introductory section, along with the approach of the Modular Business Model Framework (MBMF). Thereafter, the steps of the approach of the MBMF are explained in more detail, as well as the reasoning behind them and the criteria they address. The criteria that are addressed are placed at the end of the step and developed modules. The chapter is concluded with a short review and discussion on the developed framework.

6.1. Introducing the Modular Business Model Framework

The main criticism for many business model frameworks reviewed in chapter 3 was that the models were too complex and lacked a clear overview, hence also criteria 1. Achieving a clear overview seems almost impossible when wanting to work on several large goals within one business model, especially if one considers that the most basic business model framework already has 9 components (Business Model Canvas (BMC) by A. Osterwalder and Y. Pigneur) and there are additional aspects such as circularity, sustainability, frugality and cultural aspects that need to be added. Because of this, a new type of framework is suggested here: a modular system that allows to start broad and then dive deeper during further stages of business model development.

The idea of the modular system is that modules with specific goals are chosen to be added to the main frame of the business, which will be represented by the BMC. The BMC is chosen due to its widespread use and serves to create the general overview, after which layers of detail will be added via the modules. This modular approach can theoretically be applied to any major goal that a company wants to achieve or setting in which the company is situated. These modules do not necessarily stand on their own, but will interact with the base BMC by contributing to parts of it, refocusing the approach / tone, or adding on to it. In very modern terms, the modules can be seen as 'filters' shedding a specific kind of light over the business plan. The benefit of this modular approach is that anyone can use it because the start (the BMC) is relatively simple and has an existing guide/hand book (see [45]). The modules / layers thereafter guide the tone and reevaluation for the business' specific goals thereafter. First, however, the modules need to be developed and selected. This chapter will only focus on the modules relevant to a sustainable and circular business model framework for developing nations. Over time, authors can contribute to this approach by developing other modules.

As the description of the framework already mentions, the main targets are: (long-term economic, social and environmental) sustainability, circularity, and an applicability to developing nations. From the Frugal Business Model Canvas (FBMC), the barriers and drivers of entrepreneurs in developing nations (chapter 4), and the interviews (sections 4.3.2 and 4.3.3), it becomes clear that one module should focus on frugality when setting up a framework for a developing nation. In addition, since one of the criteria to developing successful businesses in developing nations is understanding, applying and managing local culture, the final module

should focus on cultural aspects and the effects of cultural differences, to turn them into a strengths, rather than let them be potential weaknesses.

Because this is the first time this modular approach is being set up, the modules still need to be developed. Future authors will likely also need to develop modules before applying them, so they have been included in the process of this business model framework, which essentially also has an approach and guide embedded. The overall approach of the framework is as follows:

1. Define the vision and mission of your business model, and the assumptions on which they are based.
2. Set up an assumption validation strategy and validate your assumptions.
3. Determine the largest goals and targets of the business and select appropriate modules. Develop any new modules. Apply the developed criteria.
4. Fill in the Business Model Canvas.
5. Apply the modules to the Business Model Canvas. Reevaluate where necessary.
6. Apply a SWOT analysis to determine strength, weaknesses, threats and opportunities. Translate this into a business strategy and evaluation plan over time.

6.2. Step 1: Define the Vision, Mission and Assumptions

Starting a business is usually the result of a very vivid vision or dream. Defining the boundaries of that vision is important. This should be done in a manner that allows anyone to understand what you are trying to achieve. Therefore, the vision should describe the end-goal and the mission should describe how you plan to arrive at that goal and what value you provide by achieving that goal.

This vision is often based on assumptions that have formed over time. It is important to identify the various assumptions and write them down, even if they might not be true anymore. The questions that the entrepreneur answers are: *Why do I believe that my vision is important? What does my vision contribute to? Where does my vision apply?* Any assumptions that come to mind should be considered. Assumptions that speak 'against' the vision or business idea may also come up. Proving and/or dis-proving the various assumptions and adjusting the business idea helps the entrepreneur set up a good base business plan. Examples of related areas for assumptions can be: market readiness (or lack thereof), the product / service satisfies customer A's want / need, the product/service will improve C, the product/service will revolutionize (industry) D, competitor E will be furious when ..., competitor F is a lot stronger in G than I am, I can use cooperation H to perform this task within my future business, etc.

6.3. Step 2: Set up an Assumption Validation Strategy

The assumptions that are made in step 1 need to be verified and validated. Proving and/or disproving the assumptions, or even assumptions others have about the business idea or vision, help the entrepreneur understand the obstacles he/she will face and any drivers that will support him/her in the future business endeavor. Within the entrepreneurship training provided at the Nicolas Robinson School (NRS), this step is also presented as a vital step for any business hoping to be successful [78].

Validating the assumptions can be done by means of a survey or speaking to stakeholders about their opinions and potential support or objections. However, in cultures where speaking up against ideas is not commonly accepted (collective traits vs. individualism - section 4.3.2), deeds speak louder than words. Therefore, the training promotes the creation of a Minimum Viable Product (MVP). This has the advantage that it will clearly show support, interest and objections amongst stakeholders. Based on this, the MVP allows the entrepreneur to identify any barriers (e.g. technical, social, environmental, legislative, economic, etc.) and adjust the product / service accordingly before investing large amounts of money. The MVP may also inspire valuable improvements. This initial feedback and tweaking of the MVP / prototype is important to both understand what the customer values and allow the entrepreneur to improve the value provided through the business idea. It is strategic to keep in mind that the Minimum Viable Product (MVP) should follow the lean start-up method and be developed in its truest minimum viable state and at minimal cost. Tips to the approach can be found in both [85] and [84]. [85] describes the entire lean start-up process, which is very similar to steps 1 and 2 described in this approach, but additionally advises to create a way to measure the

success and develop decision criteria on which you can base your decision to *pivot* or *persevere* towards the next steps.

Criteria 2: *Pay special attention to the value proposition. Validating the assumptions under which it was formulated (e.g. customer's need and want, existing or potential competition, potential lock-in regimes, etc.)*

6.4. Step 3: Define the Applicable Modules

To start this step, the vision must be clear. *What do you want to achieve? Are there any larger goals?* By answering these questions, it should be clear what the larger targets and goals are. These can range from a specific target (e.g. 1 million copies, 2000 dogs, 3 billion barrels, etc.) to more general goals such as desiring a completely digital business, being the most sustainable in the field, spearheading a certain industry through innovation, etc. Each target or goal can become its own module to help redirect the business into that specific direction. However, goals might sometimes contradict each other; for example, the desire to spear-head an industry through innovation while also becoming the most sustainable in that industry. The first might require a lot of research, prototyping and likely unavoidable wasting of material and resources, which would go against the second goal. Understandably, since these are the major targets that the entrepreneur has set for him-/herself, he/she is likely unwilling or hesitant to submit one goal to the other. This is why it is important to remember that the business model framework is a dynamic environment where compromise is needed to facilitate 'the best of both worlds'. In this specific example, it could mean: innovate, but try to reuse materials, source sustainably, etc. Realizing this from the get-go will save the entrepreneur from surprises or disappointments in the future. Essentially, this step is also partially managing ones own expectations by quickly shedding a glimpse of reality onto the dream.

A similar situation is likely to arise within the MBMF for developing nations. The determined modules of Frugality, (economic, social and environmental) Sustainability, Circularity and Socio-Cultural Aspects may contradict each other. For example, module Frugality, which is based on the frugal mindset, asks to remove any unnecessary actions and costs. Module Circularity, on the other hand, will ask to consider End-of-Life management, which represents an extra service; maybe even at extra cost. Even within one module, there can be contradictions. Module Sustainability, for example, may require environmentally sustainable sourcing and yet require economic / financial sustainability which may be difficult to guarantee when using new and often not yet price-competitive sustainable technologies. Both situations require a plan of attack. The modules represent major goals that the entrepreneur wishes to achieve. When these goals, or modules, contradict one another, it is important that the entrepreneur has determined an order of priority within those goals. The most important module comes first. Each module thereafter is also measured by the requirements of the ones that came before. This helps the entrepreneur make decisions and structurally work through the various scenarios of the business plan. Note that this is an advised approach and not a hard rule. In the second case, where there is contradiction within one module, the other modules may be consulted on a 'preference', but the entrepreneur will need to make a trade-off or compromise based on the situation 'now'. This realization is important because, even though the situation 'now' may not allow both requirements to be fulfilled, the future may. Therefore the component of *foresight* is added. This component will not only allow the entrepreneur to plan for goals in the future, but also to foresee drivers and barriers. The component of foresight is not included in the Business Model Canvas (BMC) because the simplicity of the BMC along with its handbook should be guaranteed. The component of foresight, however, should be added to at least one of the modules; preferably the first, so that it is considered during all other modules.

The modules are determined by the targets and goals, but their content is based on the pre-study conducted in this report and the criteria established for a sustainable and circular business in a developing nation. Since they are layers / 'filters' to be placed over the BMC, their general structure follows that of the BMC. The overall goal or main points of concern are noted in the value proposition component, since the value proposition represents the core of the business, and the modules represent core goals. Whenever deemed necessary, additional components are added onto the BMC. Once a module adds an extra component onto the BMC, it stays on. The modules include points of attention and guiding questions to help the entrepreneur through the business plan development. There is a distinction between 'active' and 'passive' components. Active components are those that play an immediate role for achieving the target; they are highlighted. This does not mean that the passive components do not play a role. This distinction is meant as an additional intuitive guide for the entrepreneur applying the module. Note that sometimes a point of interest may apply to more than one component, - as is the case in the BMC - it is still only mentioned once. Furthermore, not every point of the module may always apply to the business idea in question, nor will every applicable point

be found in the modules. The module should, however, provide enough points to start an evaluation and determine where additional research can be beneficial. Again, it is important to realize that the module is not a 'dictator', but a guide in a dynamic process where the filled-in Business Model Canvas is reevaluated under a certain light or with a certain focus. Since each layer interacts with the Business Model Canvas and therefore with the other layers, it is advisable to limit the amount of modules so that it remains manageable. The modules for the sustainable and circular business model framework in developing nations are described and visualized below along with how they fulfill the criteria.

6.4.1. Module Frugality

Module Frugality focuses on applying a frugal mindset, which is criteria 7 from the final list of criteria in table 5.1. The module is depicted below in figure 6.1; an enlarged version of the module can be found in appendix F. As explained, the main points to focus on or realize are highlighted in red in the value proposition component. In addition, the component of foresight is added to the Business Model Canvas (BMC) structure. As discussed before, the component of foresight is very important for any business and should be considered on a very regular basis, which is why it is already added in the first module. Additionally, besides reducing costs, frugality focuses on the long-term, making foresight an even more relevant component.

During the development of this module, online sources were consulted for tips and tricks on how to set up a frugal business. These tips, along with the criteria from table 5.1 provide the content for this module. The criteria that are addressed in this module are criteria 3, 7, and part of 8. They are re-capped below. Considering there are 23 criteria summarized, this does not seem like a lot, but criteria 7: *adopt a frugal mindset* can become quite extensive when applied to the module. Oxford Languages defines frugality as: "the quality of being economical with money or food; thriftiness". Applying that as a mindset means considering many aspects of cost-saving and thinking of reuse, as can be seen in the module's components.

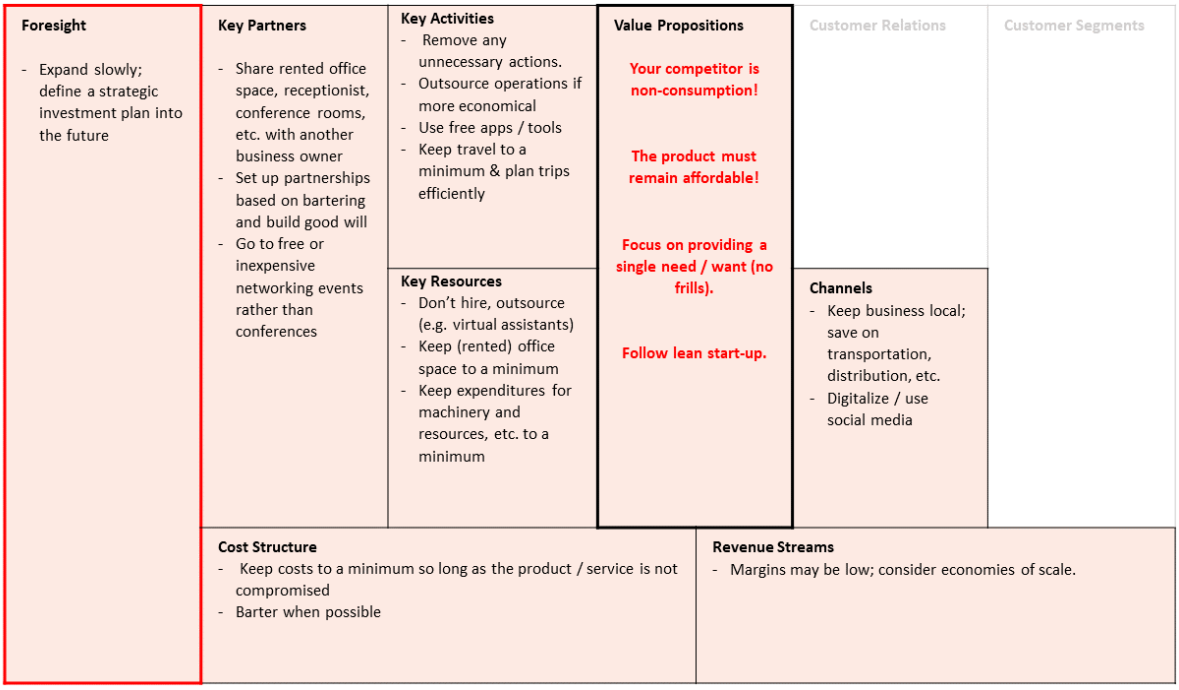

Figure 6.1: Module Frugality as the first layer / filter applied to the Business Model Canvas as part of the Modular Business Model Framework (MBMF) for developing nations.

The module is based on a mindset presented during the Frugal Business Model Canvas (FBMC) and the lean start-up. Nevertheless, none of the added components from the FBMC have been added to the module and not every tip is included either. This does not mean that they are not included in this new framework. Two of the components of the FBMC - *mission values* and *objective* - are integrated into step 1 where the vision and mission are defined because this step can, and should, be completed by any entrepreneur starting a business, no matter the setting. Two other components - *impact measures*, *output measures* - are included in step 6, where an evaluation plan is developed. These components ask for measures of impact and achieve-

ment over time that allow the entrepreneur to set up milestones by which he/she can reevaluate the business. Again, this is something any business should do. Therefore, it is integrated in a general part of the Modular Business Model Framework. The final added component of the FBMC - *adoption factors* - applies to various modules. It asks to consider adapting to local culture, but also local setting, the level of knowledge and available information or materials, for example. Therefore, it is spread over the various applicable modules. In Module Frugality, questions and tips on affordability and durability are included. In Module Socio-Cultural Aspects, the questions focus on including, adapting to, and managing cultural values and institutions. The lean start-up mindset is included in two ways. First, in step 2 of the MBMF. Setting up a Minimum Viable Product (MVP) is a lean start-up strategy. Second, in this module, where it is included in a broad and general way within the value proposition. Additional specific components, tips and guiding questions from the lean start-up business model approach, other than those already mentioned, are not included to keep the module clear. Entrepreneurs applying this module should consider the mentioned components, but may also look for additional inspiration in cited literature or online sources.

This module beautifully demonstrates what was discussed in the previous section (6.4). It shows that even within the same module, there can be contradictions recommendations. In one component, the recommendation is to outsource operations if it is more economical, where another component recommends to keep business local to save on transportation and distribution. Assuming outsourcing will be beyond the borders of the local setting, this is a clear contradiction. As discussed, here one can either decide to compromise, or objectively calculate what will result in the largest financial benefit. In addition, it is possible to make a decision with foresight in mind. If, for example, it is more economic to outsource production, even with increased costs of transportation, but the entrepreneurs desires to own his/her own production facility, a note can be made in foresight that one day, when finances allow, a self-owned production facility will be opened. At the same time, not having an own production facility means less control over the quality and manner of operations, which could be considered a cost, or a benefit, depending on personal preference and capability. These non-monetary costs and benefits are difficult to quantify, but can certainly influence the decision the entrepreneur finally makes. In this manner, one continues to work through the module in a dynamic 'give and take manner'.

Criteria 3: *The product/service must fit local conditions and include simple assessment / measuring tools. A standardized design is advisable.*
Criteria 7: *Adopt a frugal mindset.*
Criteria 8: (partial) *Stimulate fore-sight, constant re-evaluation and improvements.*

6.4.2. Module Sustainability

The second module that is applied is that of (economic, social and environmental) sustainability (figure 6.2. Again, an enlargement of the module can be found in appendix F. This module applies the concept of creating mutual value for the 'triple bottom line' which makes it quite crowded. To keep a better overview, the components of negative and positive externalities are added, fulfilling the rest of criteria 8. Each component considers all three main stakeholders - the economy, society, and the environment, representing criteria 6 and 13. In the component of *foresight*, another reminder is placed that foresight applies over all three stakeholders. The component reminds the entrepreneur that a PESTLE analysis, discussed in section 3.2, can help identify trends and therefore potential drivers and barriers in foresight over a range of points relevant to the triple bottom line. As a reminder, PESTLE stands for politics, economy, sociology, technology, legal and environment. The module makes use of another analysis method in the *Key Resources* component: MECO-screening, which is also explained in section 3.2. MECO stands for material, energy, chemical and other aspects like land use, which are screened over the various aspects of the business (resources, manufacture, transport, use and end-of-life) to help determine impact and points of improvement. Completing both fully will require quite some time. The idea is that they provide some guidance to the entrepreneur on what to consider, but he/she is free to develop them to whatever detail. The more an entrepreneur understands how his/her business will interact with the triple bottom line, the better. Whilst working through and considering the various angles, the entrepreneur may also find inspiration to improve his/her own business.

The *Cost Structure* and *Revenue Structure* components are 'passive' in this module because when it comes to sustainability, most costs and revenues are actually costs and benefits in the form of negative and positive externalities, respectively. These component are added to make the distinction between the (fiscal) costs and revenues affecting the business directly and the added value (benefits) and negative externalities (costs) experienced by the triple bottom line due to the business. However, the take-home message from module Frugality is still in place and any alteration in the business plan in favor of sustainability, must hold under

the scruple of frugality. To remind the entrepreneur of this, a reminder is placed in the component of *Cost Structure* in the form of the question: *"How does this affect my cost structure and pricing?"*. Furthermore, when considering a sustainable alternative, it is important to truly establish that it *is* a sustainable alternative (for all three stakeholders). A relatable example is biologically-produced produce. No chemical fertilizers and pesticides are required to produce the crop, which reduces GHG emissions from their production, but considerably more land is required and the crops are less resistant to illness and pests, which may affect yield more strongly. Environmentally, this trade-off to determine whether it is environmentally more sustainable would need to be assessed by a life cycle analysis. However, to truly be considered sustainable for the triple bottom line, the other two stakeholders, economy and society, must be considered also. Economically, on a large scale, biological produce may affect the fertilizer industry negatively, for example. Competition-wise, the produce is always more expensive (which is a potential red flag in terms of efficiency) and will purely be based on an assumed added value. But does this type of produce truly add value for the customer and society in general? Scientifically, it is not proven that the produce is healthier for the client. The price is steeper, so fiscally it is less attractive and it may affect how social standings are perceived, similarly to luxury goods. In addition, when considering society as a whole, producing an inefficient crop that uses more land that could be used productively (or by nature) while the population is increasing and the topic of feeding the world is discussed more seriously every day, this type of crop might not look so sustainable anymore, at least not in every setting. Therefore, it is important that the entrepreneur considers all three angles before making a decision. An alternative will rarely be perfect, but the entrepreneur must have an understanding of the impact he/she will have.

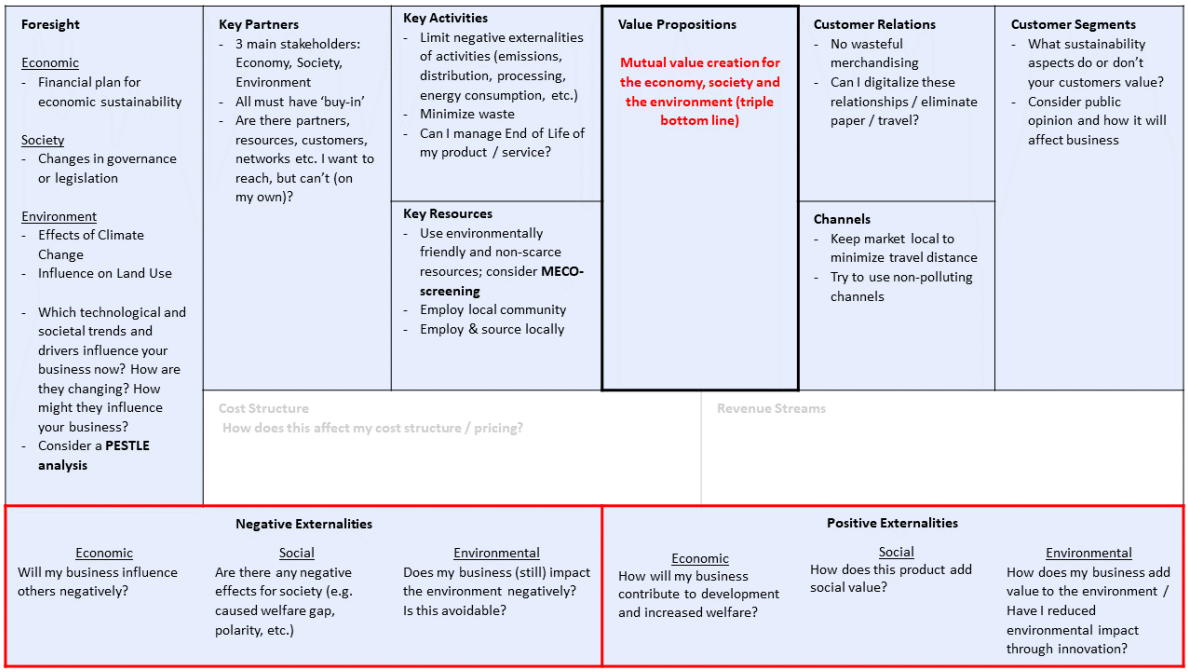

Figure 6.2: Module Sustainability as the second layer / filter applied to the Business Model Canvas as part of the Modular Business Model Framework (MBMF) for developing nations.

Criteria 8: (partial) *Stimulate foresight, constant re-evaluation and improvements. Consider all externalities, both positive and negative. Consider all externalities, both positive and nagative. Consider goals, customers, resources, networks, etc. you want to reach, but can't.*
Criteria 6: *Make the triple bottom line (profit, people, planet) part of the core business. Consider the economy, society and the environment as stakeholders.*
Criteria 13: *Ensure mutual value creation and buy-in for all stake- and shareholders.*

6.4.3. Module Circularity

The module of circularity (figure 6.3) takes the environmental aspects of sustainability one step further. However, because a business is linked to that sustainability aspect, it will also affect the economy. And because there are such strong trends in environmentalism, the target customer will likely have an opinion on the mat-

ter, which the entrepreneur can use to his/her advantage. As mentioned before, this module calls for actions on sourcing, prolonging product life, considering End-of-Life options, etc. Some might be worth considering because their impact on the environment, society, and even the economy can be substantial. However, again, there is still the consideration of frugality. Considering and understanding the options available to the entrepreneur is important, though, because it may reveal new alternatives. In some cases, it may even be a small effort that results in a big award. For example, if an entrepreneur owns a phone production company and he/she has the ability to collect and refurbish them simply within existing production lines after which they can be resold with a larger margin than perhaps the original, the small additional investment might be worth it. Note that this is only a qualitative example. No calculations have been made. One of the main points within this module is "design for durability", essentially a direct reflection of the frugal mindset, which provides a nice connector back to the first module applied. The main focus of this module is on criteria 5 and criteria 8 re-capped below.

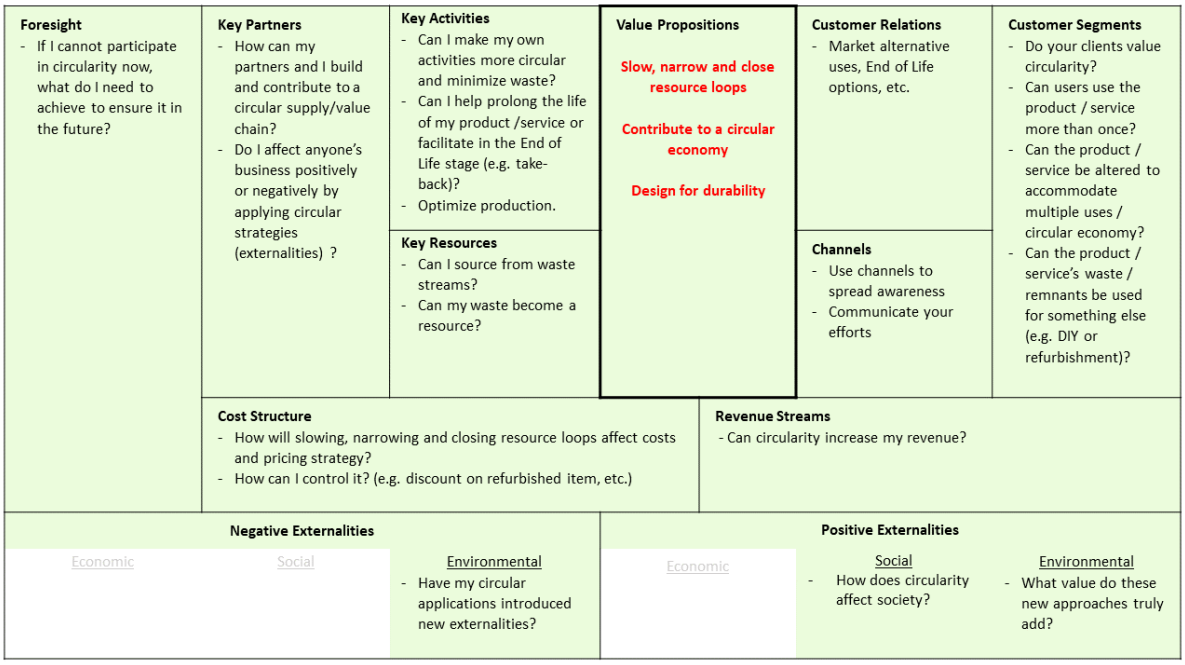

Figure 6.3: Module Circularity as the third layer / filter applied to the Business Model Canvas as part of the Modular Business Model Framework (MBMF) for developing nations.

Criteria 5: *slow, close, and narrow resource loops to stimulate circularity. Implement this where-ever possible.*
Criteria 8: *Stimulate foresight, constant re-evaluation and improvements. Consider all externalities, both positive and nagative. Consider goals, customers, resources, networks, etc. you want to reach, but can't. Turn weaknesses into strengths. Implement this where-ever possible.*

6.4.4. Module Socio-Cultural Aspects

The final module addresses a large list of criteria. This is partially because the criteria are more difficult to bundle, partially because they are new in concept, and partially because the aspects discovered in the research are so detailed. This makes the module a little crowded, but it also allows many aspects to be addressed for a hopefully successful business. However, to fill in this module, a background study is required. Whether this is a full-on on-location field study, or building a relationship with a local entrepreneur that can act as mentor is not that important. What is important, is understanding the culture and its institutions. By doing this, the entrepreneur will learn to understand the customer and future employees and the contribution or impact he/she can make. It will also deepen the understanding of existing trends and points of view that may be different from what is expected, as well as the extent to which frugality needs to be applied. If this is not in line with what the entrepreneur has applied throughout the modules, he/she can revisit decisions and adjust for the more specific situation. However, a lean start-up is generally not a bad strategy.

This module also introduces another component: *Management.* During the review of existing literature and frameworks, certain frameworks had already been criticized by experts, e.g. the Extended Business Model

Canvas (EBMC), that including management within the *Key Activities* component is insufficient when working with low-income economies because of the large contrast to management in 'developed' nations. This contrast links directly to the differences in cultural values and institutions, as described by the characteristic of System I and System II, and a mis-match in expectations when these differences are unknown or not understood. To help bridge this common barrier, the component includes various suggestions and guiding questions based on the findings of the interviews in sections 4.3.2 and 4.3.3. The criteria that are addressed in the overall module are criteria 4, 8, 10-23.

Many of the points and criteria are related to incorporating the employees as valuable and loyal parts of the business. Loyalty towards a company is not a natural trait in cultures where family-based loyalty is prevalent. The job provides them security and that's good as long as it lasts. For families living day to day, envisioning the future and committing to strategies is also not self-evident. Additionally, cooperation amongst employees with different ethnic or tribal backgrounds or social standing is also not always a given or seamless (hence criteria 17). Social standing and vertical networks may also affect the entrepreneur. If the 'correct' network and strategic relationships are not developed, this can hinder business (criteria 15; e.g. supply, distribution, licensing, etc.). Identifying these traits can be difficult. Using the characteristics of the two extremes (System I vs. System II) listed in table 4.3 may help while exploring cultural differences. The module aims to both help identify the differences, as well as manage any that may negatively affect the business. An important characteristic of System II that the module tries to emphasize is that everyone should have the same opportunities to make a career if they work hard, are committed and contribute to the company loyally. This should be communicated and presented with the employees explicitly, to make sure they understand that the entrepreneur wants to invest in them. The guiding questions are formulated to target specific actions that help reduce the extent of unfavorable behavior and stimulate successful, long-term business (criteria 16, 17, 20, 21, 22 and 23). Presenting and explaining the company goals to the employees and how they contribute is also important, as discussed in section 4.3.3 (criteria 18). Some of the points noted in the components may create additional costs (e.g. training employees; criteria 12), which goes against the goals of frugality. However, as discussed in section 6.4, when two modules contradict one another, the order of the modules serves as a reminder of priority, but the value of the latter suggestion must be taken into account. In this case, because *people make the business* [29], the added value may outweigh the extra cost.

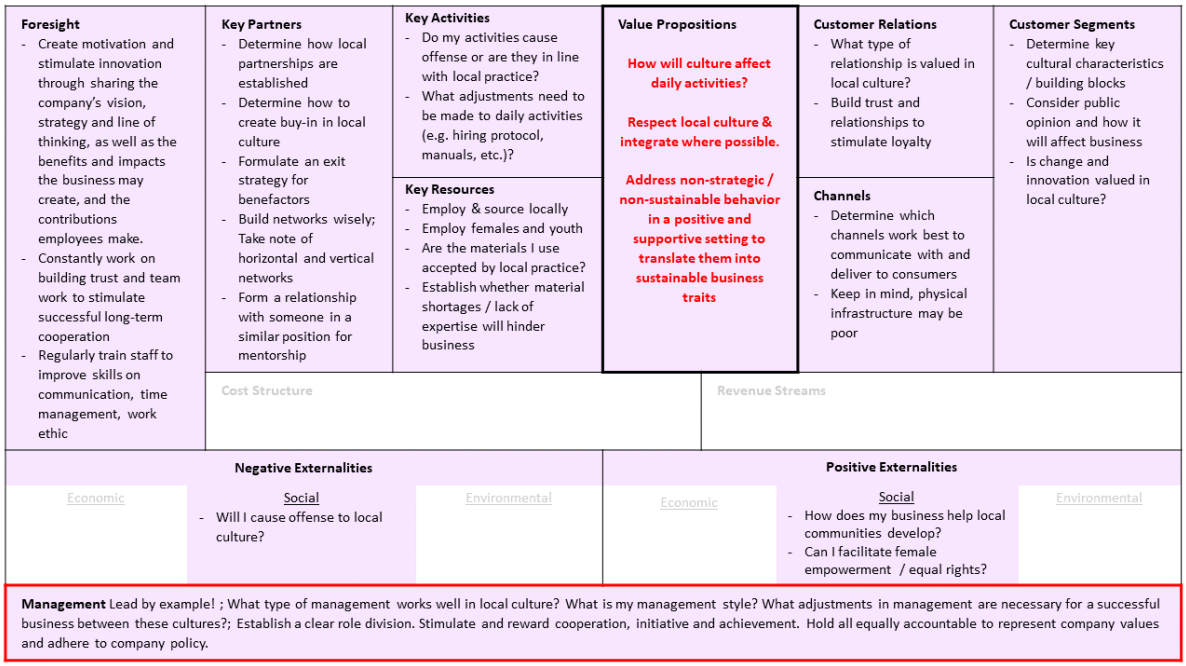

Figure 6.4: Module Socio-Cultural Aspects as the fourth layer / filter applied to the Business Model Canvas as part of the Modular Business Model Framework (MBMF) for developing nations.

Criteria 4: *Include a manual for products and services for employees to consult and for users to keep.*
Criteria 8: (partial) *Turn weaknesses into strengths. Implement this where-ever possible.*
Criteria 10: *Include a management strategy.*

Criteria 11: *Respect local culture / cultural habits and include valuable / strategic values as part of the business plan and strategy.*
Criteria 12: *Include training for unsustainable / unprofitable / non-strategic behavioral characteristics (e.g traning for improved time management).*
Criteria 13: *Ensure mutual value creation and buy-in for all stake- and shareholders.*
Criteria 14: *Include the use of awareness campaigns, if applicable. Use commonly used local media and advertising channels.*
Criteria 15: *Use your social networks (horizontal and vertical) wisely when establishing relations and building trust.*
Criteria 16: *Stimulate, create and improve stakeholder commitment and alignment by establishing a clear role division, communication expectations, and incentivizing employees and stakeholders. If applicable, formulate a sound exit strategy / plan for non-profit benefactors / stake- / shareholders over time.*
Criteria 17: *Stimulate cooperation, open communication and team work between employees (with various backgrounds).*
Criteria 18: *Help employees understand the larger company goals and strategy, along with the benefits and risks, and set up personal performance targets.*
Criteria 19: *Establish a clear hiring protocol. Hiring youth can prove beneficial.*
Criteria 20: *Provide equal treatment and opportunity.*
Criteria 21: *Stimulate and reward cooperation, initiative and achievements.*
Criteria 22: *Stimulate (gender) equality and female empowerment.*
Criteria 23: *Hold all equally accountable to represent company values, and adhere to company policies.*

6.5. Step 4: Fill in the Business Model Canvas by A. Osterwalder and Y. Pigneur

Once the modules have been selected and/or developed, the Business Model Canvas (BMC) of A. Osterwalder and Y. Pigneur can be filled in. The handbook developed by the two authors can be used as an additional guide ([45]). A description of each of the components follows in the section below, along with some guiding questions. For additional support and guidance, the entrepreneur is free to use various (free) online tools. For additional inspiration, blogs written by entrepreneurs sharing their experiences can be useful[1].

6.5.1. The 9 Building Blocks of the Business Model Canvas by A. Osterwalder and Y. Pigneur - 2010

The business model canvas by Osterwalder and Pigneur entails 9 components, also known as building blocks: customer segments, value proposition, channels, customer relations, revenue streams, key resources, key activities, key partnerships, and cost structure [45]. Each of these building blocks help "describe the rationale of how an organization creates, delivers, and captures value" [45], resulting in a business model. The guide by Osterwalder and Pigneur (2010) sets up the presentation of each of these blocks to signify how each is vital in ensuring a business' long-term success, thus making it a vital and core building component. Each building block is highlighted below. Each component is presented with its key questions as presented in [45].

Customer Segment: ***"For who are we creating value? Who are our most important customers?"*** As one can well imagine, without a customer, there is no business; not now, not ever - which is why it is mentioned as the first building block. An entrepreneur or business may segment customers into various categories based on behavior, interests, etc. in order to carefully choose which to focus on and which to ignore, so that a specific customer can be addressed in the value proposition and eventually through the business. An entrepreneur or business may choose to address anyone; then the customer 'segment' is the mass market. For extra specialized and specific customers, the customer segment is a niche market. If various markets are addressed with similar but varying needs, it is called segmented. However, if for example, two unrelated markets with different problems are addressed, it is called diversified. When inter-dependent customer segments are served, it is call multi-sided platforms or multi-sided markets. [45].

Value Proposition: ***"What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? Which customer needs are we satisfying? What bundles of products and services are we***

[1] Examples include [119, 120].

offering to each Customer Segment?" The Value Proposition is the propositional link between the specific customer segment's needs and how the business helps solve that need. The way in which this need it satisfied is defined here and can determine why a customer may choose one business over another. The 'how' can be through introducing something new (process, product, design, etc.), improved performance, customization, price, or accessibility, to mention a few. Thus, the Value Proposition ultimately acts as a very persuasive and sometimes even undeniable incentive to use one company/product over others. [45].

Channels: ***"Through which Channels do our Customer Segments want to be reached? How are we reaching them now? How are our Channels integrated? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer routines?"*** Raising awareness about the company and it's products/services, evaluating the value proposition via customer behavior, purchasing products/services, delivering the proposed value/product/service, and after sales customer services are the 5 phases of channels. These channel phases can be reached by both physical and digital, and through direct and indirect (3 parties or partners) channel types. Each has their advantages and disadvantages. A direct channel has higher revenue margins, but can be costly to set up and operate, whereas an indirect channel can expand the company's reach and benefit from partner strengths, but has lower revenue margins. Ultimately, a balance must be found between the various channel types that form the interface with the customers. Managing this interface is important as it directly affects the consumer's experience with the company, product, or service. [45].

Customer Relations: ***"What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which ones have we established? How costly are they? How are they integrated with the rest of our business model?"*** Customer Relations is closely linked to Channels, as they too affect the interface with customers and their experience with the company. Motivation to build customer relations can be customer acquisition, customer retention and boosting sales. A company may choose to apply one or more types of relationship. Again, these types can be both physical or digital, or sometimes even both. Examples of relationship types include: (dedicated) personal assistance, automated services, self-service, communities, co-creation, etc. Customer relations do not only benefit the customer, but are another means for a company to understand the customer better and improve its value proposition. [45]

Revenue Streams: ***"For what value are out customers really willing to pay? For what do they currently pay? How are they currently paying? How would they prefer to pay? How much does each Revenue Stream contribute to overall revenues?"*** Revenue streams are the cash a company generates from its various Customer Segments. Not each customer segment needs to generate revenue the same way; various pricing mechanisms (fixed or dynamic) can be used. There are two revenue streams that can be differentiated - transaction revenues (one-time payment) and recurring revenues (ongoing payments) - which can be generated via asset sales, usage fees, subscription fees, leasing, licensing, etc. However, the choice in applied pricing mechanism will strongly affect revenue generation. [45]

Key Resources: ***"What Key Resources do our Value Propositions require? Our Distribution Channels? Customer Relationship? Revenue Streams?"*** There are four categories of key resources that represent the most important assets of the business model and its future success: Physical, intellectual, human and financial. Key resources are vital to creating and offering the Value Proposition via the above mentioned building blocks. Each company requires its own balance of key resource categories. These resources can be owned, leased, acquired through licenses, etc., representing a direct link to, and interaction with, communities and other companies. [45]

Key Activities: ***"What Key Activities do our Value Propositions require? Our Distribution Channels? Customer Relationships? Revenue Streams?"*** Key Activities is quite self-explanatory: the main activities a company must complete to create and deliver its value proposition to its customers so that revenue can be generated. The three main categories include production, problem solving and platforms/networks (management, promotion, or service provisioning). [45]

Key Partnerships: ***"Who are our Key Partners? Who are our key suppliers? Which Key Resources are we acquiring from partners? Which Key Activities do partners perform?"*** This building block is another 'key' to

creating and offering the value proposition. Arguably, partners are a Key Resource and sometimes a Channel, but it is important to distinguish the two as the motivation, their role, and the relationship between them is different. Acquiring a partner is often based on one of three motivations: optimization of the business, risk reduction, or acquisition of resources. The specific workings depend on the activities or resources shared (e.g. outsourcing or shared infrastructure or use of software, etc.). Generally, all partnerships can be assigned to a specific partnership type: strategic alliances between non-competitors, cooperations between competitors, joint ventures and buyer-supplier relationships.

Cost Structure: ***"What are the most important costs inherent in our business model? Which Key Resources are most expensive? Which Key Activities are most expensive?"*** Most building blocks cost something to function properly. Even managing revenue streams can incur costs (use of financial services, etc.). This building block summarizes all costs, creating an overview that can be used to create a balance sheet with the revenues generated. Here it is determined whether the business model in its form may become profitable. However, there is still the Cost Structure to discuss. Each business can be placed somewhere on the scale from cost-driven (e.g. "no-frills" models) to value-driven (e.g. luxury hotels), although costs should be minimized in every business model. Wherever a company is on that scale, the cost structures can have one or more of the following characteristics: fixed costs, variable costs, economies of scale and economies of scope. [45]

Going through the building blocks by asking the various questions, as posed by Osterwalder and Pigneur (2010), will lead to the creation of a Business Model Canvas (BMC) that outlines the business and gives an indication of its strengths and weaknesses. It is important to explore alternatives for each block and determine which serves the company best. Sometimes, this will even be necessary to create a business model that will generate enough revenue to break-even. It can be useful to set up a rough financial overview at this point. When deciding which alternative to choose, cost vs. value must be weighed. However, sometimes this is difficult, as value can be non-measurable or non-comparable to cost. Fortunately, in the Modular Business Model Framework (MBMF), the alternatives can be revisited in the various modules that can help determine their value.

6.6. Step 5: Apply the Modules to the Business Model Canvas

Applying the Modules to the Business Model Canvas is an important step because even though the modules essentially guide the entrepreneur through the process, choices need to be made, as discussed in step 3 (section 6.4) before. As a re-cap, if there is contradiction between modules, the order of the modules serves as a reminder of the entrepreneur's priorities and therefore implies the alternative scenarios' priority and value. If there is contradiction within a module, the entrepreneur must choose between a compromise and trade-off, or decide to integrate one of the alternatives within the component of *foresight*. These alternatives, or goals, for the future can be included in the evaluation plan in the final step of the Modular Business Model Framework (MBMF).

For the MBMF for developing nations, the priority lies with frugality. The main competitor in developing regions is usually non-consumption, so whatever other goals, if the customers cannot afford the product/service on offer, there will not be a business. The modules sustainability and circularity are applied second and third, respectively. Goals in long-term sustainability relate to frugality, but may conflict it also, as discussed before in step 3. The entrepreneur will be faced with decisions that he/she can base on the established priority of the goals, but can also solve the issue through compromise or planning into the future. Section 6.4 explains an example. After module sustainability, module circularity is applied, whilst remaining aware of any costs and value that are being added or removed. As mentioned, the consideration of cost is not only monetary, but also in terms of impact. Comparing the two (monetary vs. impact) is difficult and might require the consultation of an expert and some calculating through alternatives, but it is an important process to go through to improve and adjust the business model so that the goals and targets can be achieved in a most optimal and well thought-out business plan. Finally, the socio-cultural aspects are applied. Understanding, valuing, applying and managing socio-cultural aspects was determined as a necessity to running a successful business in a developing nation and is therefore arguably the most important module. However, since the socio-cultural aspects need to be considered for the overall final business model and the focus is on both the interaction within society and within internal management, it is the last module to be applied. There is a chance that a cultural dilemma may alter the entire business plan and require to start from scratch, but this is a risk that applies to almost any module. That being said, it is advisable to complete some basic

research before starting this process. The modules should be applied one by one, but can also be revisited as often as necessary. If many modules are applied, it is advisable to go through the various layers / filters more than once to check that no aspects have been forgotten. A visualization of the order and 'layering' / 'filters' for this particular business model framework can be seen below. Although this order provides some structure whilst applying the modules, it should remains a dynamic environment where the entrepreneur can move freely.

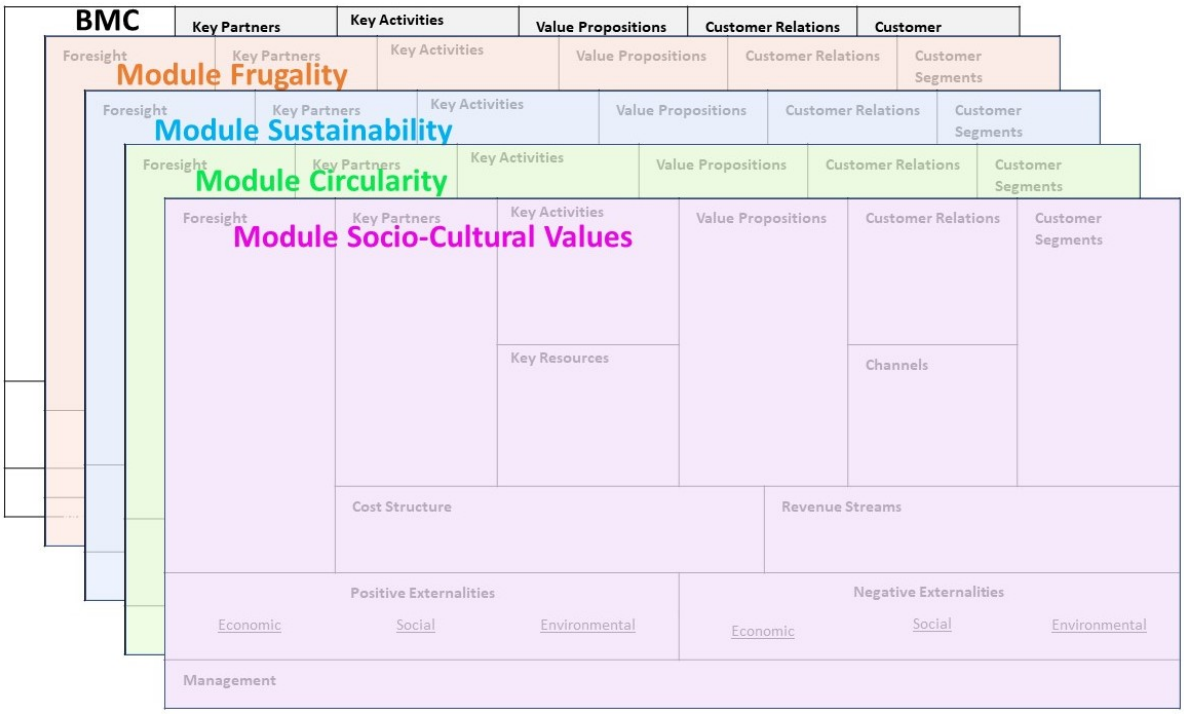

Figure 6.5: The Business Model Canvas (BMC) modules being applied as layers or 'filters' to the BMC.

6.7. Step 6: Complete a SWOT Analysis for a Business Strategy and Evaluation Plan

This step essentially satisfies criteria 9: Create a clear link from business to strategy development. During the process of applying the modules, choices are made based on the information that is available to the entrepreneur, his/her priorities, and the various options and scenarios that are possible. The entrepreneur also distinguishes between what is possible now and what he/she wants to achieve over time in the component of *foresight*. This creates a basis for a more extensive SWOT analysis. The SWOT analysis is discussed in section 3.2 and is recommended by several authors, including A. Osterwalder and Y. Pigneur. Some critics believe the process too difficult and time consuming, but as an entrepreneur, it is important to understand the business that is being set up and the struggles and opportunities it will face.

If the entrepreneur keeps track of the trade-offs he/she makes whilst applying the modules and using the component of foresight, the list of weaknesses and strengths can easily be developed. What remains to be done is make the link to a business strategy where the entrepreneur can secure the business' strengths, reduce its weaknesses, remove or manage threats and investigate or develop opportunities. If the entrepreneur is inexperienced, it can be wise to consult an expert or mentor. If the entrepreneur does not have the financial means, he/she can practice using his networks (criteria 15) or practice applying his/her frugal mindset to try and get a free consult. Again there are various (free) online blogs and tools that can be consulted also.

When developing the business strategy, it is important to include a strategy or plan to reevaluate the business. This plan should include targets or other measuring indicators that will allow an objective assessment of the business over time. Inspiration for targets and evaluation points can be found in the foresight components, such as in the module of frugality that suggests making an investment plan for the future, or the sustainability module that reminds the entrepreneur of the influence of trend developments, etc. These eval-

uation plans should include certain targets, goals or criteria by which the entrepreneur can assess whether he/she should *pivot* and reevaluate the business model, or *persevere* to the next target, goal or criteria. Setting up a functional evaluation plan can require the help of an expert and will likely go paired with trial and error as the business will be constantly developing. In the end, however, the plan should be set up and executed objectively to ensure the business can thrive in the long-term. In other words: remain dynamic!

Criteria 9: *Create a clear link from business to strategy development.*
Criteria 15: *Use your social networks (horizontal and vertical) wisely when establishing relations and building trust.*

6.8. Discussion

The framework presented above has been developed carefully based on a lot of pre-research. That is not to say that it is a functional framework or fully developed. One thing that is consistent throughout the research of the other frameworks reviewed in the literature review (sections 3.1 and 3.2) is that frameworks only become functional after being applied and altered many times over. This is especially clear when considering that the handbook for the Business Model Canvas (BMC) of A. Osterwalder and Y. Pigneur required the input of 470 practitioners. Therefore, even with the amount of work put into this framework, it is still essentially only a first draft. Especially the content of the modules can be made a lot more extensive and therefore more guiding. The problem with this, however, is that it makes the framework even more time intensive than it already is, and the more input the entrepreneur receives, the less he/she needs to think for him/herself. Therefore, alternatives in presentation style might need to be considered during future alteration.

The goal was to develop a clear and practical, yet detailed and guiding tool (criteria 1) for the development of a sustainable and circular business in a developing nation. To create clarity, steps 1, 2 and 4 make use of a tool that many people are already familiar with and for which a large amount of information is available (the Business Model Canvas (BMC)). The only addition is the extra focus on setting up the value proposition, vision, and mission and validating the initial assumptions. For the detailed and guiding part of the framework, the modules are chosen and created to act as guiding layers / 'filters' that help a starting entrepreneur adjust his/her basic business plan to the larger goals and targets he/she wants to achieve. In this particular case, the modules still needed to be developed. Next time, for a similar setting, step 3 will only require the entrepreneur to pick the desired modules and sort them based on priority. Therefore, step 3 is very relevant when developing new modules, but can almost be skipped completely when they already exist. Developing a module takes quite some time and extensive research in the field. This might not be a suitable task for any entrepreneur. Should the Modular Business Model Framework (MBMF) prove useful in the setting of a developing nation, it could be interesting to develop a type of 'library' of modules that entrepreneurs can have access to for various types of businesses and settings. The process of filling in a module also takes time, but arguably, spending time constructively on the business plan is vital to its success. Also, because a basic business plan already exists, the modules are not entirely new plans, but rather mix & matching of options and scenarios which is intended to be both an informative and fun process. Furthermore, it is up to the entrepreneur how much time is spent on the both the BMC and the modules. The MBMF can be used for both a brainstorm-type of approach, as well as detailed business development.

Finally, as a reminder, the MBMF is a tool that is meant to guide the entrepreneur through a complex process in a dynamic manner without losing sight of the targets he/she has in mind. Also, even if the entrepreneur works out everything in detail, he/she is likely to come across unforeseen obstacles. However, because the entrepreneur will know the business and its options very well at that point, he/she will overcome any obstacle encountered. Of course, if necessary, the entrepreneur can also bring the problem back to the original canvas and modules to assess his/her options.

Before this framework can become a widespread and useful tool, it will need extensive field testing and likely several rounds of iterative adjusting. In the next chapter, the framework is applied to a case study and business idea in Ethiopia. Any potential adjustments of the framework are noted in the evaluation and discussion thereafter.

7

Case Study: Biogas at the Nicolas Robinson School (NRS) in Mek'ele, Ethiopia

In this chapter, the business model framework described in chapter 6 is applied to a business idea in the case study area of Mek'ele, Ethiopia. Due to the conflict that has arisen in Tigray, access to definitive, current and reliable data is extremely limited. Therefore, the (financial) business model will rely on numbers from previous years adjusted for inflation, input from the founders of the school, and assumptions or estimations, which are noted when applicable. Additional information is retrieved form the results of the various interviews (see chapter 4.3) and additional information received from contacts before the war started (see appendix B).

Within this chapter, the founders, Kathryn and Max Robinson, take the role of client. Their request is to explore the possibilities of introducing biogas at the Nicolas Robinson School (NRS) as a clean and reliable cooking fuel for the cooking staff. They aim to cover their own cooking demand [16]. As a client, they provide all the necessary information on local setting, opportunities and pricing, to the extent of their knowledge.

Before diving into the case study's business model and the application of the Modular Business Model Framework (MBMF), this chapter takes the opportunity to elaborate on how biogas is a technology with the potential to aid a country in its development. Therefore, this chapter first elaborates on the impact a technology like biogas can have on the development of a nation such as Ethiopia. In the section thereafter, the Modular Business Model Framework is applied to the case study for an initial test on functionality.

7.1. An Assessment on The Potential Impact of Biogas on Ethiopia as a Developing Nation Based on the Millennium Development Goals

This section assesses what impact bio-digesters can have and have had on Ethiopia as a developing nation. Many of the drivers discussed in the previous chapters hint towards the benefits of installing and using bio-digesters and developing a biogas market sector. This analysis can become very extensive and is extremely interesting; entire books have been published on how development can be achieved through social development, (agricultural) technological advancements, policy changes etc. (e.g. [7, 121, 122]). However, the aim is not to analyze into detail the benefits or negative externalities that the bio-digester holds for Ethiopia, but to give an indication of the impact it could have on the country as a developing nation. In section 1.1.1, it was briefly mentioned that certain nations have embraced the Millennium Development Goals (MDGs) as targets to aid in their country's development. The National Biogas Programme Ethiopia (NBPE) is such an example. Therefore, it will be assessed based on the MDGs to help understand the potential impact it could have on the nation.

To have a better understanding, however, it is important to understand which factors are considered key to contributing to the development of a nation. Therefore, some theory is reviewed first, after which a broad assessment is made to answer the sub-question: *SQ 9 - Case Study: Biogas in Mek'ele, Ethiopia - How does biogas, as a sustainable and circular energy technology, represent an opportunity for development in Ethiopia?*

7.1.1. Some Theory

In national (economic) development, both economic and non-economic factors contribute to a nation's development [7, 121, 122] and are often summarized into categories. For example, A. Cairncross highlights the importance of investment, technical progress, trade, administration and planning, and the role of education [121]. Z. Acs, S. Desai and J. Hessels highlight three stages of entrepreneurship that occur in a nation's development: the *factor-driven stage*, the *efficiency-driven stage*, and the *innovation-driven stage*. Each stage of entrepreneurship has an individual area of focus and effects on social and institutional development [123]. These authors too distinguish that economic development does not only lie within economic aspects, but also in social development. For example, in the development of opportunity perception and start-up motivation, but also in the basics of educational provisions or social security arrangements [123]. A. Szirmai analyzes various theories of how economic development can be measured, including the equation relating national output to *proximate sources of growth* that was developed in the late 60s ($O = F(K,L,R)^e + A + P$). The primary factors of production - capital (K), labour (L), and resources (R) - along with efficiency (e), were constituted by various categories, including *Discovery and exploitation of riches and natural resources*, *Effort* (work ethic), *Saving and accumulating capital* (for investment), *Investing in education and human capital* (to improve productivity and health of labour), *Theft* (use of resources from other societies for capital accumulation), *Efficiency*, *Structural change* (shifting resources for dynamics and efficiency), *Economies of scale* (efficiency through scaled production), and *Technological change* (developing and acquiring knowledge to produce value goods and services) [122]. The two final terms, A and P, refer to revenue and costs, respectively [122]. On a deeper look, A. Szirmai also attributes development to demographic characteristics, culture, attitudes, history, distance to technological frontier, etc., but also indicates the related socio-economic outcomes: health, education, consumption, welfare, income distribution, changes in poverty, and environmental sustainability [122]. I. Goldin too, considers aspects of natural resource endowments, geography, history, culture, politics, and how the individual and government parties work together for sustainable development as factors for national development [7]. Critical thinkers, however, argue that factors such as geography might not weigh as strongly as some authors suggest. It is true that the availability of resources can give an advantage in setting up international trade - which is a common requirement to development among authors [7, 121–123] - but simple observations point back to institutional arrangements that are far more important. To make this more clear, D. Acemoglu and J.A. Robinson begin their book *Why Nations Fail* with a simple example: Nogales, Arizona, USA vs. Nogales, Sonora, Mexico. They share the same cultural background, the same climate, and the same geography. Yet the former belongs to one of the most developed, successful, and powerful countries in the world, while the latter still battles vast poverty and is marked by one leader's coup after the other [111]. Here the development is clearly not achieved because of geography, but rather in how the institutional arrangements have exploited that geography and established the communities within it to become a prosperous nation [111]. Then again, this is only one example that is supported, but also contradicted but many others, and so the debate continues.

Over the years, with increasing prosperity in the 'developed' world, especially after WWII, the contrast to developing countries has become extreme, creating a need to help the under-developed world [121], which has led to development aid plans and increased research in fields of and adjacent to nation development [122]. This research has become more focused on increasing welfare by alleviating poverty. Under the United Nations, this has led to the Millenium Development Goals. They are [9, 122]:

1. Eradicate extreme poverty and hunger.
2. Achieve universal primary education.
3. Promote gender equality and empower women.
4. Reduce child mortality.
5. Improve maternal health.
6. Combat HIV/AIDS, Malaria and other diseases.
7. Ensure environmental sustainability.
8. Create a global partnership for development.

Although these goals were officially established for 2015, they are still often referred to as a guide in creating and assessing development [122]. For example, that reducing indoor air pollution through the use of biogas stoves helps achieve MDGs 4 and 5 is often referred to in review literature. After 2015, the United Nations

established 17 Sustainable Development Goals (SDGs) which count for all countries, rich and poor, of which some are equal to the original MDGs [9].

Measuring the extent of each contributing factor - and, as mentioned, there are a lot - is a difficult and long procedure [7] which goes beyond the scope of this project. In the end, however, these books and papers have several important conclusions: development only occurs when the institutional, environmental, economic, technical and social aspects stimulate and support one another in benefit of the majority of the population. A nation that fulfills this is run by what is known as inclusive institutions [111]. A nation that favors the few at the expense of the many, is based on extractive institutions, which generally goes hand in hand with widespread poverty [111]. In that sense, to transition from one to the other, poverty must be alleviated, but by establishing inclusive institutions, rather than providing pure (financial) development aid [42, 111]. However, to establish inclusive institutions, there must also be trust in institutions; chapter 4.3 elaborates on the transition and social transformations of developing nations and the role of trust. Furthermore, achieving poverty reduction is not possible without rapid and sustained growth. As A.K. Cairncross notes: "there are always two sides to development: the initial innovation and its subsequent dissemination" [121]; distribution and growth are necessary steps to development.

Since measuring the impact of each individual factor goes beyond the scope of this thesis project and is even impossible at times, the impact of the bio-digesters will be assessed based on their contribution to the Millennium Development Goals (MDGs). The main sources of information are an extensive local survey ([89]), insights from section 4.1, and trends and statistics from other countries that have gone through economic transitions and development in the past.

7.1.2. Poverty, Hunger, and Undernourishment (MDG 1)

Improved soil fertility and increased agricultural yield and productivity are important for improving food security for the fast-growing population of Ethiopia [34, 35, 124] and reducing the percentage of undernourishment (35.3% in 2007, 27.5% in 2013 [109]) [34]. Reducing undernourishment is directly related to Millenium Development Goal 1 'Eradicate extreme poverty and hunger'. With the introduction of the bio-digesters, the financial and physical means to reduce hunger have also improved. 57% of respondents to the local survey conducted by Miklol Consultancy and Research Plc. inform that they save an average 110 ETB on their energy expenditures since the use of biogas. These savings may be low, but considering that many gather firewood for free in the woods, it is remarkable that savings can be made nonetheless [89]. In addition, they now save time on gathering fire wood and cooking which sometimes used to be cause for their children to go hungry [89]. Furthermore, this newfound time allows women to participate in income generating activities [89]. In the Figure 7.1 below, the amount of undernourishment in Ethiopia over time can be seen.

From surveys and testimonials, it has become clear that bio-slurry can improve soil fertility and agricultural productivity, crop quality and resistance to disease [37, 89, 124], which enhances food availability and helps decrease undernourishment. In addition, in the survey conducted by Miklol Consultancy and Research Plc., besides increased land productivity, an average 26% decrease of chemical fertilizers was reported. According to the report *Environmental Issues in Ethiopia and Links to the Ethiopian Economy* issued by the United Kingdom Department of International Development (DFID), the use of chemical fertilizers and inefficient use of biomass (burning) cause water and air pollution, respectively, and have a direct effect on the supply of food. The former affects fishing and life in and around lakes strongly, while the latter affects plant growth [125]. Both also have a negative effect on human health through toxic consumption (e.g. food poisoning [89]) and inhalation, respectively [125]. Therefore, the use of biogas and bio-digesters both directly and indirectly help reduce undernourishment.

A quick look at the graph shows that there has already been a trend of constantly decreasing undernourishment between 2001 and 2018. A direct impact of the National Biogas Programme Ethiopia (NBPE) cannot be observed in the graph; however, this makes sense since the dissemination of the bio-digester is limited[1] when considering a population of over 116 million [127] and, although bio-slurry enhances agricultural productivity, the absolute yield (kg's) of food depends on many more factors, including climate events, financing schemes, uncertainty in land tenure, and a farmer's mentality (self-sufficiency vs. a business for selling agricultural products) [34]. Besides, since 2011, several additional projects have been introduced concerning the enhancement of biodiversity, reduction of land degradation, and some multi-focal projects that combine aspects of renewable energy use, composting, livestock management and feed, vegetation coverage, and/or crop management [35]. Since these projects overlap one another, it is difficult to say how large each one's

[1] Only 3.5% of the population had access to clean cooking options in 2016 [126].

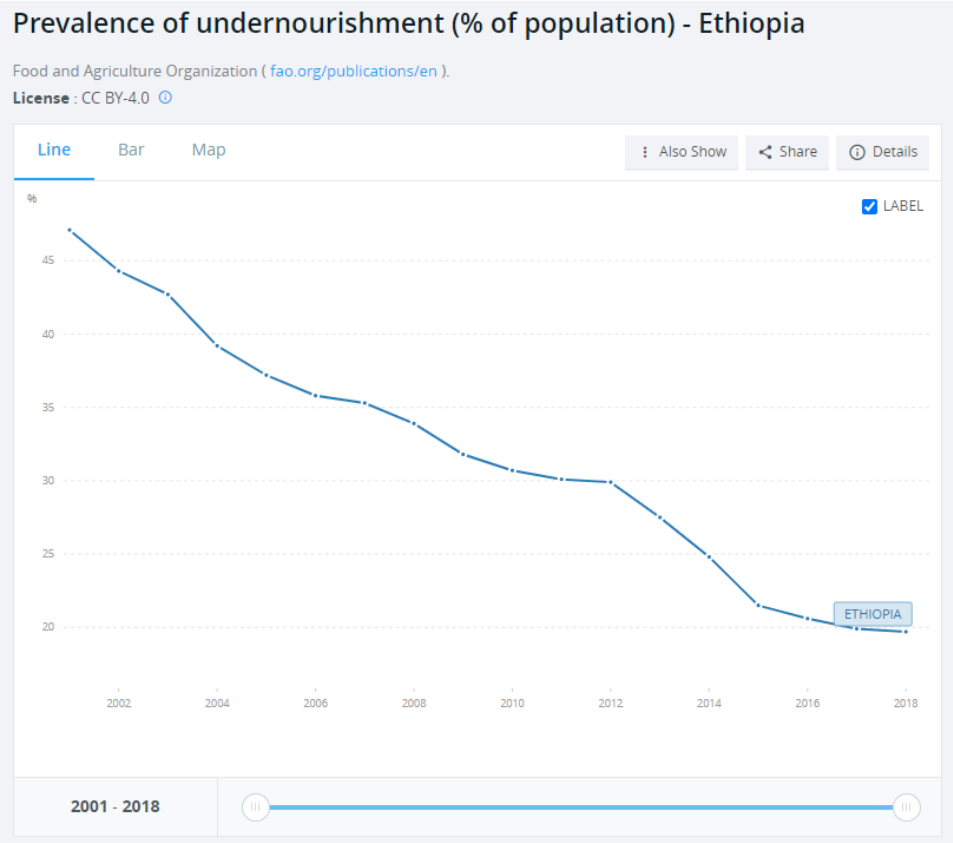

Figure 7.1: Undernourishment (% population) in Ethiopia from 2001 to 2018. Image from [109]

impact was.

It is also important to note that direct effects of a project are difficult to note in such graphs because the output value (% population) is dependent on a variable amount: population. So, even though the percentage of the population that is undernourished is decreasing, the total amount of people that are affected by undernourishment could be larger. To test whether undernourishment has also decreased in absolute terms, the prevalence of undernourishment [109] is compared to population growth rates [127] and overall population growth [128]. The population growth rate between 2012-2015 was relatively steady at 2.87%, 2,87%, 2.84%, and 2.79% [127]. The absolute number of people that were undernourished in Ethiopia when the NBPE was set up in 2007 was 28,478,045 (35.3%). After the completion of phase I of the NBPE (2013), the total number of people was 26,231,091 (27.5%). The most recent data available for both statistics is 2018: 19.7% are undernourished, resulting in a total of 21,517,238 people. In conclusion, this means that both in absolute and relative terms, undernourishment in Ethiopia is decreasing, and bio-digesters have been a contributor.

At the moment, population growth is quite stable and linear in Ethiopia [128]; however, with improved food security, health, sanitation, medical care, education, income, and mortality rates, population growth may becomes exponential, requiring even larger amounts of food production. Efficiency in agricultural productivity, suddenly becomes an even more important contributor to development, as discussed in the introduction above.

7.1.3. Child Mortality, Fertility, Gender Equality and Female Empowerment (MDG 3,4 & 5)

With an increased amount of resources available and improved living conditions, exponential population growth is a fact, until resources become limited again or external factors slow down growth [129, 130]. This balance is called the *carrying capacity* of a population [130]. For example, with increased food security, health, income, etc. exponential growth is likely, until agricultural productivity hits its limit, population density becomes too high, or one of many other factors causes a forced limit in growth [130]. A commonly observed leveller in population growth that arrives a lot earlier, however, is reduced child mortality rates through in-

creased welfare, which reduces the necessity for a large amount of children. With more surviving children, improvements in education, and increasing costs, the conscious choice to prevent additional pregnancies becomes more common (religious motivation against, disregarded), as well as the physical options to prevent pregnancies in general (birth control options). This often leads to fewer children per female and stabilized growth [131].

The trends observed in figures 7.2 and 7.3 show this clearly: with increased welfare, both child mortality and the fertility rate decrease. The trends of Ethiopia, South Korea, Brazil and Ireland have been highlighted. All four countries have a different cultural background, geographic location and are in a different stage of development, but all four display the same trend, along with almost all other countries that are seen in grey in the background. The outliers on the right that seemingly display the opposite trend, are oil-states like Kuwait, Bahrain, Qatar, United Arab Emirates, etc. They have an exceptional position where, with the discovery of oil, their wealth accumulated faster than 'traditional' development occurred. their GDP rose drastically, which could be drawn as an almost horizontal line at the height of 6-8 children, after which the decrease in fertility set in. Most states have also seen a reduction in GDP over time, but still belong to the richest in the world.).

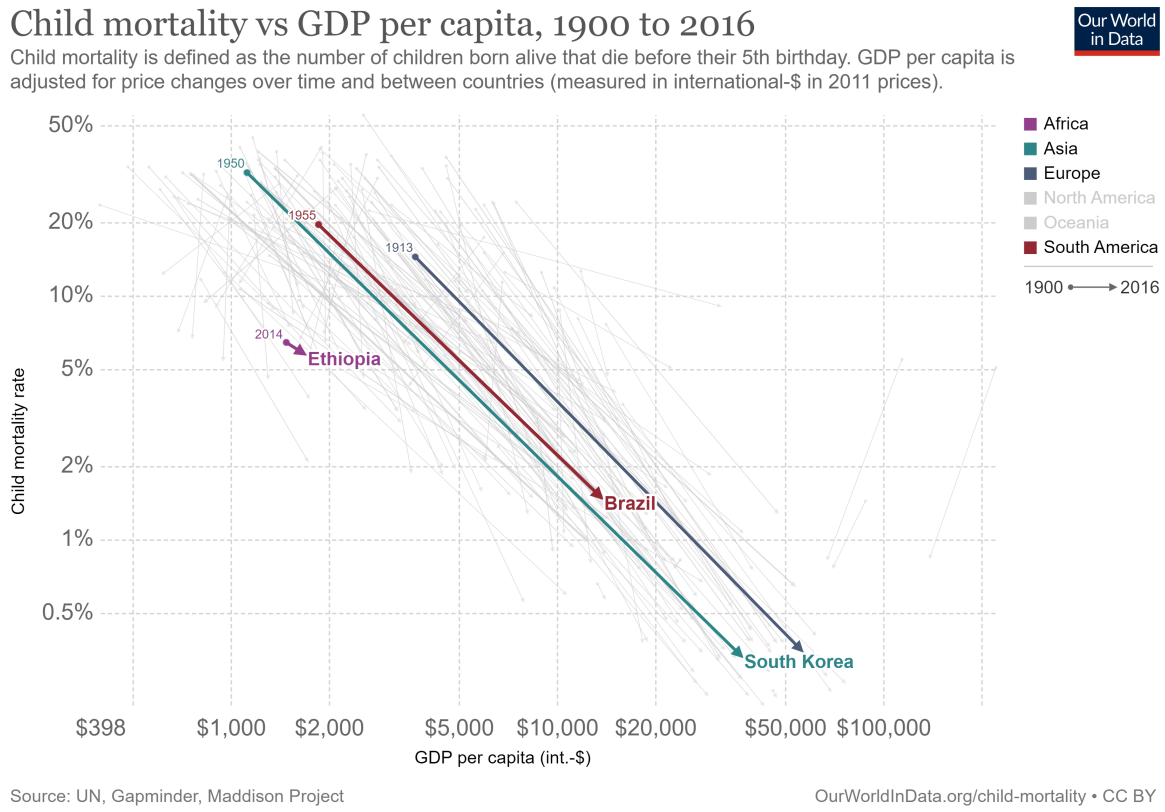

Figure 7.2: Child Mortality vs. GDP per capita, 1900-2016. Figure from [132]. With increased welfare, many reasons for child mortality can be remedied, resulting in higher survival rates.

The choice to prevent pregnancy is not only based on costs and potentially limited resources, but also on the luxury that comes with life surpassing the level of a life based on basic survival for which many children are needed. This luxury includes the opportunity to complete basic tasks more efficiently (e.g. cooking, cleaning, washing, etc.) and to choose to limit the time one is pregnant, leaving time for personal productivity to increase, especially amongst females [131]. Increased time for productive activities amongst adult females and children is already being observed amongst users of the bio-digesters.

7.1.4. Gender Equality, Female Empowerment and Education (MDG 2 & 3)

Because of the bio'digesters and the biogas lamps, children have the opportunity to study in the evening and at night. On average, 65% of respondents report their children using this opportunity, which was previously not available. In the Oromia region, this percentage was highest, at 92%. This allowed for average studying

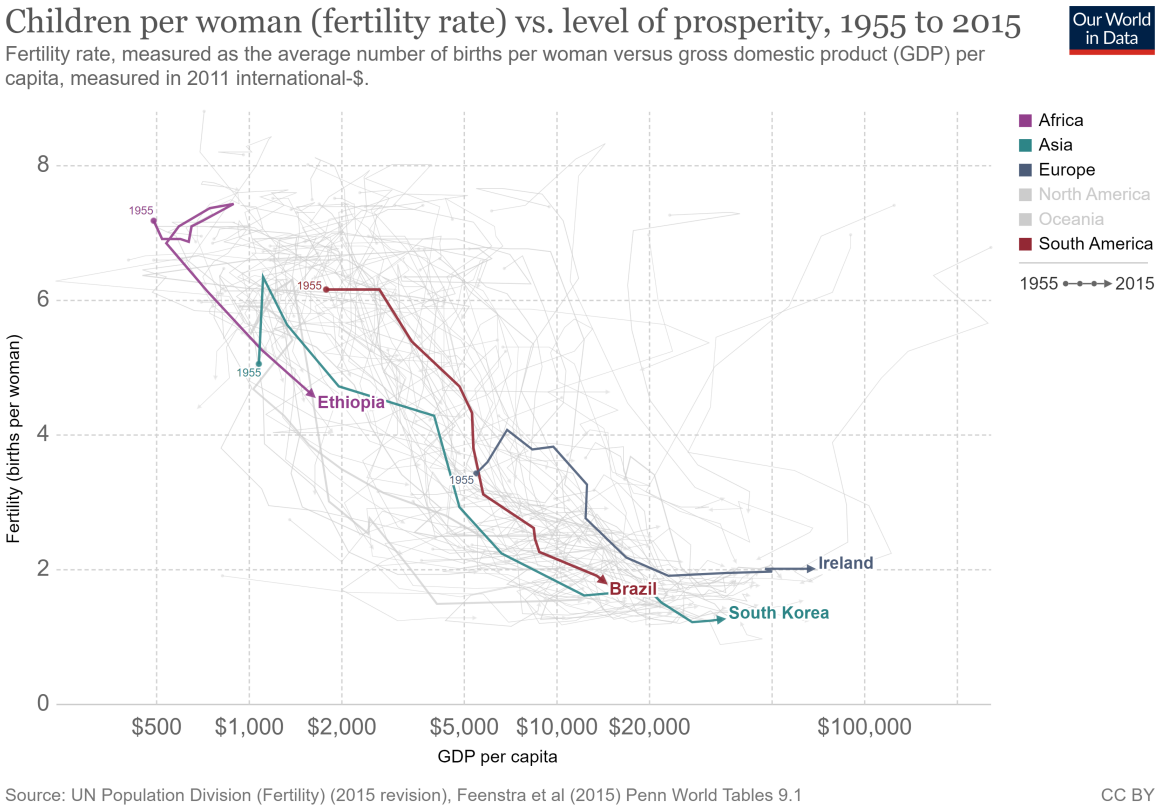

Figure 7.3: Fertility rate vs. GDP per capita, 1950-2010. Figure from [133]. With increased welfare and decreased child mortality rates, women generally choose to have fewer children.

times to increase from 2h30min to 3h20min; an increase of 33% [89]. This is an important increase for girls because girls are often required to help with household chores, which boys are not (see section 4.3.2 for details and consequences of this status quo). Women too, find themselves having more time left now they no longer need to spend time gathering fire wood; ca. 3 hours per week from fuel gathering alone [89]). 93% say they have more time available now and are using this opportunity to spend their newfound time on educating themselves (60.4%), helping in the (familial) agricultural endeavors / livestock rearing (71%), participating in other income generating activities (social work (58.1%), petty trade and handicrafts (31.1%), etc.), to take rest (42.6%), work on their child's education, or a combination of these [89]. In addition, where 68% of families noted that their children were often too late to school or back home because of the time lost on gathering fuel wood and cooking, this is now less of a problem, allowing children to have a more stable routine [89].

Female productivity increases even further when gender parity is increased. A study by the McKinsey Global institute identifies education level, financial and digital inclusion, legal protection, and unpaid care work as the four specific issues that, if addressed, can do the most to achieve gender parity and economic gains [134]. The goals identified here are, in effect, equal to the goals of the inclusive institutions that were described in the introduction. Empowering females so that they can be included and contribute to the economy will help foster prosperity. Equal education makes it easier to find a job. Financial and digital inclusion allow women to make smarter investments (e.g. for health, education, business, etc.). Increased legal protection can help score jobs previously only available to men and reduce workplace harassment, making working more attractive to women. Reducing time spent on unpaid care work (e.g. household work, taking care of children, the elderly and the sick) will improve productivity in the labor force [134]. The Ethiopian government has introduced several campaigns on gender equality and female genital mutilation, and small movements such as the Yellow Movement [115] are being established, but actual change has been slow [103]. Although their options are sometimes limited, many women are allowed to get a job if they have time to spare, which is an important first step. The bio-digester allows for this time to be created by freeing up a woman's day to be spent productively and providing children with extra time to work on their education.

When discussing equal rights and gender parity, the topic of gender-based violence is also often covered.

In Ethiopia, gender-based violence is especially important because of the (health) issues associated with Female Genital Mutilation (FGM). FGM was officially banned in 2004 in Ethiopia, but in 2013, the government conceded that it had had little effect. In 2014, they made a pledge to end all Female Genital Mutilation by 2025 [135]. There are also various non-governmental non-profit organizations, such as the Kembatti Mentti Gezzima-Tope (KMG) (Kembatta Women Standing Together), that devote their efforts to reducing this practice. The KMG's main tactic has been to focus on community conversations where villagers gather every two weeks and discuss important social issues such as FGM [135]. Their initial efforts were met with reluctance as these conversations were taboo, but over a period of 8 years, public acceptance of Female Genital Mutilation had decreased from 97% to only 5%, according to a Unicef report [135]. This is a success story to be sure, and prevalence of FGM is decreasing nationwide (age 14-49: 74% (2005) to 65% (2016), age 15-19: 47% (2016)), but there is still work to be done [135]. Bio-digesters do not have a direct role in reducing FGM, but the survey respondents did report a reduction in home violence and abuse. 20% report a slight reduction, 68% report a high reduction, and 10% report a full reduction in home violence [89]. Now women and girls do not need to spend so much time gathering wood and cooking (on a wood fire), they have more time to help the rest of the family members with work and chores, unburdening them physically and sometimes financially [89]. In addition, 58% of the respondents stated that their children would sometimes go without food or water for periods of time because there was either not enough fire wood or because gathering it took an extensive amount of time [89]. This relates to the undernourishment discussed in section 7.1.2, but it also relates to gender inequality because undernourishment is often not a fact for families as a whole, but can also affect only part of the family (e.g. girls only) on the basis of gender inequality (pg. 101 [136]). Bio-digesters along with biogas lamps and cooking furnaces are providing opportunities for women and girls to contribute productively, avoid abuse, and improve their education.

7.1.5. Improved Health, Environmental Sustainability, and Global Partnerships (MDG 6, 7 & 8)

Overall, 89% of respondents from the Miklol Consultancy and Research Plc. survey report improved health within their family after the installation of the bio-digesters due to the removal of indoor air pollution. 45% reported that they or their family members had had health incidents while using firewood as an energy source. Most common issues were "suffocation from smoke (92%), eye disease (78%), external body parts injury/burning (48%), respiratory disease (37%), fire accidents (25%), malaria (18%) and asthma (12%)" [89]. To break it down, indoor air pollution caused 6.1% of population deaths in Ethiopia in 2016 [2]. Death due to indoor air pollution affects mainly the young (age 0-5: 10,380 per year = 16.7%) and the elderly (age 65+: 30,313 = 48.61%); however, per five year age margin, the age category 0-5 years old contributes most to indoor air pollution deaths [137]. Most common causes are respiratory diseases like pneumonia and chronic obstructive pulmonary disease (COPD), and lung cancer in older victims [20]. To put this in perspective, in the Netherlands the percent of deaths due to indoor air pollution in 2016 was 0.02%. From these deaths, ages 0-5 contributed 0 deaths and ages 65+ contributed 55 deaths (85.95%) [137]. Removing the direct cause of these deaths will reduce the amount of related health issues, as well as child mortality rates. As discussed before, reducing child mortality rates is a vital step in development.

Most topics discussed so far have been society related, but bio-digesters also impact the environment in a positive way. In one ofthe previous sections it was already noted that the use of a bio-digester reduces environmental impacts related to air and water pollution. In addition, the use of bio-digesters reduces the demand for biomass as a fuel, stimulating reforestation opportunities. Most households (74%) used trees of their own that they had planted to get fuel. Others (59%) reported using public areas and forests as a fuel source. Again others reported to buying firewood, and 5% admitted to collecting wood in protected forests. From all the methods of collecting (forraging, pruning branches, cutting dead trees, etc.), the most worrying to the environment is the cutting of live trees because it contributes to environmental degradation and low productivity. 52% of respondents admitted to doing this [89]. Using protected areas as collecting grounds is a major barrier to restoration projects such as the Green Belt or Great Green Wall of Ethiopia [16] which is vital to maintaining soil fertility and preventing further soil erosion and drought complications [138] [3]

Unfortunately, only 21% of the weekly biomass consumption has been eliminated (73kg to 60.5kg) since the introduction of the bio-digesters [89]. The main reason for this is because there is still no biogas stove on which *injera* can be baked. This was already mentioned as a barrier in section 4.1 also and should be

[2] Later data not available.

[3] This sub-Saharan based project is trying to create a 'green belt' the width of the African continent by restoring the earth / soil. It also provides employment to farmers and youth that no longer have viable land to cultivate [138].

resolved in future endeavors. Consumption of coal on the other hand, has been reduced by 75.2% (19kg to 4.7kg) because it can almost be fully substituted by biogas [89][4]. In terms of reforestation, the effects of the bio-digester are not very clear yet. Opinions on whether tree coverage within their direct living environment is increasing, are split down the middle. 48% say they see forest coverage increasing while 40% say they do not see it. 95% of those that claim to see it, however, mention that they believe it is due to the dissemination of clean cooking / energy alternatives; 77% also mentioned improved plantation as a contributing factor [89]. Considering only 3.51% of the population has access to clean fuels for cooking (2016) [137], it will likely only be visible in communities where many partake in clean fuel alternatives. However, the bio-digesters do help contribute to natural forest restoration. If a functioning biogas *injera*-stove would be developed and delivered with the bio-digester, the necessity for biomass as an energy source in households could be eliminated almost completely (biomass is often also used to create tools or build stuff).

Another environmental contribution that bio-digesters have provided is increased agricultural productivity. This however, along with the decrease in chemical fertilizers purchased, has already been discussed in more detail in section 7.1.2 above. To summarize the main figures, agricultural productivity increased from 17.58 quintals of product per hectare to 19.02 quintals of product per hectare (+ 8.2%). Demand for chemical fertilizers decreased by 26.2% (105kg to 77.52kg). The use of organic fertilizer increased by 162% (69kg to 181kg). Some might argue that the improved productivity is due to the larger increased use of organic fertilizer compared to that of chemical fertilizer. However, to make such a claim, the concentration of active fertilizing components would need to be compared. Until then, the additional benefits of non-toxicity and reduced methane release compared to chemical fertilization and manure-fertilization, respectively, are enjoyed. These figures and arguments are convincing enough to conclude that the widespread dissemination of bio-digesters will have a positive environmental impact, especially when one considers their lifetime (30-40 years [90]) and that no scarce materials or energy intense processes are required for their construction.

Finally, the Millenium Development Goals argue for global partnerships (MDG 8). The bio-digesters and dissemination thereof are part of an international initiative between the Dutch government and the Ethiopian government (see section 4.1.1), called the National Biogas Programme Ethiopia (NBPE). Since the initialization of the final phase, NBPE+, it is also supported by the European Union and receives benefits based on the Certificate for the Emission Reductions (CERs). With similar initiatives in other countries, such as Nigeria and Tibet, there is little that stands in the way of developing further global partnerships.

7.2. Case Study: Introduction

The business model developed in this chapter aims to fulfill the client's request by introducing biogas at the Nicolas Robinson School (NRS). As discussed extensively in section 7.1, biogas in nations such as Ethiopia, can be key in breaking the cycle of economic and social poverty. However, for the positive impact to occur, widespread dissemination is necessary and functional biogas digesters are essential. Without either, the impact on the nation as a whole, especially in terms of the Millennium Development Goals (MDGs), will be limited. Introducing this technology at a school where it can be integrated into children's education, allows for widespread awareness in the community and its future endeavors. Besides developing a business plan, a rough financial overview is created also. Setting up the business model via the framework developed in chapter 6, allows answering the sub-question: *SQ - 10 Case Study: Biogas in Mek'ele, Ethiopia - How does the business model for the introduction of biogas at the Nicolas Robinson School in Mek'ele, Ethiopia look when based on the developed business model framework for developing nations?*.

The framework discussed in chapter 6 describes 6 steps that guide the entrepreneur through the process of setting up the business model. Each step is completed as instructed throughout the next several sections. Additionally, for the reader's understanding of the business setting, section 7.3 provides some background information on the school and its related activities and projects.

7.3. Case Study Setting: The Rainbows4Children Nicolas Robinson School

The Nicolas Robinson School was founded through the Swiss and UK foundation Rainbows4Children (R4C) set up by Kathryn and Max Robinson and the Ethiopian Tigray Disabled Veteran's Association (TDVA) foundation. The founders' inspiration dates back to the death of Max's son, Nicolas. Their full story can be read on their website [139]. The school focuses on providing education to the most disadvantaged children in Ethiopia, mainly focusing on providing education for those that would otherwise not receive it. Usually these

[4] Coal is oftentimes still used for roasting coffee beans and making coffee; a large part of Ethiopian culture [16].

students have parents with a physical (or mental) disability resulting from the effects of war or illness, making it hard for them to find and keep a job, which often results in them living in extreme poverty. The school's logo is ***Uplifting Ethiopia*** and on the home page of their website it says: *Breaking the cycle of poverty through education in Ethiopia*. The school's vision is to become the most admired school in Ethiopia and set up a financially self-sustaining project that can be copied in other regions of Ethiopia. The school aims to educate children wholly and fulfill each child's unique potential, thereby preparing them as best they can to be successful in their future, become part of a caring community, and be part of breaking the cycle of poverty in their communities and country. [16, 139]

The school provides education from ages 4 (Kindergarden entry level) to 18/19 (grade 12) and is in the process of setting up a vocational college to further educate students that will not go to university in their technical skills. The college provides education in areas that the community identifies as essential or lacking, such as hospitality, agriculture, computer programming, entrepreneurship, etc. [139]. To cater to these needs and further improve the staff's teaching skills, volunteers and experts are brought in from other regions of Ethiopia, other nations in Africa, or even from overseas [16, 139].

Momentarily, the Nicolas College provides courses in food preparation, table waiting, entrepreneurship, ICT, and agricultural practice and maintenance. All courses aim to provide certification wherever possible and provide hands-on learning experiences. The food preparation and table waiting / service courses provide full practical training and placement at local hotels and restaurants. The entrepreneurship training uses a business management simulation game next to lessons on theory. The ICT training provides full practical training during evening hours so office employees can join - individual tailor-made training is also possible, and the agricultural course provides full practical training at the school since the summer of 2020. This final project includes planting vegetables, learning about agricultural techniques, setting up drip-irrigation systems, garden maintenance, etc. and was set up with a local partner in this field. The school uses the vegetables and fruit directly and engages in composting waste material to produce its own fertilizer. This practice was new to local staff but has seen major improvements over the years [16]. Most other garbage is picked up by the municipality and dumped at landfills, except for plastic bottles, which are recycled in Mek'ele [16]. The sanitation system of the school is also based on composting (dry toilets), which were recently emptied and successfully used in the agricultural program [16].

The school also has several after-school activities / clubs including sport clubs (soccer, basketball and volleyball), debating, drama, music, health, charity, women's club, and a technology club (STEM projects). In line with the technology club, the school has always tried to be supportive of initiatives and innovation introduced by staff [16]. In section 4.3.3, the initiative by one of the biology teachers to fight the desert locust plague is mentioned. More interestingly however, in line with the business model of this chapter, the school used to own a demonstration-scale anaerobic bio-digester. It was an initiative that was introduced by one of the staff members, ran on compostables and produced gas for some time. However, others were employed to run and use it and unfortunately, once the 100 gallon tank was stolen, the rest of it slowly disappeared and was most likely sold as spare parts [16]. The exact situation and circumstances of the bio-digester's demise are not exactly clear, but one main issue that the owners believed played a role, was a lack of commitment to the project due to a perceived minimal benefit by the cleaners compared to the additional amount of work [16].

The school has recently expanded its involvement in sustainable projects. Besides the dry composting toilets, which have been at the school for quite a number of years now, the school has installed several rainwater collection tanks and drilled a borehole connected to a solar-powered water pump. These projects have allowed the school to navigate water shortage issues that are increasingly more common in Northern Ethiopia. It has also allowed the school's agricultural endeavors to expand, now that irrigation is possible year-round and they no longer need to rely on the 2 month rainy season. Next, the school wants to improve power issues since power surges and outages are also very common [16, 139].

Power outages are a nuisance because it affects the children's education (IT and science labs often require power), makes refrigerated milk and food go bad, and requires the staff to cook on coal stoves. This latter issue also affects the health of the staff and is therefore an issue worth resolving. However, setting up and maintaining a renewable electric mini-grid is a project the school does not see itself equipped to do yet, nor do they know anyone in the community who has experience with such projects. In addition the import of solar panels is costly. Another clean alternative to cooking, however, is gas. In this case, biogas. Locally produced in a bio-digester and used at the school or by the surrounding community, it would allow the school to increase its autonomy, especially in the department of cooking.

Since the school already purchased cow dung on occasion and has existing partnerships with local dairy

farmers, cow dung is likely an attainable good. In addition, the bio-digester will improve the composting of agricultural residues from the school grounds and produce an abundant natural fertilizer in the form of bio-slurry or bio-compost. Water is also readily available on site, making this a unique opportunity to set up a well-functioning bio-digester from which hundreds of students can learn. This knowledge can then be taken into the community and applied in future businesses. These businesses can range from small-scale bio-digesters on farms to large-scale bio-digesters that provide gas or electricity (via a generator) for cooking or stabilizing the electric grid and bio-slurry to nurture lands. The bio-digester also provides additional opportunities for the school. For example, it could become a learning centre for bio-digester handling and management. It could also expand the agricultural college department to teach sustainable farming techniques, including, for example, inter-cropping with cattle on college campus grounds which would make the school more autonomous while helping the community by providing valuable knowledge and hands-on experience. These opportunities are also likely to provide additional employment positions, which benefits the community also.

From the above paragraph it becomes clear that a vision is forming: biogas can be a potential solution to many of the problems the school would like to see resolved. In addition, it may provide many opportunities for the school and its students in the future. Because there is potential, it is important that the basis is set up right. To that end, it is important to understand that any business model in relation to the school is unique in the sense that it is not a new business, but a 'project' / 'concept' being added to an existing business model with an existing logo, vision and mission. They are listed below. Nonetheless, this project is located in a developing nation and needs to be economically sustainable. Therefore, the framework of chapter 6 still applies, as demonstrated in the next several sections.

School Logo: Uplifting Ethiopia
School Vision: To become the most admired school in Ethiopia.
School Mission: To provide top quality academic and vocational education for any child from the most disadvantaged backgrounds especially those whose parents have disabilities, to provide this education without any entry restrictions of any kind and to develop young individuals who will break the cycle of poverty in their communities and their country. [139]

7.4. Step 1: Define the Vision, Mission and Assumptions

As mentioned in section 7.3 above, the school already exists as a business and this new component should fit as seamlessly as possible into the existing structure. Therefore, for a business model that aims to introduce the production of biogas at the Nicolas Robinson School (NRS), the vision and mission will be defined as follows:
Vision: To relieve the school cooks from their dependence on an unstable electric grid or the use of charcoal for their cooking activities.
Mission: To set up a biogas digester that will produce biogas as a clean and reliable fuel at the school and bio-slurry as a natural fertilizer for the Nicolas College's agricultural department. The bio-digester will also act as a first-class education tool on sustainability and clean-cooking alternatives for students and surrounding community members alike to aid in breaking the cycle of poverty.

Based on the vision described in section 7.3, figure 7.4 provides a visual overview of the business model in a sketch.

Dairy and/or cattle farmers sell their dung to the school. The school has a man that drives an animal-drawn cart to deliver the dung to the school every second day. Another man is responsible for mixing the dung with water to the set ratio and feed it to the bio-digester. He is also responsible for removing any superfluous bio-slurry into storage and prepare it for transport. Part of the bio-slurry is used as liquid fertilizer by the agricultural department of the Nicolas College. Meanwhile, the bio-digester produces biogas which exits the bio-digester at the top and goes to the kitchens via piping. The gas is used on biogas stoves to prepare food at the school. Both the agricultural department and kitchens can recycle their waste streams (food scraps, gardening residue, etc.) as an additional resource to the bio-digester. The bio-slurry is transported by another man to farmers or other partners as fertilizer via storage tanks on an animal-drawn cart twice a month. The biogas digester also functions as a learning tool for students of all ages. This is the rough business model that is formulated as a base case for the Business Model Canvas (BMC) that is filled in in step 4 (section 7.7) and adjusted in step 5 (section 7.8). The assumptions on which this business idea and visual are based are listed below. The validation of these assumptions is discussed in step 2 (section 7.5).

1. Cooking staff want an alternative to cooking on electricity, biomass and charcoal.

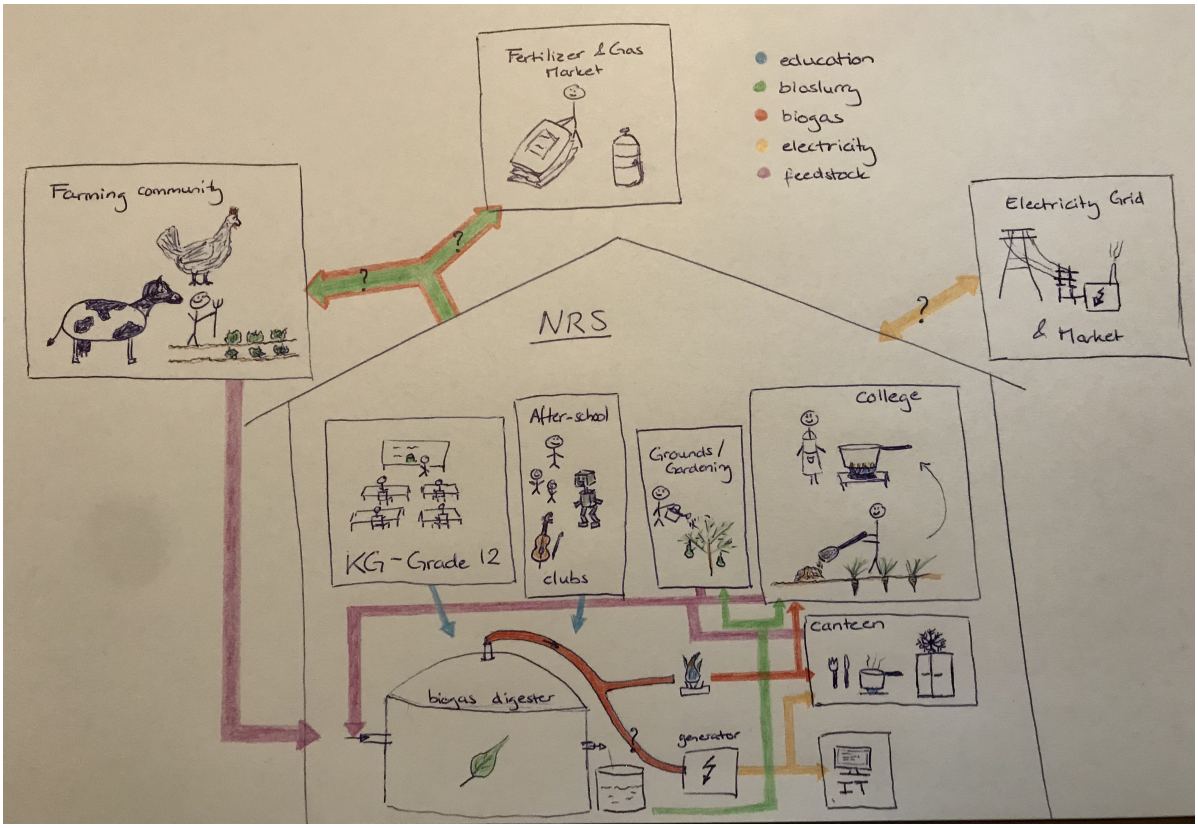

Figure 7.4: A rough sketch of the business plan of a bio-digester at the Nicolas Robinson School (NRS) and the interlinked parties and their 'stakes' in and around the school. Paths marked with a question mark are alternative pathways that can be explored in the expansion of the business plan.

2. Biogas is an acceptable alternative to electricity, traditional biomass and charcoal.
3. Biogas will be preferred over electric cooking.
4. The means exist to cook and prepare food on biogas.
5. Introducing a bio-digester in a learning environment will help spread awareness and knowledge more broadly than as a separate business in Mek'ele.
6. The Nicolas Robinson School can gather the physical means, labor and expert knowledge to properly run the bio-digester.
7. The school wants to be able to cover at least its own demand for cooking.

7.5. Step 2: Set up an Assumption Validation Strategy

Each assumption on which the business idea is based, needs to be validated or dis-proven. Validating an assumption reinforces the idea. Disproving an assumption requires considering how it affects the business idea and potentially altering it.

Assumption 1: *Cooking staff want an alternative to cooking on electricity, biomass and charcoal.* Unfortunately, at present, it is not possible to set up a survey that would allow answering of the question by cooking staff and college students directly. In addition, if asked point-blank without any additional information on the technology and the advantages, the idea might be dismissed without proper reasoning. However, the founders of the school would like to see an improvement in terms of health and reliability for cooking on campus. Therefore, the business idea remains unaffected.

Assumption 2: *Biogas is an acceptable alternative to electricity, traditional biomass and charcoal.* On a technical and scientific level, assumption 2 can easily be argued for. On a cultural level, this does not have to hold. From conversations and testimonials in reviewed literature (see chapter 3), biogas seems an acceptable alternative for cooking food [34, 37]. However, the practice of roasting coffee beans and making coffee on a

charcoal stove is an important part of social life and local tradition and will likely take some time to find its replacement in gas [16]. Since the main aim is to provide clean cooking, the business idea remains unaffected, since the lag in roasting and cooking coffee on biogas stoves will have a minimal effect on the overall project.

Assumption 3: *Biogas will be preferred over electric cooking.* This assumption might not be correct. Individuals may have a preference, but it is important to compare what is known of the two technologies. Electric cooking does not require working with an open flame or dealing with the carbon monoxide and carbon dioxide produced during use of fuels where proper ventilation of the kitchen is required. In addition, they have an efficiency of 70-74% [140, 141], compared to 40% of a biogas stove [140]. However, electric stoves require a reliable electric grid. In Ethiopia, the electric grid is often unstable and fluctuating or has surges or complete outages[5], forcing cooks to revert back to traditional charcoal / biomass stoves, delaying meal preparations and increasing health risks. In the food program of the Nicolas Robinson School, the milk is warmed and the eggs are boiled on coal stoves because it is faster and more reliable than the electric stoves [16]. If the electricity would be produced via a biogas generator, the grid would play no role, but the required amounts of biogas per meal would increase (see calculation in next two paragraphs). Furthermore, the required cooking material for all types of food exist in electric form, but there are some issues with safety standards; there have been several unfortunate electrocution incidents [16, 142].

Biogas may have an open flame, but it is fair to say that it is an improvement to traditional biomass and charcoal which release more toxic gases and fine particle matter such as soot during use. In addition, biogas more closely resembles cooking on fire than electric stoves due to the more direct response, which is often considered a benefit by cooks and would potentially be less of an adjustment from traditional fuels [140]. However, biogas stoves are less efficient (40%) and there are still very few biogas *mitads* (cooker for *injera*, a staple food) available on the market.

Both clearly have their advantages and disadvantages, making validation or dis-proving of the assumption difficult. In terms of being able to cook everything you want, the necessary appliances are available in electric form. However, to accommodate them properly with a fluctuating grid, a biogas generator is needed. When one calculates roughly with the above-mentioned stove efficiency and the properties of a 2 kW [6] and 70kW [7] biogas generator, it takes ca. 63L and 101L of biogas to boil 1L of water from 20 degrees Celsius to 100 degrees Celsius at 1 bar, respectively, compared to the 30-40 L of biogas via a biogas stove [143]. A generator of 2kW will be too little for an electric stove, which usually requires 2000-5000W of power (depending on type and size) on high heat [145]. A generator of 70 kW will clearly be too much, but the information available on various sizes of generators is limited. To finalize this assumption, if the resource available is biogas, then biogas is preferred over electric cooking. When consulting with the client, they indicate a preference to explore the biogas cooking options first [16]. Therefore, for now, the business idea remains unchanged.

Assumption 4: *The means exist to cook and prepare food on biogas.* This assumption is already partially discussed under assumption 3. Having the means to cook on biogas means that there are stoves that can run on biogas and pots and pans that can be used on a biogas stove, respectively. As is discussed in section 4.1, biogas-fueled *mitads* have been a struggle to make and get on the market. SNV Ethiopia has supported endeavors for the creation and production of biogas *mitads* in the past because of the barrier it poses to complete adoption of the bio-digesters [146, 147]. However, although there still do not seem to be many models on the market, research is making head-way and a new stove has been developed (publication January 2021) that shows promising results in even heat distribution, proper insulation for minimal heat loss, use of sturdy, cheap and durable material, and cooking capacity (20-25 injera per hour with hotel standard diameter of 50cm) [148]. The consumption of biogas of this stove is 1510 L/h [148]. Should this stove make it to the market, this assumption would be validated since normal biogas stove pits exist and are used by bio-digester owners. Since the client has many good relations with various non-profits and international sponsors, the assumption is made that they can provide a biogas *mitad* at a reasonable price, validating the assumption.

Assumption 5: *Introducing a bio-digester in a learning environment will help spread awareness and knowledge more broadly than as a separate business in Mek'ele.* This assumption is fairly speculative and difficult to prove if there is no point of reference (i.e. another business designed around biogas). However, it is clear that if various grades, the extended staff, including gardeners, and an after-school club would be connected to the bio-digester in one or more ways, the knowledge would be spread amongst many people and likely extend into the community, especially if the school would organize awareness days for parents or commu-

[5] 58% of households face 4-14 outages per week [142]. The Nicolas Robinson School faces an average of 48 hours loss of electricity per week (pre-war) [16].

[6] Specific consumption is 0.5 cubic meters of gas per kWh energy produced [143]

[7] Specific consumption is 0.8 cubic meters of gas per kWh energy produced [144]

nity members interested in the technology. Whether a normal business would have access to such a broad audience would depend on the type of business and how it is set up. Therefore the assumption, as is, cannot be confirmed nor denied. However, the school's extensive reach into the community via the education of the students is indisputable, validating the first half of the assumption. Whether the school is better or worse at spreading awareness does not have to influence the base business idea, and so it will remain unchanged.

Assumption 6: *The Nicolas Robinson School can gather the physical means, labor and expert knowledge to properly run the bio-digester.* The Nicolas Robinson School (NRS) has good connections to various NGOs, the bank, and some government officials in the region. Therefore, it should not be a problem to start up the project in line with the National Biogas Programme Ethiopia and in collaboration with SNV Ethiopia who can help provide a construction team and user training. The availability of the physical means, such as water, dung or other feedstocks, construction material, etc. are reviewed. The NRS has had a well for a while and has recently finished the construction of a borehole that is powered by a solar panel. The water is used on campus for various purposes (watering plants, cleaning, drinking, etc.) and has a pumping capacity of $30 m^3/h$ [16]. This presents an upper limit, but as it is not used to its full capacity and the bio-digester should not require these amounts of water, water is readily available. The school does not hold any cattle, however, except for some goats (in 2014). This means that the manure must be retrieved from outside the school. Since the NRS has purchased cow dung in the past and has long-standing relationships with the dairy farmers in the region that deliver milk to the school daily, an extended partnership in buying the dung or bartering it for bio-slurry can likely be established. In addition, from a random sample survey conducted by Kunom Tesfay at a dairy farm and an poultry/egg farm, the dairy farmer was willing to explore the option of selling his dung, even though he needed it himself. This particular farmer was also interested in exploring the benefits of a bio-digester. This could either mean an extended partnership to include various means of bartering or product sales, or potential competition in the long run, which wouldn't necessarily be a bad thing since competition is necessary to create free open markets. The poultry / egg farmer was less optimistic because his chicken were free-range and the minimal manure that is collected, is redistributed in the fields where the chicken feed and most of the manure ends up naturally [149]. If animal manure is not sufficiently available, agricultural scraps, residual water from cooking, food waste, slaughterhouse waste, municipal sludge and human feces can be used as alternative resources [143, 150]. Since the bio-digesters have been designed to be constructed with local and affordable material, this should not be an issue either, unless there is a nation-wide shortage. The knowledge to run the bio-digester long-term will come from the user-training and the provided manual, as well as regular supervision and learning-by-doing. A management strategy for supervision and knowledge building and retention will be beneficial to improve long-term operations, as is discussed in chapter 4.3. Since a management strategy is part of step 5 of the new framework, this criteria will automatically be met, making the assumption true.

Assumption 7: *The Nicolas Robinson School wants to be able to cover at least its own demand for cooking.* This assumption is easily validated by asking the client and subsequent representative of the school. In (written) personal communication, the client confirmed this assumption [16].

Construction of a Minimum Viable Product (MVP): In the framework description of the previous chapter, the strategy to validate assumptions via a Minimum Viable Product (MVP) is promoted. This is also presented as a vital step in the entrepreneurship training at the Nicolas College [78] and even in the office space of Mr. Rai [90] (see section 4.3.3). In addition, both the Robinsons and Mr. Rai repeatedly state that one must "lead by example" [16, 90], so it is only appropriate to explore an MVP. In addition, the construction of an MVP will give the staff and students the opportunity to get acquainted with the technology, explore possible improvements and opportunities, and provide feedback on the level of 'public support' for the project. Without this support, the project will be a failure [16, 90], meaning that it is essentially another assumption.

To construct a MVP that simulates a bio-digester to validate the assumptions would usually require quite some material and (expert) knowledge, but the school has the unique position where it has staff with engineering backgrounds, a functioning laboratory, and an after-school technology club. This means that there is a good foundation to build a prototype bio-digester that even presents a unique learning activity for students. The technology can be tested for usefulness and hands-on learning experiences and problem-solving skills.

The most simple biogas digester available is to place animal (or human) manure in an air- and water-tight tank and let it bio-degrade (rot) which will produce methane. The methane can be used in the lab for demonstrations. Since the objective is to produce a clean fuel, some safety precautions should be built into the design (e.g. removal of hydrogen-sulfide and CO2 through scrubbing). Once gas production dies down or ends, the remaining digestate (bio-slurry, i.e. sludgy fertilizer) can be removed from the tank and used in

the agricultural activities. This type of production is called a batch process. Since the bio-digester that will be installed will be a plug-flow reactor (constant production), the school should also consider constructing a plug flow MVP. A quick search on YouTube provides many such prototypes for home build.

Since there is currently no option to build an MVP and assess public support, this final assumption cannot be validated. However, for this thesis project, the assumption is made that there is support from the staff at the school.

7.6. Step 3: Define and Develop the Applicable Modules

This business model is for an endeavor located in Mek'ele, Tigray, Ethiopia, where GDP is still very low and the main competitor will be non-comsumption[8]. Therefore, the module of frugality is needed; it is depicted in section 6.4.1. Since one of the goals is to provide a clean cooking alternative to traditional fuels, the module of sustainability is needed (see section 6.4.2). To make sure sustainability in all stages of the business model (sourcing, use, end-of-life management, etc.) is explored, the module of circularity is applied also (see section 6.4.3). Finally, because the business is in a foreign and developing nation, the cultural values and institutions that may influence the business need to be considered and integrated or managed within the business model. The Socio-Cultural Aspects module is used (see section 6.4.4) to address and accomplish this.

7.7. Step 4: Fill in the Business Model Canvas by A. Osterwalder and Y. Pigneur

The Business Model Canvas (BMC) is filled in based on the description of the base business idea/model depicted in figure 7.4 from step 1 (section 7.7). Figure 7.5 visualizes what the paragraphs below describe. Additionally, a rough financial overview is presented in section 7.7.1 where adjustments are made to the basic business plan to make the business roughly break-even.

Value Proposition: The production of biogas and bio-slurry via a bio-digester to ensure clean on-campus cooking, provide valuable natural resources for the agricultural section of the Nicolas college, and use as a first-hand learning tool for students at the Nicolas Robinson School, the Nicolas College and the community. The clients desire to produce their own demand in gas to provide clean cooking at the school. Therefore, the goal is that of self-sufficiency. The side benefits are that of the produced bio-slurry and the value of the bio-digester as a learning and awareness tool. The bio-slurry can be used by the agricultural department of the Nicolas College. Any excess can be sold to farmers or community members and generate extra revenue.

Key Activities To run the bio-digester successfully, resources need to be acquired and delivered at the school, the installation needs to be run and maintained, and the products need to be stored, used and/or distributed. In addition, relationships need to be maintained with partners of the business and those involved with the day-to-day workings of the installation. The latter is important for receiving feedback and keeping track of the installation.

Key Resources The key resources of this business are the bio-digester (including the construction material, piping, valves and installation team), the resources necessary to keep the bio-digester running (in this case cow manure and water), the bio-slurry storage units, the biogas cooking appliances, and the necessary labour to keep operations running. Additionally, there are some 'free' resources, such as food scraps from the kitchen and garden waste from the campus grounds. Alternative feedstocks such as other animal manure, human feces, cooking water (recycled) [150], slaughterhouse waste and municipal waste (mainly sewage sludge and grey water resources) can be considered. Human feces is not an option at the school because they use dry compost toilets. Additionally, it is a lesser attractive resource because there is often an aversion to working with human feces and the derivative bio-slurry requires 'pasteurizing' (i.e. heat treatment) before use on the land because of potentially harmful pathogens. The same counts for municipal sludge and slaughterhouse waste [151]. Other animal manure can be valuable to influence the nutritional values in the bio-slurry to meet specific demands based on fertilizing specific crops, for example.

Key Partners The main partners in this business endeavor will be the dairy and cattle farmers, since they can produce the vast amount of dung that will be required to run the bio-digester. Some farmers require the dung themselves [149] and will be reluctant to sell their dung. With these, a bartering agreement for bio-slurry, or an attractive price for bio-slurry can be established. If any alternative resources are used, the

[8] When your main competitor is 'non-consumption', this means that the consumer does not decide between the product of two different firms, but simply whether or not he/she will use it at all. Effectively, this means that your 'competitor' offers an alternative 'product' at price = 0 $. Therefore, your product must add enough value to overcome a relatively large 'price barrier'.

<table>
<tr>
<td rowspan="2">Key Partners
-Dairy farmers
-Cattle farmers
-Municipality
-Tigray Plant Tissue Laboratory
-SNV Ethiopia
-Municipality</td>
<td>Key Activities
-Procurement of animal manure
-Operation of bio-digester (production of biogas and bio-slurry)
-Use of biogas
-Distribution of bio-slurry
-Upholding partnerships</td>
<td rowspan="2">Value Propositions

The production of biogas via a bio-digester to ensure clean on-campus cooking, provide valuable natural resources for the agricultural section of the Nicolas college, and use as a first-hand learning aid for students and the community.</td>
<td>Customer Relations
-Awareness Campaign & Demonstration Days
-Delivery of bio-slurry (samples)
-Inauguration party
-Update meetings</td>
<td rowspan="2">Customer Segments
-Cooking staff at the Nicolas Robinson School
-Agricultural department staff Nicolas College
-Technology Club
-Farmers
-Tigray Plant Tissue Laboratory</td>
</tr>
<tr>
<td>Key Resources
-NRS employees
-Animal manure
-Storage containers
-Bio-digester
-Biogas cooking appliances
-Kitchen food scraps
-Garden waste
-Water</td>
<td>Channels
-Personal Communication
-Awareness Campaign & Demonstrations
-Animal-drawn carts</td>
</tr>
<tr>
<td colspan="3">Cost Structure
CAPEX:
-Bio-digester construction
-Storage tanks purchase & installation
-Pipes purchase & installation
-Biogas stoves purchase
OPEX:
-Maintenance
-Labour
-Manure acquisition + transport
-Bio-slurry distribution</td>
<td colspan="2">Revenue Streams
-Savings from Pesticide
-Savings from Fertilizer
-Selling of over-produced bio-slurry
-Selling over-produced biogas or other revenue generating activity</td>
</tr>
</table>

Figure 7.5: Initial Business Model of Biogas at the Nicolas Robinson School based on the Business Model Canvas (BMC) of A. Osterwalder and Y. Pigneur [45] and step 4 of the outset business model framework from chapter 6.

producers of those of them will also become key partners. The municipality is a key partner because the school will possibly require a permit to build and run the bio-digester. The Tigray Plant Tissue Laboratory is also a key partner. The client already has an established relationship with this institution in relation to the agricultural college activities [16]. This relationship can be extended, for example, to include trade in bio-slurry, or the delivery of agricultural residue as a resource, or a combination of both. SNV Ethiopia is a key partner because they have the expertise and connections to help construct the bio-digester and train the bio-digester operators.

Customer Segments With the main goal to be self-sufficient in providing clean cooking at the Nicolas Robinson School, the main 'customers' of this business plan are the cooking staff. Additional 'customers' are the students and teaching staff - especially of the agricultural department of the Nicolas College - and the student in the Technology Club who get to learn about the bio-digester via demonstrations and mock builds. If farmers require bio-slurry in return for their dung, they may also become 'customers'. The same goes for The Plant Tissue Laboratory, should they purchase excess bio-slurry from the school.

Customer Relationships The setting and culture in Mek'ele requires the relationships to be of mainly personal nature (one-on-one communication, etc.). Most partners, such as farmers, rarely have access to computers for contracts and billing, for example, which makes this even more important. It is also the only local way to establish trust (see section 4.3.2). However, acquiring customers also falls under customer relations. To this end, the school may participate in awareness and demonstration days. In addition, to maintain relation-

ships, the school may opt to celebrate the bio-digester's inauguration or other milestones to which partners are invited. Keeping close personal relations with external, but also internal partners and customers, allows for more open communication and feedback to be provided. This task will likely fall to the head supervisor of the bio-digester which may be one of the senior staff at the school, or the head of the science department, depending on interest and management strategy.

Channels Similarly to the customer relations, the component *channels* includes all stages of the customer relationships, but also all channels through the various phases of the business, including awareness, evaluation, purchase, delivery and after sales. Considering that the main customers are the cooking and teaching staff and students of the school, communicative channels will be mainly face to face, as discussed in the previous paragraph. This personal communication also applies to the channels to maintain partnerships, negotiating purchases, receiving feedback and spreading awareness. This method uses few physical resources, but is very time-intensive. For awareness, an additional channel can be awareness campaigns or demonstrations and education in relation to the school students. For the acquisition of manure and distribution of bio-slurry, animal-drawn carts are the main channel, as they are the most common transportation medium in Mek'ele.

Cost and Revenue Structure The school has the unique situation where it can find funds for educational purposes in sponsoring. However, this project should initially be treated as a separate, financially sustainable business. The capital and operational expenses of this business are presented in a brief overview in figure 7.5. The main income is represented by savings. Additional revenue comes from excess bio-slurry, biogas, or other revenue generating activites. The capital costs are the fixed components such as the bio-digester, foundation, piping, storage tanks, etc. The operational costs include labour, resources, transportation / distribution, and maintenance. To be able to understand the implications of the decisions that have been made, a rough financial overview of the business model is presented in the following section (7.7.1).

7.7.1. The NRS Biogas Business Model in Rough Numbers

Before exploring alternative forms of the business model through the four modules, it can be beneficial to have a rough financial overview that guides the entrepreneur in his/her decisions. The rough financial overview is presented in table 7.4. It is set up by 1) determining gas demand, 2) determining bio-digester size, 3) determining resource demand, 4) determining bio-slurry production, 5) determining school bio-slurry demand, 6) determining costs and savings to set up a rough balance sheet.

1) Determine Gas Demand: The school has a food program that caters for 1000 students every school day, 40 weeks per year. Each school day, the school prepares 250 portions of one fruit, 250 portions of another fruit, 250 eggs, and 250 portions of milk. The assumption is made that 1 portion of milk is 2 dL, resulting in 50L of milk. Total preparation time is 5.5 hours. Based on average boiling and cooking times, 3 burners would allow all food to be prepared in 4 hours. The school also has a staff café where teachers can buy a meal (stews, eggs, injera, etc.). The café is available to teachers Monday through Saturday. Once a week, the cooks spend additional time on preparing meals for the next week and baking injera. There are two burners in the café. The assumption is made that the stoves are used for 2 hours Monday through Saturday for reheating stews and cooking small things like eggs, and an additional 4 hours for preparing food. An injera stove is used to prepare injera. Assuming ca. 30 injera per week are necessary (hotel size, diameter 50 cm), this will take ca. 1.5 hours to bake. The college students cook on electric stoves and work with gas stoves when there are power outages. To keep the size of the bio-digester as small as possible, their demand is not included in the calculations. Table 7.1 provides an overview of the calculated energy demand and the equivalent in m^3 biogas.

With a school period of 40 weeks, and an assumed bio-digester down-time of 4 weeks for the removal of all sludge and bio-slurry and a full restart, the overall yearly consumption and demand of biogas equals 2937.60 m^3/year, resulting in an average daily consumption of 8.74 m^3/day. However, because consumption during school weeks is significantly higher at 9.77 m^3/day, sizing the bio-digester based on the smaller value would require a long build-up time of biogas in storage to overcome the higher consumption rate during a normal school week. As this is both unrealistic and unpractical, the bio-digester is sized on the larger value. Since the average consumption should equal average production during school weeks, the production rate should also lie at 9.77 m^3/day, resulting in a yearly production of 3283.2 m^3/year.

2) Determine Bio-Digester Size: Based on the production rate of 9.77 m^3/day and data on fixed-dome bio-digester volume vs. average production rates gathered by IRENA [152], the volume of the bio-digester will be 24 m^3. However, because daily production rate is lower than the actual daily consumption rate on Monday through Friday, a small buffer must created to always have biogas available. This buffer is equal to 14.99 m^3 (including a 10% margin) and is established after 36.5 hours of full production. This buffer is also represented

Table 7.1: Overview of the 6 biogas burners with their rated power [kW], the hours of use on the respective days, the resulting energy consumption, and the equivalent in biogas consumption / demand based on electric and biogas stove efficiencies of 70% and 40% [140, 141], respectively, a higher heating value of methane of 55,500 kJ/kg, a 50% methane content (low quality biogas) and a methane volume : mass ratio of 1.5 m^3/kg. Burner 6 is a biogas *mitad* (injera stove) and assumed to have double the rated power due to its larger size. The asterix (*) marks cooking activities that continue through vacation weeks.

	Mo	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Food Program	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]
Burner 1 (2 kW)	4 | 8	4 | 8	4 | 8	4 | 8	4 | 8		
Burner 2 (2 kW)	4 | 8	4 | 8	4 | 8	4 | 8	4 | 8		
Burner 3 (2 kW)	4 | 8	4 | 8	4 | 8	4 | 8	4 | 8		
Lunch Café*	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]
Burner 4 (2 kW)	2 | 4	2 | 4	2 | 4	2 | 4	2 | 4	2 | 4	4 | 8
Burner 5 (2 kW)	2 | 4	2 | 4	2 | 4	2 | 4	2 | 4	2 | 4	4 | 8
Injera Baking*	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]	[h | kWh]
Burner 6 (4 kW)						1.5 | 6	
Total Time (h/day)	16	16	16	16	16	5.5	8
	= 93.50 h per School Week (= 33.5 h per Vacation Week)						
Total Energy Consumption (kWh/day)	32	32	32	32	32	14	16
	= 190 kWh per School Week (= 70 kWh per Vacation Week)						
Total Biogas Equivalent (m^3/day)	11.52	11.52	11.52	11.52	11.52	5.04	5.76
	= 68.40 m^3 per School Week **= average 9.77 m^3 per School Day** (= 25.20 m^3 per Vacation Week) (= average 3.60 m^3 per Vacation Day)						

as the initial and final available volume in the weekly consumption graph of figure 7.6. Holding such a buffer requires an expansion vessel. Additionally, this higher production of biogas will result in an excess amount of biogas during school vacations. This excess gas (345.6 m^3) can be used for additional revenue generating activities throughout the year, such as baking and selling injera[9].

3) Determine Resource Demand: This business model considers cow manure as its main resource. 1 kg of cow manure produces between 27-40 L of biogas per day [151]. Because a wide range of conditions is mentioned in the source, an average value is used. This results in a resource demand of ca. 303.10 kg cow manure per day. The cow manure (B) is mixed with water (W) in a 1:2 ratio[10]. B:W ratios between 1:3 and 2:1 are common [153]. Ideally, this should result in a solids content of 4-8% [153]. The density of cow manure is $990-1065 kg/m^3$ [154] and can therefore essentially be exchanged with water one on one, resulting in a daily water demand of 303.10 L.

4) Determine Bio-slurry Production: Depending on the B:W ratio, the amount of produced bio-slurry ranges from 0.68 L/kg cow dung to 3.70 L/kg cow dung [151]. With the chosen ratio (1:2), this amounts to ca. 2.19 L/kg cow dung, resulting in a daily bio-slurry production of 664 L/day.

5) Determine School Bio-Slurry Demand: The school currently cultivates 600 m^2 of land which is fertilized twice a year to have two harvests. On average 10-20 ton of bio-slurry are required to fertilize one hectare of land. This translates to 1-2 L/m^2. For the 600 m^2 cultivated land, 900 L of bio-slurry is required per fertilizing round, resulting in a yearly demand of 1.8 m^3. The school has another 600 m^2 of land. Should this be cultivated in the future, demand would increase to 3.6 m^3/year.

6) Determine Costs and Savings to Set up a Rough Balance Sheet: Table 7.2 provides an overview of the various costs indications that have been used to create the balance sheet. Local current data is limited, the devaluation of the currency is strong and inflation does not apply to all goods equally. Therefore, at

[9] This example has been used in the balance sheet. Note: this is only an example and can be replaced by another activity.

[10] The business model assumes fresh delivery of manure (1 cartload (ca. 750 kg) every second day), so a 1:2 ratio should suffice. However during droughts or the rainy season, this ratio may be adjusted slightly.

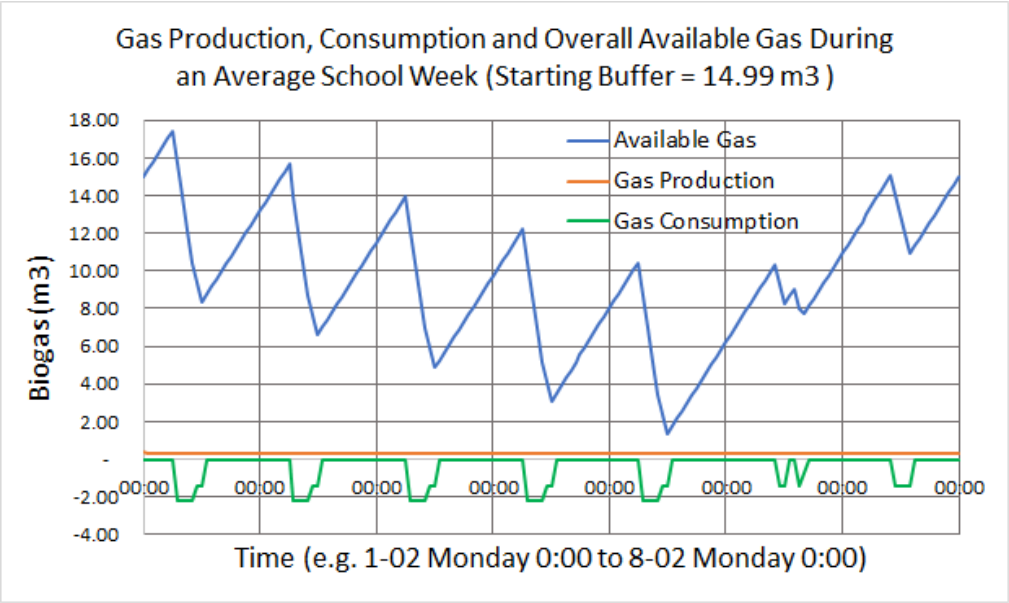

Figure 7.6: Gas Consumption, production and available gas during an average school week. A built up buffer of 14.99 m^3 (incl. 10% margin) is required to always have enough available gas. The gas production curve has been graphed as a constant; in reality, this is not the case. There will be some variation based on temperature (day vs. night) and input. The consistency of when the bio-digester is fed will also affect production. The consumption graph is also smooth, but would also show more 'noise' in reality. A more accurate and detailed model and complete mass balance check can help determine more ideal sizing and loading of the bio-digester.

times, assumptions or estimations have been made. They are noted under the comment column. In addition, because inflation data is only available up until 2019, prices have been established for ca. 2020. Please note that this is rough data. If any endeavor is planned in Mek'ele, local and current prices should be gathered.

Table 7.2: ETB = Ethiopian Birr. Exchange rates (2020) 1 USD = 36.81 ETB [155], 1 EUR = 45.09 [156].

Subject	**Price**	**Source**	**Comment**
Bio-digester	ca. 4712 ETB/m^3	[37, 43, 157, 158]	Data came from various size bio-digesters. For larger bio-digesters, actual price per m^3 may vary. However, since an expansion vessel is needed, this price is used. Price includes material, connectionss to piping and labour.
Piping & Extra construction	ca. 23$/3m	HomeDepot.com	1 inch steel piping is sufficient to cover the pressure drop over 100m of piping. An assumed 150 m of pipe are required. Price includes valves, fittings and flame arresters.
Subsidy	ca. 11,538 ETB	[43, 159]	The subsidy is 43% of the cost of a 4-6 m^3 bio-digester. It is a non-size flexible subsidy.
IBC holding tanks (1 m^3)	7362.80 ETB	[160]	Caged 1000 L IBC tank. Ca. 200 $ a piece. For import products, full American price is usually accurate [16].
Foundation of IBC	1,000 $	[16]	Tanks of 500 L and larger require a foundation. Price is for a 1000 L tank.
Biogas stoves	117.9 ETB	[161]	Extremely limited data available. Price of 1982 has been corrected for Ethiopian inflation up to 2019. Via US inflation, the price would be 247 ETB per stove.
Legal Fees	5% of CAPEX	-	Assumption. No data available.

Subject	Price	Source	Comment
Contingency	10% of CAPEX	[28]	
Maintenance	1% of Bio-digester	[153]	Alternative value: In the industry, with a 30 year life span, 3% maintenance is calculated [28].
Labour	2000 ETB/month	[16]	This is the wage of a gardener pre-tax. For loading the bio-digester, the assumption is made that the same skill-level labour is required. The man is hired full-time.
Cow Dung	0.02-0.57 ETB	[161]	Limited data available. This value is from 1982. Correcting for Ethiopian inflation = 0.14-4.05 ETB/kg (2020). Correcting for US inflation = max. 0.776 ETB/kg. Both inflation corrected values are a gross overestimations compared to the international market value 0.33 ETB/kg (status: long market) [162]. Assumption: 0.57 ETB/kg is still correct.
Rent of a driver and cart	772.5 ETB/day	[16]	Price based on the assumed dung price of 0.57 ETB/kg and a cartload containing 750 kg of dung. Total price was 1200 ETB for 1 cartload of cow dung (2020).
Unforseen costs	10% OPEX	-	Assumption. No data available.
Electricity rate	0.816-1.47 ETB/kWh	[163, 164]	Ethiopian electricity is heavily subsidized by the state resulting in one of the lowest electricity prices globally [164, 165].
Charcoal	5.5 ETB/kg	[16]	
Bio-slurry	0.4-1 ETB/kg	[166]	Values are from 2011. Compared to an international price of 0.12 ETB/kg (adjusted for dilution ratio of 1:2) [162], these values are very high. Assume 0.4 ETB/kg is a good price. This also leaves incentive for a farmer to sell manure and buy bio-slurry in return.
Teff flour	13.5-16.95 ETB/kg	[167]	
Injera	5.5 ETB/piece	-	Assumption. No data available. Price is for a standard hotel sized injera with a diameter of 50cm.

The food program and lunch café currently have 2 electric stoves each. Assumed both are rated at 2 kW and cooking behavior is the same, the annual electricity spent on cooking is 7,760 kWh/year. However, the food program often boils the milk and eggs on charcoal stoves because they are more reliable and faster. To this end, the school purchases 1,800 kg charcoal per year [16] that can now be saved. The charcoal that will potentially still be used for preparing coffee etc. is disregarded for now. The resulting rough balance sheet is presented in table 7.3 below.

Table 7.3: Rough balance sheet of the described business model for the introduction of biogas at the Nicolas Robinson School.

Costs			Revenues		
CAPEX			**Savings**		
Bio-digester	113,183.09	ETB	Electricity (@ 0.816 ETB/kWh)	6,332.16	ETB
Extra Piping & Construction	42,336.10	ETB	Charcoal	9,900.00	ETB
Subsidy	-11,538.42	ETB	Fertilizer (@0.57 ETB/kg)	2,400	ETB
IBC tanks (2x)	14,725.60	ETB			
Foundation of IBCs	73,628.00	ETB			

Costs (Continued)			Revenues (Continued)		
Biogas Stoves (6x)	707.40	ETB			
Legal Fees	7,775.96	ETB			
Contingency	24,081.77	ETB			
OPEX			**Revenues**		
Maintenance	1,555.19	ETB	Bio-Slurry (@ 0.4 ETB/kg)	88,525.85	ETB
Labour Bio-digester Operator	24,000	ETB	Selling Injera	27,693.77	ETB
Manure (@ 0.57 ETB/kg)	58,048.80	ETB			
Manure Transport (By cart; every second day during operating weeks; incl. labour)	129,780.00	ETB			
Bio-slurry Distribution (By cart; every second day during operating weeks; incl. labour)	129,780.00	ETB			
Resources for Baking Injera	11,863.26	ETB			
Additional Payment to Cook for Baking Injera (@ 0.5 ETB/injera)	2,517.62	ETB			
Unforseen Costs	35,754.49	ETB			
Total CAPEX:	264,899.51	ETB	**Total Revenue:**	134,851.79	ETB
Total OPEX:	393,299.35	ETB			
		Profit:	-258,447.57 ETB		
		Pay-back time:	- years		

This business model is clearly not profitable in its current state. The cost that sticks out most is that of the transportation costs. This value may be an overestimation because it is based on a day-rent rate, but even if a double full years wage is payed for the the use of a driver and his cart (48,000 ETB/year) times 2 for both transportation activities[11], the loss will be 78,531.57 ETB/year and there are few other costs that can be reduced, and none that will cover this gap. In addition, momentarily, the bio-slurry is also being sold for a price far above the international market value, meaning that revenue is likely to be even less. Another value that sticks out are the very low savings in electricity due to the low electricity rates in Ethiopia. Before moving on to the application of the modules in step 5, the business model should be made at least break-even and preferably profitable.

With the transportation costs so high, alternatives in this area should be explored. Renting a cart and the driver is expensive, but they are vastly available. Renting a truck lorry is even more expensive and more difficult to come by than a cart, so it is not an option. However, sometimes, internalising capital reduces overall costs. If the school purchases a donkey and cart of its own, the balance sheet looks as in table 7.4.

Table 7.4: Rough balance sheet of the business model when a donkey and cart are purchased by the Nicolas Robinson School. The changes have been highlighted in red.

Costs			**Revenues**		
CAPEX			**Savings**		
Bio-digester	113,183.09	ETB	Electricity (@ 0.816 ETB/kWh)	6,332.16	ETB
Extra Piping & Construction	42,336.10	ETB	Charcoal	9,900.00	ETB
Subsidy	-11,538.42	ETB	Fertilizer (@0.57 ETB/kg)	2,400	ETB
IBC tanks (2x)	14,725.60	ETB			
Foundation of IBCs	73,628.00	ETB			
Biogas Stoves (6x)	707.40	ETB			
Donkey	7,362.80	ETB			
Cart	18,407.00	ETB			
Legal Fees	7,775.96	ETB			
Contingency	26,658.75	ETB			

[11] This is necessary due to the volumes being transported per day.

Costs (Continued)			Revenues (Continued)		
OPEX			**Revenues**		
Maintenance	1,555.19	ETB	Bio-Slurry (@ 0.4 ETB/kg)	88,525.85	ETB
Maintenance Cart (5% cost)	920.35	ETB	Selling Injera	27,693.77	ETB
Donkey Feed	3,068.52	ETB			
Labour Bio-digester Operator	24,000	ETB			
Manure (@ 0.57 ETB/kg)	58,048.80	ETB			
Manure Transport	n/a	ETB			
Bio-slurry Distribution	n/a	ETB			
Resources for Baking Injera	11,863.26	ETB			
Additional Payment to Cook for Baking Injera (@ 0.5 ETB/injera)	2,517.62	ETB			
Unforseen Costs	10,197.37	ETB			
Total CAPEX:	264,899.51	ETB	**Total Revenue:**	134,851.79	ETB
Total OPEX:	112,171.11	ETB			
		Profit:	22,680.68 ETB		
		Pay-back time:	12.93 years		

This balance sheet considers the purchase of a donkey[12] and cart[13] to minimize transportation costs. Maintenance costs for the cart (assumed 5% due to wear and tear) and feed for the donkey[14] have also been included. The consequence is that the business can become profitable without any other adjustments. The pay-back time of the capital expenditures are also relatively acceptable, assuming a life-span of up to 40 years. Note, however, that the labour load of the bio-digester operator has increased significantly and there is not enough profit to employ a second employee. The school employs two gardeners that can help with part of the tasks for a small reimbursement, such as supplying water, loading the bio-digester and managing the bio-slurry, while one employee manages the transport and distribution. In addition, if the working of the bio-digester is integrated into the agricultural college department, students can also partake in the day-to-day operations for hands-on learning experience. This addition of a donkey also has a positive benefit. Non-profit organizations aim to improve the lives of donkey and horses in Ethiopia. Over the past years, they have expanded their efforts to teach donkey and horse owners via demonstration days how they can prevent over-working their animals, damaging them through improper packing and neglecting wounds that infect. They also find that teaching children from a young age how to take care of their animal helps improve animal welfare in the country [168], a lesson that can be taught at the Nicolas Robinson School to all ages, if a donkey or two would reside at the school.

Finally, should electricity prices rise to a global average (0.14 $/kWh [164]), this business model becomes more attractive due to the larger revenue from electricity savings. Profit would be 56,343.25 ETB/year with a pay-back time of 5.20 years. However, if an international electricity price is applied, it is important to see how international prices of manure and bio-slurry (0.35 ETB/kg for cow dung and 0.12 ETB/L bio-slurry [162]) affect the business model, especially since the current prices are far above the international norm. Profits become 35,857.69 ETB/year, meaning a pay-back time of 8.18 years. Note however, that the combination of international cow dung and slurry prices, but a subsidized electricity price (0.816 ETB/kWh) results in a profit of 2,195.12 ETB/year and a subsequent pay-back time of 133.59 years. This final condition essentially renders the business unprofitable again, even with diminished transport costs, and proves the importance of the electricity price in these endeavors. The low electricity prices in Ethiopia make many of these business endeavors not worthwhile, as it is very difficult to provide an alternative form of energy at lower cost than a state-subsidized power source. This also means that any scenario where the biogas is transformed into electricity is inherently unsustainable, unless the value of a stable electricity supply outweighs the financial cost or other sources of revenue can cover for the additional cost. With the base business plan described in table 7.4 worked out, step 5 can be completed.

[12] A donkey costed $90-$150 in 2016 [168]. Due to limited data, the price has been estimated at $200, as their value is increasing [168]

[13] As there is no available data on the expense of a cart, it has been estimated at $500.

[14] A average grown up donkey eats 2-3 kg of food per day. With hay prices at 0.33-1 ETB/kg in 2000 [169] and wheat bran prices at 3.63-4.8 ETB/kg in 2016 [170], the latter price is used to calculated feeding costs.

7.8. Step 5: Apply the Modules to the Business Model Canvas

In this step, the modules that were determined in step 3 are applied to the Business Model Canvas (BMC) from step 4. The modules are applied as best they can with the current available local information. This is good practice in the sense that an entrepreneur will never have all information available to him/her. Because of these restrictions, and because this exercise is focused on testing the framework suggested, little additional time will be spent on calculating through various alternative cost schemes and scenarios. Like described in the framework in the previous chapter, the manner of application will be dynamic, which will be reflected by the manner of writing, to demonstrate the train of thought that will lead to the final result. Since the modules are meant as a guide to work towards a specific goal, not every suggestion may be applicable and therefore not every point is discussed in detail.

7.8.1. Module Frugality

As already mentioned by interviewee 1 in section 4.3.2, sustainability and circularity are essentially a luxury one may consider once one is past bare survival, and although some might argue that sustainability is a necessity, in business, without income, there is no survival, and thus, frugality - largely affecting cost - is the first module that is applied. In developing countries especially, where a business may compete against 'non-consumption' instead of a regular competitor, the value to price ratio must be high.

In line with a frugal mindset, the module warns to follow the lean start-up method. The lean start-up method does not only remind the entrepreneur to keep costs to a minimum, but also to make products sturdy and durable. This is kept in mind, especially for the Minimum Viable Product development and execution, but also in later stages. Within the value proposition component, the module also reminds the entrepreneur to focus on one need or want.

In step 4, where the Business Model Canvas (BMC) is filled in, the specific need is determined to provide reliable clean cooking on campus. With the choice of biogas as a clean fuel, there are just various additional benefits (bio-slurry) that come for 'free'. In terms of sturdiness, the fixed dome bio-digester in itself is a sturdy and lasting construction and the most common type of bio-digester in Ethiopia. One of the main technical issues lies in blockage and corrosion of pipes (see technical barriers in section 4.1). The most commonly used pipes are steel, which is easily corroded. An alternative could be to used polyethylene (plastic) piping. Local cost and availability would need to be explored and compared. To keep costs low, the size of the bio-digester should be minimized. This is not only advisable because of the construction costs, but also because of the amount of work and more difficult problem solving associated with a larger bio-digester. In addition, the amount of bio-slurry that needs to be handled is minimized. If the bio-digester size can be decreased significantly, the additional costs of handling bulk bio-slurry decrease and the income from the bio-slurry is needed less. Some additional points of research and improvement have been noted already in section 7.7.1.

An additional option that can be explored is the use of fireless cookers. These cookers are basically isolated boxes in which a boiling pan can be placed. It will continue to boil for a prolonged period of time due to the heat retention. This can halve the energy use of a cooking process [171] and therefore save considerable amounts of gas consumption, reducing overall demand. Boiling the milk, or even the eggs of the food program this way could be beneficial. The costs of fireless cookers, the amount of labor and the employees safety associated with transferring boiling pots and pans to a fireless cooker need to be considered also. Alternatively, better insulated pans (on the sides) could be an interesting project for the after-school technology club to explore. However, a quick check in the excel file shows that the bio-digester volume could be reduced to $14.4 m^3$ if the fireless cookers could reduce gas consumption by 40% and the biomass:water ratio is set at 1:2. The reduction in size saves 45,272 ETB in construction costs, reducing pay-back time by three years.

A further possibility that can be explored is to paint the dome of the digester black[15] and install a mobile or strategically fixed shade construction so that the temperature in the digester can be raised slightly, improving gas yield per day, requiring a smaller input per day and thus a smaller bio-digester. To determine the best temperature and how it will affect sizing needs to be explored, preferably via experiments. When considering this option, one should also remember to research how variable production affects the digester overall on a technical level. Also, with a non-fixed shade construction, an employee must constantly monitor the temperature of the bio-digester. Since this is sub-optimal, a strategic shade construction is preferable. Since Ethiopia is close to the equator, sun and temperature variation during the year is minimal. A fixed and strategic shade construction could be made so that the digester catches sun in the morning hours to warm up, is protected in the shade during the warmest hours of the day, and depending on experimental results,

[15] Assuming the construction allows the dome to remain unburied.

receives some additional sunlight hours in the evening.

Should the overall size of the bio-digester be difficult to adjust (due to a lack of available data or a lack of profitability in its smaller size), the school could also consider constructing several smaller standard-sized digesters. The advantage is that if one has technical issues, part of the demand can still be met while the faulty one is fixed. In addition, more laborers are familiar with building the smaller digesters, unlike the larger sized biogas digesters that are fairly new and uncommon. The costs and labor associated with this option need to be considered; however, the bio-digesters could potentially be located closer to the respective kitchens which is more optimal for easy use.

Another option lies in the important component of key partners. With such a large construction, the local government will likely need to provide a license and approve of the project. This will bring extra costs (legal fees etc.). However, if the government can be convinced of its use and importance to the city's development, they could perhaps be persuaded to make the subsidy size-flexible. In the case of the $24m^3$ digester, the pay-back time would be reduced by 1.5 years[16], which makes the business more attractive overall. However, if the construction and investment is considered too large, or the school cannot receive a proper permit or additional subsidy, or wants to test the technology's support base and operations on-campus first, the option exists to install a standard $8m^3$ bio-digester and cover part of the demand (i.e. one of the two kitchens; the staff café) first. Later, when everything is up and running and potential obstacles have been removed and operations are understood and run smoothly, a second bio-digester can be installed to help the second kitchen. This would make the overall initial investment and operational costs a lot lower. Such plans can be placed in the component of foresight. However, because the goal is to cover the school's gas consumption, this is a less satisfying option in terms of meeting the vision. If the school wants to detach itself from the risk of investment, this business should perhaps be set up separately from the school. Then the school can be the main buyer of the products and the business stands on its own to make a profit by managing and selling bio-slurry or other activities. However, that makes the school more dependent on a third party that will need to manage and run the operation. It would also require a different business plan, but is worth mentioning as an option to consider.

Since the costs of transporting the cow manure and bio-slurry are very high, alternatives to the current solution (own donkey and cart) can be considered. It can be worth looking into partnering up with another company that needs to make deliveries but does not require the trucks full-time. Or, perhaps one of the existing partners has access to transportation devices that could be 'rented' or used in exchange for bio-slurry or the excess biogas, for example. Or, a system can be set up where farmers can purchase various sizes of jerry-cans at the school with a deposit for the jerry-can and the option to refill them again at the school. If the jerry-can is handed back in, the deposit is payed back. These kind of options can make a large difference in the expenditures of the business plan, but require local communication and building of trust, reflected by the level of dependence one has on the farmers to pick up bio-slurry regularly, for example. An example partner could be the Plant Tissue Laboratory Mek'ele, with which the school already has an existing partnership.

While considering all the various options and scenarios discussed above, they are noted in the module. For each scenario or alternative, the entrepreneur must also consider the effects on cost and other factors such as dependability and one's own preference. The result is the discussion from the previous paragraphs, and the filled-in module presented below in figure 7.7.

The two highlighted suggestions are potential improvements that can easily be added to the current business plan. If the two highlighted suggestions would be implemented in the business plan, the fireless cooker would be added as a key resource (see figure 7.8) in the filled in Business Model Canvas (BMC) and the component of *foresight* is added to the BMC also. The government is already listed as a key partner; therefore, it does not need to be added again. The financial overview from section 7.7.1 would need adapting also. Due to the fireless cookers, gas demand would decrease, resulting in a smaller bio-digester and investment costs. The subsidy would add additional savings. Since both relate to capital expenditures, the overall pay-back time would be decreased also. Several indicatory values to represent the savings are included in the figure. Once all desirable scenarios have been worked out, and the entrepreneur has made a decision andadapted the financial overview, he/she can move on to the next module and redo this process under the light of another target. Since many cost indications are difficult to come by and calculating and discussing all options in detail goes beyond the scope of this report, the following modules will not presented in figures or monetary values.

[16]This is without adjusting for a reduction in other capital expenditures such as storage tanks.

<table>
<tr><td rowspan="3">Foresight

<u>Build-up plan for spreading investment over time:</u>
-Build one smaller ~8m3 digester now to cover the staff kitchen
-Build another ~16m3 once everything is up and running and potential obstacles have been removed.</td><td rowspan="2">Key Partners

-Convince the government of the overall benefit to the region and make the subsidy size-flexible.
-Partner with another company that needs vehicles part-time to deliver product</td><td>Key Activities

-Improved production through a black painted bio-digester dome and shade construction</td><td rowspan="2">Value Propositions

<u>Option - A complete 180:</u>
Set up business outside the school and act as main customer for biogas.</td><td>Customer Relations</td><td rowspan="2">Customer Segments</td></tr>
<tr><td>Key Resources

-Fireless Cookers
-PolyEthylene Gas Pipes
-2 smaller digesters closer to the kitchens</td><td>Channels

-Farmers bring manure and take bio-slurry with them on their own carts.</td></tr>
<tr><td colspan="4">Cost Structure

-Fireless Cookers: costs ca. 1273 ETB; saves 45,272 ETB on digester construction and 3 years pay-back time.
-PolyEthylene Gas Piping: (? ETB)
-Black Dome and Shade Construction: (? ETB); potential savings in bio-digester construction due to size reduction
-Construction 2 smaller digesters: assume similar cost; saves ca. 20,000 ETB in piping
-Farmers supply manure & transport bio-slurry: saves 25,700 ETB for the donkey and cart and ca. 4000 in feed and maintenance per year
-Size-flexible subsidy: saves ca. 37,000 ETB and 1.5 year pay-back time</td><td>Revenue Streams</td></tr>
</table>

Figure 7.7: Module Frugality applied to the case study of biogas in Mek'ele, Ethiopia. The ideas most worth pursuing are blue. The figure has been adjusted in shape to make the visual more legible.

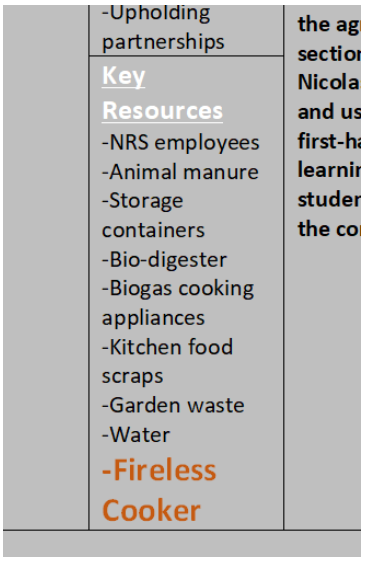

Figure 7.8: A zoom-in on the affected component of the Business Model Canvas (BMC) after applying Module Frugality to the case study of biogas in Mek'ele, Ethiopia.

7.8.2. Module Sustainability

Within the sustainability module, there are many aspects to consider that fall under three main categories: the economy, society, and the environment. The framework description in chapter 6 mentions that it can make the module quite crowded. This is true, but luckily by going through various options, many will be eliminated for the business "now" and transferred to foresight as future steps, or eliminated completely[17]. One should remember, however, that the component of foresight does not only allow listing future steps, but also threats and opportunities that may affect the business in the future. The entrepreneur should also keep

[17] If possible, the business model should be made as sustainable as possible from the beginning, but sometimes a lack of funds, social support, or even networks can be reason for the entrepreneur to postpone certain sustainable aspects or milestones of the business into the future.

in mind that the module of frugality still holds. Therefore options that increase costs, should increase value even more to justify it. The module speaks of creating mutual value amongst the three P's (people, planet, profit), but in the end, it is a balance that the entrepreneur can establish based on his own values and/or bias.

The introduction of the case study already addresses a societal / economic threat that is formed by the current political instability. When looking at the components of PESTLE, the legislative (L) components raises questions: Will the rights of Tigray be impaired in the coming years? But also: Are the rules on owning and operating a bio-digester clear and consequent or are they ever-changing? But also in the purely technical sense there are challenges: will supply chains be disrupted due to the current situation? How long until things go back to normal? What if martial law is imposed and assets are confiscated or freedom of movement (supply and distribution chains) is limited? Or for economic sustainability: If a large bio-digester is installed where community members can buy excess biogas, are community members still interested or even capable of buying a biogas stove as initial investment? Or more in general: How will inflation change in the coming years and how will devaluation of currency affect my investment and my business? Or socially: How will the current situation affect social relations (e.g. polarity amongst the community) and building relationships? Again, these are fairly negative topics, but if the school does invest in a large-scale bio-digester, these are things to consider.

On a more positive note, the bio-digester as a technology offers quite some positive externalities for the environment. There is a large greenhouse gas reduction associated with using animal dung to form biogas because the methane that would usually escape to the atmosphere is caught and used. In addition, the burning of biogas is very clean and efficient and - as a social positive externality - affects the health of the cook and surrounding children positively. Additionally, the produced bioslurry provides many natural nutrients that a chemical fertilizer does not. The bio-slurry also helps retain water in the soil and decreases soil erosion. In addition, farmers have reported stronger and better-tasting crops with less issues related to common pests (see section 4.1). However, any negative externalities should be considered also. For example, the bio-slurry that is produced in very large amounts in the presented Business Model Canvas needs to be transported. The larger the volume, the larger the transportation operations and fuel consumption. In the previous section, it was mentioned that the school could become a 'refill' station where farmers or households could come buy the bio-slurry on campus. This option eliminates the large bulk transport for the school, but requires many individuals to come to the school which may be less environmentally friendly in the end (depending on transport method and distances travelled). In addition, there is less economic security because there are no contracts involved that secure that the bio-slurry will be taken off the entrepreneur's hands. Furthermore, there is a social cost in terms of the time individuals need to spend on gathering the bio-slurry which may also be considered a negative social externality. Therefore, this option is not ideal. The better option is to minimize the volume of transport. This can be done by drying or composting the bio-slurry or by adding additives. There is some volatilisation of NH3 associated with drying and composting bio-slurry; however, in the case of composting, where new organic matter is added (food scraps, agricultural waste, straw, etc.), the resulting nitrogen content is higher that the bio-slurry alone. Adding an additive can minimize the volatilisation, but is rarely done because it requires mixing phosphate fertilizer and bio-slurry, reducing the overall positive environmental externality. The preferred method is therefore composting [172]. Composting bio-slurry requires larger areas than storage, but fortunately the school has land available. The composting will also require additional labor. This can be considered a positive social and economic externality because it creates additional employment, however in terms of profitability, it could be a negative factor. Again, this would need to be weighed and calculated in various business model scenarios.

A different possible negative economic and/or environmental externality is associated with the use of steel pipes. Steel pipes corrode easily and will need regular exchanging. The waste this produces (especially if it is not recycled) is a negative externality. Plastic pipes could be a solution, if they are more durable. However, if their price is higher, the value from the positive externality vs. the extra cost needs to be weighed. Also, their end of life options need to be considered (e.g. incinerated to produce electricity, land fill, recycling, etc.). If they are disposed of on a land fill, it might be more environmentally sustainable to use the steel pipes. To say for sure, more research is required.

Moving on from the externalities, the question is whether there are improvements possible that will add value to any of the three main stakeholders: society, economy, environment. Several ideas have already been mentioned and discussed in the previous two sections. One worth mentioning again is to consider the resources used. There are many alternatives with various gas potential [35], pricing and nutrient content [172] that can be considered. An interesting option not often mentioned is ground coffee residue from roasting and boiling coffee. Since this is a waste product of almost every home in Ethiopia, it has been mentioned as

an interesting and valuable resource [173, 174], although gathering it is likely time and labor intensive. On a smaller scale, having students bring some in, making their own bio-compost and planting a vegetable or flower plants (perhaps even to take home) can be a fun and valuable lesson that may extend into the community. In this area, there are many more options to consider.

This module is quite extensive and there are many more possibilities and options to discuss, but that goes beyond the scope of this thesis project. In addition, without working out the various business model scenarios and making concrete choices, the discussion becomes somewhat aimless and endless because most components are interlinked. Therefore the next module is considered.

7.8.3. Module Circularity

This section explores how applying module circularity can affect the business plan. The module focuses largely on resources, their origin, their use, the possibilities for re-use (and durability), their end-of life paths and options, minimization of waste streams, and finding new purposes for waste-streams. One of the main questions this module asks is: *Are there ways to get the resources from waste sources and provide our own waste streams as a resource?*

Essentially, the bio-digester is one big circular technology because it does exactly this: cow manure (waste) becomes fuel (resource) and bio-slurry (waste) which can be used as fertilizer (resource). This then again allows plants to grow (resource) and animals to eat and produce waste which is used as a resource for the bio-digester. This means that overall the business plan fits in the concept of a circular economy.

An idea expressed in section 7.8.1, where jerry-cans are used by farmers for which they pay a deposit is also a circular idea. However, it was mentioned that the execution of this idea might actually be less sustainable than bulk transportation in section 7.8.2. Whether or not a circular path is actually more sustainable or not is important to keep in mind when going through various options to create circularity. Sometimes a linear approach is more sustainable if disposed of properly or when the alternative is more polluting.

Again, this module allows for many opportunities to be considered and researched. These opportunities can be dismissed, integrated into the business model, or placed within foresight as a future goal. As with the previous two modules, talking through the various options would result in a long discussion that is becoming less and less concrete without further research, but the concept remains the same: the module is a guide in this process of exploration.

7.8.4. Module Socio-Cultural Aspects

The final module, although the same in concept, is slightly different as it zooms in on a specific subject: culture. The main question is: *What are the main cultural differences and are there any cultural values and institutions that need to be integrated into the business model? What needs to change?* To fill in this module, the local culture needs to be understood. As mentioned in chapter 4.3, it would be best to visit and spend time in the area in which the business is to be set up so that the entrepreneur can formulate a deeper understanding of the local culture and its values. Translating this understanding into a form of management and business culture that values the various cultures involved is listed in section 4.1 and repeated in the analysis of the culture review of sections 4.3.3 and 4.3.4. Another three main criteria are to have a clear role division, set up a clear management strategy, and reward all and hold all equally accountable, which lead to the additional component of management.

The topic of role division is mentioned under section 7.7.1 and touched upon during the application of the other modules, but no concrete plan has been presented although some roles were 'divided' for the general balance sheet overview. For example, due to the proportion of the manure and bio-slurry that needs to be handled, the costs of a laborer specifically for that role has been included. However, this employee is considered under-qualified to monitor the bio-digester[18], problem shoot, and alter production if necessary, at least at first. Someone with more experience will likely need to monitor the bio-digester, especially since the bio-digester size is above average. This means hiring an additional person as a consultant, for example. However, depending on local working culture and ethics, it can be necessary to hire a second man to deal with the amount of manure and bio-slurry. Another alternative: if culture dictates that these workers cannot work without constant supervision, yet another employee needs to be added. These cultural considerations, along with the amount of different business activities, and the type of employee hired, directly influence the costs of a business and therefore the business model and its potential to remain profitable. If a choice is

[18] Managing and monitoring the bio-digester includes maintaining proper pH levels, production and substrate temperature, substrate loading adjustments, recognizing inhibitors, etc. [151].

made against cultural convention, a very clear and consequent management style will be needed to keep the business running as planned and will likely require more effort from the managing party, as discussed also in section 4.3.3.

In a more general point of view, broader cultural conventions and public opinion may affect the business too. Some cultures may not accept working with human feces. The Robinsons believe that this may be the case since introducing the dry compost toilets already took quite some convincing [16]. Therefore, this particular business model should avoid using human feces as a resource. Since the school has the dry composting toilets, this should not be a problem. Additionally, sticking to animal dung allows the step of 'pasteurizing' the bio-slurry to be avoided.

Keeping the business within the bounds of the local culture and making sure that there is public support and that no offense is given through any activity is important. The module reminds the entrepreneur to keep this in mind when going through all the various options discussed in the previous modules. This is especially important now there is political instability and there is hypothetically a risk of polarization within the city. Should this happen, an acquaintance and business activity with one partner can influence the relationship with another if the two parties are strong advocates of their beliefs. And even though the entrepreneur may not have an opinion, he/she may get stuck in the cross-fire. The module therefore warns for unspoken expectations. To mediate this, it advises to try and create an environmental of open dialogue and leading by example.

By far not all options have been discussed during the modules, but the purpose of the modules becomes clear: they are a guide to walking through various option, coming up with new ones, and considering the various aspects and impacts of each option through their inter-relatedness. Meanwhile, they also continuously remind the entrepreneur of the major goals in mind he/she has set for him/herself and the business.

Setting up a concrete business model with a financial plan means going through the various options listed above, among others, and goes beyond the scope of this thesis project. The purpose of this chapter is to demonstrate how the modular approach can be used. Once a concrete business model has been developed, however, the entrepreneur can move on to step 6.

7.9. Step 6: Complete a SWOT Analysis for a Business Strategy and Evaluation Plan

As mentioned several times in the previous sections, developing a full thought-out business plan that considers and integrates all the target aspects of the four modules is beyond the scope of this thesis project. Therefore, a final SWOT analysis can not be completed. However, to demonstrate in short what it could look like, the original rough business plan for the bio-digester from section 7.7.1 is used.

Completing a full SWOT analysis can be time intensive, but even a broad brainstorm may lead to some important conclusions and strategy decisions. Table 7.5 represents the initial insights from the broad brainstorm.

This rough SWOT analysis is clearly not complete. For example, most of the alternative options to increase efficiency, limit bio-digester size, increase revenue streams or improve sustainability, could be listed under opportunity. Knowing who the employees will be, what role they have, and how they will be trained and managed, will also add points in the various rows. However, from this very rough SWOT analysis, it already becomes clear that part of the strategy should be to maintain close contact with direct sources of news to stay up to date on the current situation. In addition, the business plan should focus on minimizing capital expenditures to minimize the overall pay-back time. In addition, the business should add a strategic component on creating awareness to make farmers familiar with the technology, so they will be open to providing the manure and taking bio-slurry back as fertilizer.

Furthermore, this step includes setting up an evaluation plan. The first evaluation step was actually already completed after the Minimum Viable Product (MVP), where the entrepreneur received valuable feedback on how to set up the business plan. Next, after working through all the options the modules present, creating a concrete business plan, and finalizing the SWOT analysis, the next evaluation step is completed. Again, this is a *pivot or persevere* moment. If there are any threats or weaknesses specifically related to the business, the modules can be revisited to see whether there are clear points of improvement. If the entrepreneur decides to persevere, he/she may set up an evaluation plan for the future. From the concrete business plan, there should be a clear list of goals within the component of foresight. These goals can be used as milestones and evaluation points. Once this plan has been completed, the business plan is ready to move

Brainstorm SWOT Analysis	
Strength	Self-sufficient in cooking activities. Clean cooking fuel. Additional income for the school. Spreading awareness of clean cooking alternatives to 100s students and school staff; the bio-digester is a valuable learning tool.
Weakness	Depending on financial plan, long pay-back time. New employees are unfamiliar with the school culture and given an important task of operating the bio-digester, where time management is important. General inexperience with the technology. Potential issues in relation to dealing with animal manure.
Opportunity	Leading by example in a sustainable endeavor with local products, thereby being an inspiration to the community and children. Good relations with various local parties; this opens up opportunities for the future.
Threat	Current political instability. Reliant on local farmers to provide bio-digester resource; they may not understand the technology and benefits of bio-slurry and lose interest in the endeavor.

Table 7.5: Rough SWOT analysis brainstorm for the business model of the bio-digester with volume $Vd = 24m^3$. As presented in section 3.2, strengths and weaknesses are internal and threats and opportunities are external.

into the execution phase where the evaluation plan is the guide and the modules can be consulted at any point in time.

8

Evaluation of the Constructed Modular Framework

This chapter is a discussion on how the conceptual framework developed in chapter 6 holds up during a real-life application, as was done in chapter 7, and how it is perceived by experts in the field. Hereby, the final sub-question of this research project is answered: *SQ 11 - Does the developed business model framework for developing nations deliver on its promises to preemptively address commonly faced barriers in developing nations and include aspects of sustainability and circularity, and does it meet the expectation of experts?*. The chapter includes a reflection by the author on the application of the framework to a real business idea, followed by a general peer review from three experts in the field.

8.1. Reflection on Using the Developed Business Model Framework for a Real Business Idea

In chapter 7, the author applied the newly developed sustainable and circular business model framework for developing nations described in chapter 6 to a real life business idea in a developing nation. With an engineering background, the author has little experience as an entrepreneur, which required an extensive literature review on existing Business Model Framework (BMF). However, as one of the goals of the newly developed framework is to cater to unexperienced entrepreneurs, this is an advantage in regards to reflecting on the experience of building a business model based on the framework, which was done in chapter 7.

The business idea /case study that was developed is: the introduction of biogas as a clean cooking fuel at the Nicolas Robinson School (NRS) in Mek'ele, Ethiopia. This business idea requires the application of all four modules; frugality, sustainability, circularity, and socio-cultural aspects due to the setting in a foreign and developing nation and at a school that values and pursues sustainable projects. Additionally, since biogas produced in a bio-digester derives its value from a circular concept, the circularity module is important also.

The business model framework developed in chapter 6 sets out to guide new and experienced entrepreneurs alike in setting up a business model in a foreign, and specifically developing, nation. The framework has this guiding ability because of its 6 steps that represent a ready-made approach set up for the entrepreneur. this approach starts with a broad and easy to understand and apply, but well-formulated basis, followed by steps and layers that guide the entrepreneur through the complex process of exploring value-adding alternatives in a simple way. Meanwhile, the framework is dynamic enough to allow the entrepreneur to set his/her priorities by altering the order of the modules or deciding to add or remove one or more modules depending on his/her desires and priorities. This essentially makes the framework broader than the specific business setting of developing nations and can therefore be applied to any business once the applicable modules have been created.

During the first two steps of the application, the framework subtly, but clearly, reminds the entrepreneur that although it may work in your head, it needs to be proven and checked in reality. The framework is not aggressive about this 'reality-check', but simply guides the entrepreneur through the process of defining assumptions and validating them to form the basis of a business model which is then easily described in step 4: fill in the BMC. The one thing that can be improved in step 1, is to clearly state that the entrepreneur should

define and write down his/her vision and mission. Some guiding points or questions on how best to do this would have been appreciated. The same holds for the formulation of the value proposition in step 4. Having additional guidance or information on how the vision and mission and the value proposition are alike or differ would be helpful. Creating clarity in those components at this stage of the development will help keep a clearer picture during application of the modules and exploring alternative business scenarios. Step 3 on the other hand was completed without difficulty. It is very clear and straight-forward as it asks the entrepreneur to define his/her major goals which will become modules and prioritize them. Because the modules of this business idea had already beenn developed, step 3 seemed out of place and small compared to steps 1, 2, and 4. Since the idea is that modules will be developed and readily available over time, this step could perhaps best be integrated with step 5 where the modules are actually applied. The new step 3 (current step 4) would be filling in the Business Model Canvas which arguably should come before any talk on modules anyway. Besides a desire for some guiding tips on how to formulate a proper value proposition, this step has another drawback. Whilst applying the framework to the business idea the first time around, arriving and working through step 5 was a chaotic procedure because there was little structure in how to determine where to begin. Of course the modules are built such that it essentially does not matter, but some additional structure would not be a superfluous luxury. To that end, setting up a rough financial overview / balance sheet after filling in the BMC can help identify where the main (financial) barriers of the business lie which can be addressed by adjusting the initial BMC or by searching strategically in the modules. It allows many ideas to be categorized into various extents of likeliness to add value to the business model. The option to create a financial overview at this point is mentioned in the framework, but added so much structure and support in the process that it may even deserve to become its own step, and at the very least be emphasized in step 4. Step 5, as mentioned, was a somewhat chaotic experience at first. There are so many ideas to explore and the modules at first seem to only create even more ideas and options. However, due to the order that the entrepreneur has established and the goals and priorities they present, the entrepreneur is constantly reminded of his/her priorities, making decision-making and trade-offs easier to od. In addition, when it all seems too overwhelming, the entrepreneur can take a step back and visually see the progress that has been made via the filled in modules. And because there is a basic financial model (if the advice is followed), testing ideas becomes easier. Because of the lack of current information and local contacts during the development of the business model, step 6 was not completed in detail. One possible improvement would be to add some core guiding concepts and tips on completing the SWOT analysis properly. Also, some additional tips, pointers or guiding steps, or even additional references to related literature or blogs for business and management strategies could be beneficial to the entrepreneur.

Overall, the framework made a desultory vision form into a concrete business plan that meets the desires and priorities of the entrepreneur now, and includes a strategy to improve and grow into the future. Essentially, a mental vision is translated into a physical well-thought-out plan and pathway. This means that, even though the process of completing all 6 steps is fairly time intensive in comparison to the BMC alone, the framework makes a complex and overwhelming task clear and manageable. The balance between creating a clear tool and providing enough depth is a delicate one. If the tool does not meet the expectations of the reader, it often results in negative feedback. As an inexperienced entrepreneur, however, the additional guidance, and thus time spent on the business model, was very valuable. In addition, because the framework is modular and acts as a guide, it can be used for both in-depth business plan development and for general business plan brainstorming. The entrepreneur decides how much time is spent on the business plan or how in-depth he/she goes.

A final comment and point of improvement is to reduce the amount of text that describes the framework. Ironically, some of the feedback in this reflection asks for even more information. However, the key lies in the presentation and conciseness of text. Forming certain sub-steps or tips into small visuals or 'survey boxes' that automatically lead the entrepreneur to formulate the vision or a value proposition, for example, will make the tool even more simple and definitely more appealing. Therefore, although there is some room for improvement, this new modular framework is a valuable tool in guiding an (inexperienced) entrepreneur through a complex process and preparing him/her well for his/her future endeavors.

8.2. Peer Review by Experts of the Field

The assessment on whether the new modular framework described in chapter 6 is a valuable asset to entrepreneurs starting a business in a developing nation was completed by a peer review of individuals related to this academic field or with experience or ties to such activities. The individuals have not applied the mod-

ular framework to a business idea, but reviewed it in general based on their experiences with businesses aiming to adjust their business strategy for new priorities or businesses being set up in developing nations. Their review was asked to answer whether the tool was feasibile as a real tool and whether they thought it had a chance at creating successful businesses in developing regions. also, general feedback was accepted also.

The individuals that provided feedback and their occupation are listed in table 8.1 below.

Table 8.1: Review panel for the independent assessment of the modular business model framework described in chapter 6.

Name	**Profession**	**Date**
Ton van Kampen	International Business Development Professional at Fontys Hogescholen	27/01/2021
Guido De Wit	Business Advocacy - Value Chain Network at Uetliberg Partners	05/02/2021
Dr. David Russell	Sustainability Measurement - Eco-Innovation - Life-Cycle Analysis at Uetliberg Partners	05/02/2021

All three individuals relate to the topic of (sustainable) business development and have personal experience with, or relate to the topic of, entrepreneurship in developing nations. T. van Kampen helped set up the entrepreneurship training in Mek'ele, Ethiopia and supervises students at Fontys Hogescholen on projects related to business (model) development. These academic activities follow a 33 year global career with 20 years of expat experience in Europe and Asia that form the basis of a thorough understanding on how cultural-based customs affect a business. G. de Wit is an entrepreneur himself and is a partner in his own business, Uetliberg Partners. He is passionate about business advocacy, specifically in relation to businesses that aim to improve their market position by the implementation of sustainable business opportunities. He helps these firms adjust their strategies and business management to allow innovation through sustainability, while taking into account any scientific, economic, public, or political aspects that may influence the business. Dr. D. Russell is also a partner at Uetliberg Partners and specializes in evaluating the sustainability of a business over its entire value chain. He advises companies on sustainability integration and helps them assess the risks and opportunities that sustainability issues pose. He also provides facilitated multi-disciplinary innovation workshops to stimulat out-of-the-box thinking in relation to sustainability drivers. Having grown up in Kenya, the topic of this thesis project is dear to him as he understands the struggles of developing businesses and entrepreneurs in the region.

Overall, the feedback on the concept of the modular framework is positive. The framework has several valuable characteristics. First, due to the flexible, non-binding and replaceable nature of the modules, the framework can be applied more broadly and to many more businesses than just those in developing nations [175, 176]. Secondly, the use of the modules allows for a broad and clear basis to which complexity is added along the way and to the extent the entrepreneur desires [176, 177]. Third, because the modules are flexible and can be shuffled around, the entrepreneur is confronted with setting priorities in his/her goals, thereby setting up an opportunity to strategically evaluate his/her business plan and alterations to it when working through the modules [175, 176]. The modules also stimulate the entrepreneur to consider the business in a broader setting, where drivers and barriers can be identified and addressed. Consequently, important questions such as *Why has this not been done yet? / Why has this business idea failed in the past?* can be answered [176]. Specifically in relation to its use in developing nations, the framework helps navigate the particularities of the business setting and challenges that are often faced by entrepreneurs in these regions, and help identify opportunities that this unique setting presents [176, 177].

The modules and their additional components help identify and address the common challenge of how to integrate "the effects of potential future changes due to, for example, political upheaval, actions by large power factions, unexpected withdrawal of charitable support, etc." [177]. The framework also reflects the common decisions / contradictions an entrepreneur in such a region is faced with. For example, the contradiction between the concept of frugality and keeping a stock of spare components in anticipation of irregularities in the supply chain [177]. That being said, the framework could be improved by adding some emphasis and tips on how the entrepreneur can build resilience to these circumstances [177]. The additional requirement of completing a financial or sensitivity analysis could help entrepreneurs make their business more resilient to the inherent risks of their region [176, 177]. However, the amount of available and reliable data remains a challenge in such nations. Therefore, it is also understandable that this might not always be possible [176]. To improve data acquisition skills, the framework could add the tip to look at similar nations for data acquisition (e.g. consider Kenyan data for Ethiopian business) [176, 177]. Finally, the SWOT analysis

and derived business strategy and evaluation plan (step 6) should include a short discussion with recommendations on building business resilience (in developing nations) [177].

Furthermore, it is important to must remain aware of the differences between developing nations. The Socio-Cultural Aspects Module presented in chapter 6 was developed specifically with Ethiopian culture in mind. Other nations, although also developing, have their own or similar drivers and barriers which will require emphasis on other aspects [175]. Therefore, the module can be broadened to be applied to any developing nation, or named for its more specific application of Sub-Saharan / Eastern Africa. The framework should also clearly distinguish between the vision (the goal) and mission (how and when) and link the mission to the business strategy and evaluation plan [175]. The framework should also emphasize even more that making businesses in developing nations profitable is best achieved by reducing capital intensity, specifically [175]. Finally, although the idea of the modular framework is good and the steps make it a clear process, many small steps can also be considered complex. The recommendation is to reduce the amount of steps to a maximum of 3 in which the most important components are prioritized [175].

"Highly readable. Very interesting. [The framework] argues for a well-researched, pragmatic and flexible modular approach to address the needs of business entrepreneurs in underdeveloped and developing countries like Ethiopia; starting simply and adding complexity when possible and as needed." [177]

In conclusion, the modular framework is considered a well-researched and pragmatic tool that helps address the needs of entrepreneurs in developing regions [176, 177]. The modules add value to the framework by considering important aspects at various levels and with the prioritized goals in mind, while allowing a broader application of the entire framework through their flexible and exchangeable nature [175, 176]. There are still some points of improvement, but the modular framework has potential. It would be nice to see it applied and used in a real life setting, such as with the introduction of biogas in Ethiopia [176, 177].

8.3. Discussion / Conclusion

Both the author and the review panel were generally positive about the developed modular framework approach, its handling during the application to a real life business idea, and meeting the expectations for its use by entrepreneurs in developing nations. Both also listed points of improvement; several being the same.

Both the author and the review panel note that the current steps should be altered or reduced because many small steps can also make for a complex or even overwhelming tool. At the same time, some points (i.e. the vision, mission, financial overview and strategy development to include building resilience) would benefit from some additional guidance or tips / hints. The key lies in how the tool and information or guidance is presented. A more visual/graphic approach would make the tool more appealing in general.

Furthermore, the author notes that some additional emphasis should be on the usefulness and guidance that a rough financial overview can provide. Similarly, the review panel points out that profitability in developing nations is often directly linked to capital intensity, and that a sensitivity analysis can improve identifying approaches to building business resilience, which should be linked directly to the business' mission and strategy (the *how*).

The modules are considered pragmatic and are appreciated for their flexible nature, but specifically the socio-cultural aspects module should either be broadened for use in any developing nation, which could both reduce and increase its value to a certain extent, or be 're-titled' for its specific application to Sub-Saharan or Eastern Africa. For an in-depth business plan in Ethiopia or other (East-)African country, the latter option is preferred due to its level of detail.

In conclusion, the modular business model framework presented in chapter 6 performs as expected when applied to a real business idea. However, some minor alterations could make the process and framework even clearer and more useful for entrepreneurs using the tool. This additional clarity will optimise the balance between clarity vs. in-depth analysis. and reduce the amount of time necessary to use the tool.

9

Discussion & Recommendation for Future Research

Throughout this thesis project, there are several small discussions. Some of the most important points are re-capped below along with additional insights.

From the review of the various business model frameworks and approaches in chapter 3, the common denominator seems to be the target to establish a 'one-fits-all' type of framework. Such a framework would make it easier to evaluate and compare all businesses based on the same directive. However, the fact that most of the reviewed frameworks are based on the Business Model Canvas (BMC) of A. Osterwalder and Y. Pigneur, suggests that there already is such a framework. This framework will of course, not unlike all other frameworks, be flawed to a certain extent when applied to a specific type of business or goal without proper adaptation. Therefore, it stands to argue that adaptations of the BMC are not irrelevant, but might just need a different format. Instead of developing thousands of very specific business model frameworks, each with their own approach, a modular and flexible form of the already 'one-fits-all' BMC should be considered, which has been attempted in this thesis project. Hereby, no matter what type of business or setting - digital, sustainable, micro, macro, circular, innovative, traditional, in the modern or developing world - the same approach and framework can be used. This is also exactly the comment made by the review panel: the presented modular framework can be applied much broader than is presented in this thesis project.

In elaboration on this, ironically, even though the modular framework is presented as a specific BMF for the setting of developing nations, the developed modular framework of chapter 6 also sub-consciously follows a goal of 'one-fits-all developing nations', despite mentioning that each nation is different and thus there can't be a 'one-fits-all' framework in chapter 3. This realization only happened after receiving feedback on the Socio-Cultural Aspects Module. The feedback was to adjust that module to be more general (i.e. broaden for the application to all developing nations) or more specific (i.e. specific to Ethiopia). In line with the reasoning, the latter option would likely prove most valuable to entrepreneurs in (East) Africa, or Ethiopia specifically. This does not dismiss the modular framework and the Socio-Cultural Aspects Module, as is, for developing nations because there are several coinciding aspects between developing nations. However, it might be beneficial to review these aspects in the context of the local culture and setting, and adapt the module accordingly.

Remaining on the subject of how the modular framework may be perceived, a very experienced entrepreneur may consider the modular business model framework unnecessary and superfluous in its evident idea that the business model must be applied to the setting, type of business, and goals of the entrepreneur. However, for an inexperienced entrepreneur, or a lesser skilled / educated individual, this 'obvious' thought may not be so obvious. Therefore, the modular framework is not redundant and has value to most entrepreneurs with various levels of skill.

Going back to the subject of adjusting the BMF for the context of the local culture, this thesis project was only able to do so in a very tangential way. Ideally, learning about local culture would be done by experiencing the culture for many years so that one would truly understand it. If this is not possible, an extensive survey amongst various groups of locals and foreigners living and working in that nation, as well as amongst experts on that nation might give some insight into the culture of respective country. In this thesis project, the elaboration on the local culture was not done by an extensive survey. It covered 6 nationals working abroad and 3 foreigners working in Ethiopia. The advantage of having open conversations with these individuals about

the culture was that if unclear, they could elaborate on a topic to create deeper understanding of the culture, which a survey would not achieve. However, the parties that were interviewed all had a higher level education, which is not representative for Ethiopia as a nation. In addition, the 6 nationals were all between the age of 20 and ca. 30, which means that their opinions could be proportionally 'progressive' compared to the average in the nation, especially on subjects such as female rights, etc. This is even more the case when considering that several of the interviewees mentioned that older generations were very set in their ways and very rigid in their beliefs. This is not to say that the results from the elaboration on Ethiopian culture are invalid, but the actual 'mean opinion' may be more conservative, making issues like patriarchal hierarchy, other vertical networks, and a lack of respect for equal rights more prevalent in daily life than considered when setting up the criteria and consecutive business model framework. Since the case study is also located in one of the more conservative regions of the nation, perhaps this should have been taken into consideration more strongly.

In the previous chapter, the reflection by the author on the case study indicated that the emphasis on the usefulness of a financial model should be integrated into the developed modular framework. The financial model in the case study was set up based on the client's desire to cover the school's own demand. This was blindly accepted and little discussion followed on how a normal business would usually consider scaling such a business. This might give the reader a false idea on how a business should be scaled. Or, if the reader is more experienced, it might give him/her cause to see this lack of information or displayed knowledge as a reason to question the author's credibility and hence the modular framework. To remedy this, this information - gathered by means of an interview - has been added to appendix E. Additionally, the author's preference to develop a financial model before applying the modules has several implications. Setting up a financial model after the Business Model Canvas is filled in has the benefit that the finances can provide insight into where the largest costs are located and so help the entrepreneur make targeted decisions. Also, when there are hard economic factors that will render the business unprofitable[1], this is important to know before considering various alternatives of the business plan. However, at the same time, following this approach may put boundaries on the entrepreneur's creativity and solution-thinking abilities. The better solution may be to go through the modules in a brain-storm like fashion first, and then go through them again whilst adjusting the financial overview. This option may take more time, but may also deliver better results.

Going back to the Business Model Canvas (BMC), it was chosen for its simplicity and the component of *foresight* was not added to it to 'guarantee' its simplicity. However, the report also argues that the component of *foresight* should be added to any version of the Modular Business Model Framework (MBMF), yet there is not a very clear instruction or step where this needs to happen. With the exchangeable modules, it seems likely that many entrepreneurs will forget to add the component. Therefore, it might actually be wiser to include *foresight* in the BMC and add a clear explanation as to how it is used and what its benefits are. This small adaptation of the BMC is not likely to affect the simplicity of the BMC strongly.

Finally, taking another step back, to step 3: choosing and developing the modules, the text states that the entrepreneur can essentially choose any target or goal to be fulfilled by the modules, including general goals like being the most innovative or a leader in the field. This is a noble sentiment, but materializing these goals via a simple module is a lot more difficult that initially conceived. Some of these goals also link to strategy. Additional research on how to formulate such goals and modules is needed. Additionally, step 3 may be somewhat ambitious for the average entrepreneur. It tells the entrepreneur to develop his/her own modules based on the targets he/she wants to achieve. This is not as easy as it is portrayed. When considering the modules in this thesis project were developed based on extensive research, this is not a task an entrepreneur is waiting to complete additionally. The tool would likely lose its attractiveness. Instead, it is recommendable to have collaborations between practitioners and academia set up a type of library for various modules.

9.1. Recommendations for Future Research

Future research in relation to the Modular Business Model Framework (MBMF) should include the points from the evaluation in this report. For example, steps should be merged, component *foresight* should be tested in the Business Model Canvas (BMC), additional points of guidance should be added for establishing vision, mission, strategy and business resilience, the criteria and their formulation should be reviewed and bundled, and the entire Modular Business Model Framework (MBMF) should be presented in a more appealing and compact way. In addition, the current MBMF for developing nations should be tested in several real

[1] For example, this was almost the case for the bio-digester in the case study of chapter 7 due to the low electricity prices. The large effect of the low electricity prices and subsequent minimal savings on the overall financial overview was not anticipated beforehand. Realizing this before going through various scenarios and options is important.

case studies and adapted based on the user's experience to learn from the current model before moving on. However, after that there are many more areas to expand on.

First, the Modular Business Model Framework (MBMF) has implied that it has been developed for foreigners active in developing nations. Although this was the original aim, the MBMF should also be applicable in its current form for locals starting a business. However, to him/her the Socio-Cultural Module may be less relevant or need other question, such as: *Is the product I am introducing in line with local tradition? Is there support to build this market? etc.*. To be sure that this could work and to test whether large adaptions are needed within the framework or modules, a case study should be completed with a local entrepreneur using this framework. He/She can then provide feedback to an academic analysing and adapting the framework and modules. Because of the cultural differences, this research should likely be completed by someone who knows the culture and its institutions well and can bridge the communication gap to report on this successfully.

In addition, it was mentioned several times already that the MBMF has a broader application than only in developing nations because of the exchangeable modules. However, as discussed under section 9, developing modules requires quite extensive research which is not something an entrepreneur is likely looking forward to spend his/her time on, or even qualified for. Therefore, once the tool has been reviewed and has been tested in various applied case studies - and proven useful - academics should team up with practitioners to create a type of library full of modules that address various wishes and targets. This library should become accessible to entrepreneurs wishing to use the framework and draw inspiration from the modules. Perhaps, as a final test, the MBMF can be used to set up a business model for the library, which would be a fun 'full-circle' moment. However, as mentioned in section 9, some of the more broad-ended targets, such as becoming the best in a specific field, must also be translated into modules. Whether this is even attainable in any form must be explored, as it will require points on strategy to be integrated into a module, for example. Or perhaps, in this library, such a target can be deconstructed into various modules. One may address how to set up a strategy for the BMC more clearly, for example. Another may perhaps teach the entrepreneur how to analyse the competitor's strategy from outside. This is a fun challenge to tackle that will likely require some out-of-the-box thinking.

The application of the MBMF developed in this thesis project is for use by entrepreneurs willing to start a business in developing nations. However, the evaluation and feedback on one of the most topic-specific modules, Module Socio-Cultural Aspects, was not considered broad or detailed enough. It is not broad enough to be applied to all developing nations, but also not quite detailed enough to be considered specifically for the nation or region in question. Ideally, for an entrepreneur going through the list of modules to choose from in the established library, there is a module per country, addressing its specific characteristics. As this would require very extensive and detailed studies to the point that even specific regions could have their own module, it is best to first create modules for bundled regions. For example, with some small adaptations, Module Socio-Cultural Aspects presented in this report could very well become a module for East Africa. Other modules could be developed for South-East Asia, Central Asia, Central America, South America, Southern Africa, etc. However, because the framework should become broadly applicable and usable by any entrepreneur, other nations and regions that are 'developed' should also get modules, as there are different cultural values and institutions in those nations also. In addition, it is easy to forget that there are regions within the United States, Europe, Russia, the Middle East, etc. that are considered 'developed', but still have people living in poverty, with similar characteristics, but different problems than traditional underdeveloped regions. Although these might be small communities or provinces, it could be worth developing modules for these regions separately also, especially since it is sometimes extra hard to understand how they can exist amongst generally high levels of welfare and inclusive economic institutions.

Finally, as an extension of this thesis topic, it would be great to see the case study of this thesis project worked out in full and implemented in real life. To achieve this, the assumptions must be truly validated in the local setting and an Minimum Viable Product (MVP) must be tested within the setting of the school. Further, the various discussed options from the modules must be evaluated based on true price points and actual data and experiences from local users of bio-digesters. In addition, considering the school requires a non-standard bio-digester size, the SNV Ethiopia should be consulted for the various options available to them in terms of construction and knowledgeable labor. Furthermore, anyone wanting to implement this business plan should work on location and build relations with the local partners necessary to run the business. For the first stages, up until working through the various options, this could be an interesting project for a student majoring in entrepreneurship. For the final part, where relationships - and essentially trust - are built, someone more locally involved and more committed to the long-term must be found. If the person

involved plans to leave shortly after start-up, a detailed exit plan must be formulated, as stated by one of the criteria from table 5.1. Unfortunately, due to the combination of the covid-19 pandemic and the civil war in Ethiopia, this final point of future research will likely remain on hold for a while. Nevertheless, it would be very interesting to see a real business with a large impact potential rolled out based on the developed Modular Business Model Framework for developing nations.

10

Conclusion

This chapter summarizes all the major findings, conclusions, and answers the sub- and major research questions. The chapter is concluded with a final list of recommendations for future research. The main research question of this paper is

How can a business model framework for developing nations be designed so that it preemptively addresses commonly faced barriers of businesses in such nations and includes aspects of sustainability and circularity? Does the developed business model framework for developing nations meet expectations when applied to the case study of biogas in Mek'ele, Ethiopia?

To answer this multi-part question, seven sub-questions are formulated to structurally answer the main research question. Below, each sub-question and its specific answer are discussed. By answering all the sub-questions, the main research question should be answered also. Any additional conclusions and recommendations have been integrated.

SQ 1: What sustainable and/or circular business model frameworks exist and are there any that focus specifically on developing nations? An overview of the reviewed business model frameworks has been provided in table 3.1. One business model frameworks was identified as being specific to developing nations, the Frugal Business Model Canvas (FBMC) by G. Perangin Angin. The FBMC is based on the Business Model Canvas (BMC) of A. Osterwalder and Y. Pigneur and has 5 added components. However, the components focus on creating awareness for the economic, environmental, and societal value that is created by the mission for the Bottom of Pyramid (BOP) citizens, and setting up methods to analyse whether this value is truly created, rather than creating value in itself. The framework also does not include aspects of circularity, nor does it include a clear way to address or incorporate local cultural aspects, which has been identified as an important criteria for business models in developing nations.

SQ 2: What are the advantages and limitations of the reviewed business model frameworks? Most of the frameworks and approaches in chapter 3 were reviewed positively in their goals to create value for the triple bottom line (i.e. sustainability) and incorporate aspects of circularity. However, there are two main limitations that were established, specifically in relation to the application in developing nations. The first was that, even though many mentioned that society and culture plays an important role in business success, they failed to incorporate the aspects of society and culture clearly within their frameworks. The second is that most have been identified to be too complex or too time consuming. This seems a common struggle in any adapted form of the Business Model Canvas (BMC) because in contrast, these frameworks are more complex and time consuming than the BMC. However, they also allow for a more in-depth study of the developing business plans, preparing the entrepreneur in more detail. For any developed Business Model Framework, the balance between simplicity & fast and detailed & long needs to be kept in mind. Additional limitations included not considering fore-sight and the effects of the future, and the lack of a clear link to the development of a business strategy. The limitations were translated into criteria under the next sub-section.

SQ 3: Based on the advantages and limitations of the reviewed business model frameworks, what criteria can be established for the design of a business model framework for developing nations that incorporates the principles of sustainability and circularity? A list of 10 criteria is developed for the development of a business model framework that wants to incorporate aspects of sustainability, circularity, or the setting of a developing nation. These criteria have been listed in table 3.2. More specific criteria for the setting of a developing nation are included under SQs 4-6.

SQ 4: What are the drivers and barriers of a business in a developing nation with a foreign partner or owner, such as the National Biogas Programme Ethiopia (NBPE)? The list of discussed drivers and barriers is very extensive. Because there are so many, they have been categorized into technical, political / institutional, economic, social and environmental drivers and barriers, which again are translated into a preliminary set of criteria (see table 4.1). They are preliminary, because they are specific to an Ethiopian business. Some are: that the customer's need or want must be validated before a business is set up, that the delivered product must suit local conditions, that cultural habits should be respected and considered before setting up a business, etc. To be able to generalize for the development of a framework for all developing nations, the drivers, barriers, and criteria from the NBPE are cross-referenced with literature that discusses common drivers and barriers of entrepreneurs with businesses in developing regions of the Global South. Another preliminary list of criteria has been established in table 4.2. This list is only comprised of 5 main criteria / categories, with various sub-criteria.

SQ 5: How do the drivers and barriers from the NBPE differ or coincide with those found in literature from similar initiatives in developing nations? The drivers and barriers for the literature on general entrepreneurship in developing nations overlap significantly with those established during the analysis of the National Biogas Programme Ethiopia (NBPE), although there are less of them. The sub-criteria of table 4.2 are almost perfectly in line with criteria found in table 4.1. This means that almost all of the barriers determined in the more general literature, can also be found in the NBPE.

SQ 6: What criteria can be derived from the coinciding drivers and barriers for the design of a business model framework for developing nations? The final list of criteria has been established by cross-referencing table 4.1 and table 4.2 to determine the criteria for the common barriers and drivers, as well as integrating the criteria from the business model frameworks and approaches to allow for the integration of sustainability and circularity aspects. The final list of criteria is listed in table 5.1 in chapter 5. However, within this table, overlapping criteria from the elaboration on culture in section 4.3 (SQ 7) have been noted. Examples of these overlapping criteria include providing equal treatment and holding all equally accountable, establishing a clear hiring policy, integrating employees in the company's strategy to help understand its goals, etc.

SQ 7: To what extent does culture play a role in the success or failure of such initiatives? As was mentioned in SQ 2 and mentioned as a criteria in table 5.1, integrating cultural aspects in ones business in a developing nation is essential. The interviews conducted with the 9 interviewees showed that culture and cultural differences do influence business in developing nations. In Ethiopia, on which the elaboration was completed, even regional differences can become clear in the work-place, making open communication difficult at times. In addition, there are issues with time-management and commitment, when referenced to a 'Western' standard, or even corruption. These effects can be so severe, that they strongly influence the business to the point where it may fail. The cultural aspects included in table 4.3.4 are used during the business model framework development for the more detailed development of the Socio-Cultural Aspects module (see SQ 8).

SQ 8: How does a business model framework for developing nations look based on the established criteria? The developed business model framework follows a modular approach. To meet the criteria of being a clear and non-complex, yet detailed framework, it has been developed, in essence, as both an approach and framework. It follows an approach of starting with a strong base and moving from a broad picture to various layers of complexity. The layers are represented by modules that reflect the entrepreneur's goals (i.e. Frugality - in relation to the setting of a developing nation, Sustainability, Circularity, and Socio-Cultural Aspects). The order of the modules reflect the entrepreneur's priorities. The modular framework is composed of 6 steps. The six steps are: 1) Define the Vision, Mission and Assumptions, 2) Set up an Assumption Validation Strategy, 3) Define the Applicable Modules, 4) Fill in the Business Model Canvas by A. Osterwalder and Y. Pigneur, 5)

Apply the Modules to the Business Model Canvas, 6) Complete a SWOT Analysis for a Business Strategy and Evaluation Plan. The advantages of this approach are that many entrepreneurs are familiar with the BMC which is easy to understand, even for inexperienced entrepreneurs, allowing any level of skill. The steps and order of modules based on priority offer additional guidance through the process. In addition, any module can be removed and others can be added (when developed) to cater to the entrepreneur's specific needs. Also, the entrepreneur is in complete control over the level of detail he wishes to achieve. The framework works for both a brain-storm approach, as well as detailed business model planning. Due to the flexibility of the modules, this framework can also be adapted for any other type of business or setting.

SQ 9: Case Study: Biogas in Mek'ele, Ethiopia - How does biogas, as a sustainable and circular energy technology, represent an opportunity for development in Ethiopia? To answer this question, the technology of biogas produced in bio-digesters was discussed in relation to the Millennium Development Goals (MDGs) because the NBPE was set up based on these goals. The goals represent 8 areas in which poverty can be alleviated. The areas include reducing hunger, poverty and child mortality, and stimulating gender equality and female empowerment, education, improved health, environmental sustainability, and global partnerships. In both direct and indirect paths, all eight Millennium Development Goals are catered to. This analysis reinforces why sustainability and circularity aspects are important to include in a business model framework for developing nations; they stimulate national development.

SQ 10: Case Study: Biogas in Mek'ele, Ethiopia - How does the business model for the introduction of biogas at the Nicolas Robinson School in Mek'ele, Ethiopia look when based on the developed business model framework for developing nations? The business model for biogas at the Nicolas Robinson School (NRS) was scaled based on self-sufficiency, based on the wish of the founders of the school, who take the role as client. The business model uses cow manure from surrounding farmers and mixes it with water to load the bio-digester. The produced biogas is used by the school kitchens, catering both to the student food program and the staff café. The by-product of bio-slurry is used on the cultivated land of the agricultural department of the Nicolas College. The rest is sold to farmers at a price lower than the cow dung is purchased to create incentive. Since the scaling is based on a school week of consumption, and scaling production is difficult in a bio-digester (e.g. can cause blockages), there is overproduction during vacation weeks. This over-produced gas allows for additional revenue-generating activities, which are necessary to make the business profitable. Because there is both transport of manure and bio-slurry required, transportation and distribution costs are disproportionately high. Renting a driver and cart is not an option if the project is to break-even or make a profit. Transportation costs must be internalized. To minimize dependence on others via a bio-slurry pick-up station, for example, a cart and donkey are included in the capital costs; maintenance and feed are added to the operational costs. This allows the business model to become profitable. Throughout the modules, many more scenarios and options are discussed and should be considered before implementing them in real life. Options where the biogas is transformed into electricity is not attractive due to the increased amount of biogas required and the low (state subsidized) price of electricity.

SQ 11: Does the developed business model framework for developing nations deliver on its promises to preemptively address commonly faced barriers in developing nations and include aspects of sustainability and circularity, and does it meet the expectation of experts? Both the author and the review panel would agree. The author, as an inexperienced entrepreneur, finds the level of guidance in the framework adequate and helpful. The review panel finds that the amount of steps could be decreased, thus also reducing the effect of overwhelm when first approaching the modular framework, but agrees that the guidance provided by the model is beneficial. Both the author and the review panel also agree that the modular framework allows for a well thought-out business plan that incorporates both the local setting, as well as sustainable and circular aspects and can preemptively address commonly-faced challenges of entrepreneurs in developing nations, as well as challenges that the future in such nations pose. The review panel also highlights the potential for the framework's broader potential than just for developing nations due to its modular framework. Of course the framework is still new and requires testing in 'real life'. Before this is done, the framework should be made more appealing through the use of better graphics and survey / guide boxes, for example. In addition, the review panel would like to see a stronger emphasis on business resilience and some additional tips on data acquisition in such nations. Furthermore, some small adjustments in the the steps (integrate step 3 with step 5) are suggested, as well as some additional emphasis on creating a financial overview of the business idea after filling in the Business Model Canvas. Finally, the module of Socio-Cultural Aspects should be adjusted

slightly since it is fairly specific to (East) Africa. It should therefore either be broadened to be applicable in any developing nation, or made more specific and labeled accordingly.

All in all, the modular framework developed in chapter 6 allows commonly-faced barriers by entrepreneurs in developing nations to be addressed preemptively, while also incorporating aspects of sustainability and circularity that inherently allow for development in such nations. In addition, due to the modular approach, the entrepreneur is not limited to the modules developed in this thesis project (i.e. modules Sustainability, Frugality, Circularity and Socio-Cultural Aspects). New modules can be developed and applied, allowing the framework to be applied broader than presented in this thesis project. Furthermore, the modules allow the entrepreneur to establish his/her priorities which helps in making decisions and trade-offs. In addition, the entrepreneur is in control of how detailed the modules are applied. Although there are some points of improvement for the modular framework, it is a well-argued concept with a large potential to serve almost any entrepreneur.

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A

Interview Protocol

This appendix summarizes the types of interviews conducted and the overall approach to the interviews.

Throughout this thesis project, interviews have been a common medium to acquire data or non-literary knowledge unknown to the author. The interviews that were conducted can be categorized into four types of interview topics: local background on Mek'ele, Ethiopia, determination of socio-cultural differences, determination of the effect of socio-cultural differences on conducting business, and insights and verification of the business model. The various interviewees and the questions they were asked are located in the appendices B, C and D. The 'review panel' from chapter 8 can be found in section 8.2. The interviews are semi-structured to allow for follow-up questions for further insight, to clarify, and to go into new or more detailed topics if necessary. If the party felt more comfortable writing his / her answers in the questionnaire, this was allowed, although not preferred.

Guidelines

- Send questions ahead of time for the interviewee to understand the topics that will be discussed.
- Ask for permission to record interviews.
- Introduce yourself and the thesis topic.
- Ask for permission to quote the interviewees name and answers within the report.
- Ask for the interviewee to introduce himself.
- Apply some small talk to establish a comfortable setting.
- Walk through the questions and allow for open conversation and elaboration on topics (semi-structured interviews).
- Try to keep the interview within an hour.
- Thank the interviewee for his/her time and contribution.
- Send final report to interviewee with another thank you note.

Approach: The questions for the interviews can be found in the following appendices. They were set up in the following way.

- Set up topic list
- Set up questions based on findings in literature
- Set up a list of interviewees
- Approach interviewee candidate (set up date)
- Follow the guidelines during the interview

Exceptions

- The review panel did not have specific questions. They were asked to evaluate the modular framework based on the targets it aimed to meet and their experience as experts in functionality and potential.
- The conversations with Kathryn and Max Robinson were often open-ended with a combination of set pre-determined questions and open conversation. The pre-determined questions were often for specific information and not for qualitative assessment of a component of the thesis. They have not been included in the thesis report.
- The final unstructured interview / personal communication with P. Platteeuw about scaling a commodity business was an open conversation based on one question: In short, how can you scale a commodity business; specifically a bio-digester that produces biogas and bio-slurry?

B

Additional (Local) Background Information

B.1. List of Topics and Contacted Parties

With 'local', we understand 'Mek'ele, Ethiopia'.

Topic	Name of Contact	Role	Date
Working with local population	Kathryn Robinson Max Robinson Ton van Kampen	Co-founder NRS Co-founder NRS International Business Development Professional - Fontys Hogescholen	10/07/2020 10/07/2020 11/08/2020
Entrepreneurship training	Ton van Kampen	International Business Development Professional - Fontys Hogescholen	11/08/2020
Biogas projects Africa	Carol*	Volunteer at Ulwazi Fefe Home Caring	31/08/2020
Local cooking methods survey	Tekleweyni* Shewit*	Teacher at NRS Teacher at NRS	27/09/2020 21/08/2020
Biogas user	Tekleab*	Biology teacher at NRS	13/10/2020 **
Local cattle & dairy farmers	Kunom Hailu Tesfay Tsegazeab* Desta*	PUM Representative Tigray MU sector Agriculture & Nutrition MU sector Agriculture & Nutrition	05/11/2020 ** 05/11/2020 ** 05/11/2020 **
Local poultry farmers	Kunom Hailu Tesfay Tsegazeab*	PUM Representative Tigray MU sector Agriculture & Nutrition	05/11/2020 ** 05/11/2020 **
Local crop farmers	Kunom Hailu Tesfay Mesfin*	PUM Representative Tigray MU sector Agriculture & Nutrition	05/11/2020 ** 05/11/2020 **
Biogas production	Kunom Hailu Tesfay Desta*	PUM Representative Tigray MU sector Agriculture & Nutrition	05/11/2020 ** 05/11/2020 **
Local slaughterhouses	Kunom Hailu Tesfay Teweld*	PUM Representative Tigray MU sector Agriculture & Nutrition	05/11/2020 ** 05/11/2020 **

Table B.1: List of topics for local (Mek'ele, Ethiopia) information with list of contacts. NRS = Rainbows4Children Nicolas Robinson School Mek'ele, Ethiopia. *Last names have been omitted for privacy reasons. **Answers not received due to delay and/or Tigray crisis.

B.2. Local Cooking Methods Survey Questions and Answers

Some definitions:

- Fuel: cow dung, wood, charcoal, kerosene, biogas, electricity, etc.
- Waste from fuel: ashes, fuel canisters, etc.

- Waste from cooking: parts of the food that are not used for eating. For example: the peels of fruit or leaves from vegetables, etc.
- Waste from coffee: the wet grinded coffee beans at the bottom of the coffee pot

Additional instructions:

- If a certain question is not applicable (for example: if the restaurant you have picked does not serve coffee, you can write 'n/a' for the sub-question about the waste from coffee).
- If you cannot find the answer to a certain question, you can write '—'.

Questions about Cooking:

1. Do you cook yourself?
   (a) If YES:
      i. What type of fuel (cow dung, wood, charcoal, kerosene, biogas, electricity, etc.) do you use for cooking?
      ii. How much fuel do you use in a week? (an estimated average is fine)
      iii. Where do you buy or get the fuel?
      iv. How much does it cost?
      v. How much time does it take to prepare a normal dinner? (an estimated average is fine)
      vi. Do you have any waste from the fuel? (for example: ashes) If yes, what do you do with it?
      vii. What do you do with the waste from cooking (vegetable leaves / fruit peels)?
      viii. When you make coffee, what do you do with the waste from coffee (used and wet grinded beans)?
   (b) If NO:
      i. Where do you get your food?
      ii. What type of fuel do they use for cooking?
      iii. What do they do with waste from fuel, cooking, and making coffee? (you may need to go ask them)
2. How does your family cook?
   (a) What type of fuel do they use?
   (b) How much fuel do they use in a week? (an estimated average is fine)
   (c) Where can they buy or get the fuel?
   (d) How much does the fuel cost?
   (e) How much time does it take to prepare a normal dinner? (an estimated average is fine)
   (f) Do they have any waste from the fuel? If yes, what do they do with it?
   (g) There are some ashes and they are put to the garbage disposal
   (h) What do they do with the waste from cooking?
   (i) What do they do with waste from coffee?
3. Do you have a favorite restaurant? (for these questions you may need to ask someone who works there)
   (a) What type of food do they serve?
   (b) What fuel do they use to cook?
   (c) Where do they get it or buy it?
   (d) Do they have any waste from the fuel? If yes, what do they do with it?
   (e) What do they do with the waste from cooking?
   (f) What do they do with waste from coffee?

4. Cooking at school:
   (a) For how many people do they cook?
   (b) What type of fuel do they use?
   (c) How much fuel do they use in a week? (an estimated average is fine)
   (d) Where can they buy or get the fuel?
   (e) How much does the fuel cost?
   (f) How much time does it take to prepare lunch? (an estimated average is fine)
   (g) Do they have any waste from the fuel? If yes, what do they do with it?
   (h) What do they do with the waste from cooking?
   (i) What do they do with waste from coffee?

Questions about Biogas: (If you do not know the answer to these questions, you might need to ask friends, family and staff and teachers at the Nicolas Robinson School).

1. Do you know anyone who uses cow dung as a fuel?
2. Do you know anyone who uses biogas to cook?
3. Do you know a cattle farmer?
4. Do you know anyone with a with a biogas digester? (if you do not know what a biogas digester is, let me know)

Questions about Sewage and Waste Disposal: (If the answers to this are complex or difficult, we can also schedule a skype call or you can text message me)

1. Do you know where all the garbage/waste goes to in Mekelle?
2. Do you know how sewage is disposed of in Mekelle?
3. What type of sanitation (toilet/bathroom) do you have and use and where does the used water and waste from toilets go?
4. Have you heard of recycling and is it used/done in Mekelle?
5. Do you know where slaughterhouses bring their waste?

B.3. Biogas User

Questions to ask if the biogas installation is not his/her property: Q1 – Q5, Q15, Q17.
Questions to ask if the biogas installation is his/her property: Q1 – Q17.

1. How is the biogas used? / For what purposes? (for example cooking, heating, production within a firm, etc.)
2. How much biogas is used per week / month?
3. If the biogas is used for cooking, is this the only type of fuel he/she uses for cooking?
4. If the biogas is used for cooking, what type of stove is used? Can injera be made here?
5. Is the biogas produced by the user or is it produced elsewhere? If elsewhere, where?
6. What equipment is used to produce the biogas? (for example a mono-fertilizer, a biodigester, a gasifier, etc.)
7. How much biogas is produced per week?
8. What resource is used to produce the biogas? (for example dung, compost, coffee grinds, etc.)
9. How much of the resource is needed per week? (If he knows how much resource is needed to produce $1 m^3$ of biogas, that is fine also)

10. Is water required to create the biogas? How much per day/week/month?
11. How much time does it take to keep the biogas installation running?
12. How often does the installation need to be fed resources?
13. How important is it that the feed is consistent and regularly added to the installation?
14. Does he spend any time on maintenance? If yes, how much time?
15. Is the biogas stored in containers or directly fed through a pipeline?
16. What does he/she do with the bio-slurry / residue that is left over?
17. Does he/she know of other producers in the region?

C

Socio-Cultural Differences Interviews

C.1. Name of Interviewees & Date of Interview

Interviewee #	Home Town	Current Studies/Employment	Date
1 [105]	Addis Ababa, Addis Ababa, Ethiopia	PDEng TU Eindhoven NL	28/9/2020
2 [106]	Eritrea (pre-independence)	PDEng TU Eindhoven NL	29/9/2020
3 [38]	Bahir Dar, Amhara, Ethiopia	PDEng TU Eindhoven NL	29/9/2020
4 [107]	Bala, Tigray, Ethiopia	PDEng TU Eindhoven NL	2/10/2020
5 [103]	Harar, Harari, Ethiopia	Doctoral Candidate TU Delft NL	2/10/2020
6 [102]	Mek'ele, Tigray, Ethiopia	Macalaster College USA	19/10/2020
7 [77]	The Netherlands	International Business Development Professional at Fontys Hogescholen	11/08/2020

Table C.1: List of interviewees, origin, employment / studies and interview date for Socio-Cultural Differences Interviews. The names of the interviewees are known to the author and have been withheld from this document for privacy reasons. For further information, please contact the author.

Interviewee #7, Ton van Kampen, who organized the entrepreneurship training in Mek'ele, was contacted at the very start of this thesis project where he discussed some insights he gained while working in Ethiopia. The list of questions below was not used during that conversation although similar topics were discussed. His insights have been included in the text.

C.2. List of Questions:

Most questions have various formulations and/or follow-up questions. Some of the questions have been bundled and are meant as questions during conversation pieces. The questions are phrased for a European setting, but have been adjusted to address the United States of America for the interview with Feven.

About you and your background:

1. Where did you grow up? / Where are you from? / What was your upbringing like?
2. Where did you go to school and what is your educational background (primary school, high school, university, etc.)?
3. What would you consider general strengths of the Ethiopian people?
4. What would you consider general weaknesses of Ethiopian people?
5. What would you consider benefits of working with Ethiopians?
6. What would you consider disadvantages of working with Ethiopians?
7. Do you know of any large cultural differences between the different regions of Ethiopia (like tribes in other African countries)?

8. Do you have any working experience in Ethiopia? If so, what did you enjoy and what did you dislike in the working environment?

Going abroad:

1. How did you come to do the PdEng in Eindhoven? (Did someone refer you or did you find it yourself?)
2. When was the first time you came in contact with / lived in America or Europe?
3. What were your expectations in terms of what it would look like and what the people would be like before coming here? (e.g. some believe what they see on film (mansions, shopping streets, etc.) is a fantasy and unreal and are surprised to find it exists. Others believe that all houses in Europe and the USA are large and spacy and modern, but are shocked to find that many cities have mainly smaller and older buildings.)
4. What was your first impression of the locals / people / the social environment?
5. What were the biggest cultural differences you noticed?
6. What was the most difficult adjustment for you, coming to Europe?
7. Were there things you would have wished to know beforehand?
8. What would you consider positive social aspects in Europe / the Netherlands?
9. What would you consider negative social aspects in Europe / the Netherlands?
10. How do you experience familial bonds in the Netherlands? How does that differ to where you're from?
11. What would you consider benefits of working with Europeans?
12. What would you consider disadvantages of working with Europeans?
13. Do you have any working experience (with companies) in Europe? If so, what did you enjoy and what did you dislike in the working environment?
14. Have you experienced a difference in education level? If yes, how has this been for you? How would you suggest to improve education in Ethiopia?

Working in Europe / the Netherlands: more specific questions

1. During your stay here, have you ever noticed that there were expectations of you that you had not expected or that you were not used to? If so, what were they, how did you deal with them, and has your opinion changed?
2. **Time Management:** The Dutch are very time-oriented. For work, as well as in their personal lives. (e.g. you are expected to be on time. If you are delayed, you are expected to notify the person you are meeting. Deadlines are strict. Meeting up, even with friends, goes by time and date and may be planned a week or more in advance). How have you experienced this? / How does it differ from what you are used to back home? Have you considered this to be a challenge and how have you dealt with it? Or do you prefer this to how it is back home?
3. **Agreements:** The Dutch also work based on agreement. If you agree to a certain task (with or without time frame), you are expected to deliver without being reminded, as agreed upon. The agreement does not change unless you contact the relevant person and agree upon something new. Is this different to what you are used to and how has it affected you here?
4. **Anonymous Trust:** In Europe and America, businesses and collaborations work based on 'anonymous trust'. This means that business is done between two people, even if they do not know each other personally. The trust between the two is based on the trust that the establishment they work for will ensure that they live up to the agreement. Have you encountered this during your stay here (or perhaps during your application)? Is it different to what you are used to? How has it affected you? Do you value this approach / how does it make you feel? Would you prefer another approach (e.g. more face to face business)?
5. **Equal Rights / Gender Discrimination:** Women and men in Europe have 'equal rights'. This is not the case yet in Ethiopia. Do you agree with that statement? If so: In what way is it represented/noticed in daily life in Ethiopia? Has the concept of 'equal rights' affected / influenced you during your stay here?

If so, how? Do you agree women should have equal rights? How would you suggest creating them in Ethiopia?

6. **Hierarchical Structures:** Within Europe, hierarchy exists in different degrees. In the Netherlands, it is very hidden and often there is an 'open door' culture. Anyone can approach anyone. You always know who is 'ranked higher', but no one will act on their 'rank' unless necessary due to responsibilities within a company, for example. How is this different to Ethiopia? How have you experienced this in Europe and what is your opinion on this? Would you consider this a strength or weakness of Europe?
7. **Horizontal and Vertical Networks:** In Ethiopia, social ties are strong. In literature, you can find descriptions of horizontal (community) networks and vertical (insurance) networks. Would you agree that horizontal networks are strong and are the basis for trust? Would you agree that horizontal networks act as a social safety net if you would ever need it? Have you ever experienced someone making use of such a horizontal network? The vertical networks are for insurance and can help certain individuals 'climb' the ladder or get certain positions that they might not be qualified for. They may also help avoid corrupt 'fines' for business men, for example. Have you ever experienced / encountered / heard of a situation like this in Ethiopia? Would you consider horizontal networks a strength or a weakness of Ethiopia? Would you consider vertical networks a strength or a weakness of Ethiopia?
8. Have your impressions of Europe / the Netherlands changed with time?

About the National Biogas Programme Ethiopia

1. Do you know of the National Biogas Program in Ethiopia?
2. Do you know anyone who has been involved with this program?
3. Do you know why it was not a success as planned? / Do you have any ideas?
4. Do know any cattle or dairy farmers?
5. How do I approach / get into contact with a farmer?
6. Do you have any contact information that you could share?

Garbage and Sewage

1. Do you know how and where garbage was disposed of in your community / city?
2. Do you know how and where sewage was disposed of in your community / city?

D

Doing Business in Ethiopia Interviews

D.1. List of Interviewees

Interviewee #	Interviewee Name & Nationality	Role	Date
8 [117]	Kathryn Robinson (British) in name of Tesfagabir Tamru Meresa (Ethiopian) (contact via Kathryn due to Tigray crisis)	General Manager, Nicolas Robinson Schools and College	18/11/2020
9 [90]	Saroj Rai (Nepalese)	Energy Sector Leader at SNV Netherlands Development Organization	1/12/2020
10 [118]	Messele Kada (Ethiopian)	Renewable Energy Advisor at SNV Netherlands Development Organization	4/12/2020

Table D.1: List of interviewees per case study and date of interview.

Because of the conflict in Tigray, Mr. Meresa was not able to communicate directly. As he and Kathryn Robinson work together on an almost daily basis, she tried as best she could to describe how he handles the daily affairs at the school. At SNV Ethiopia, Mr. Kada offered to partake in the interview via email, limiting the extent of additional explanations or insights beyond the direct answers. The conversation with Mr. Rai, however, was long and extensive and provided many valuable and additional insights. Each of the topics included several questions to allow the topic to be approached from various angles, depending on how the conversation is going. In addition, within these topics / talking points, additional points were indirectly addressed, such as on what basis employees are hired (merit or through connection), what the employees prioritize and value, how independent and / or entrepreneurial the employees are, how much room there is to be entrepreneurial in relation to leadership style (supportive or authoritarian leadership) and what the observed effects have been. The result can help plan and prepare for future business plans in these regions. However, because the list of questions was long, not all questions applied to all interviewees, and some topics were discussed more elaborately than others, there is not always (an extensive) overlap in all topics. This means that the results can provide an indication of how you can approach business. It is not to say it will worked guaranteed. For that, this study is too small.

D.2. List of Questions

Background

1. Please quickly explain your involvement and role at the Nicolas Robinson School (Interview #8) // during NBPE-I, NBPE-II, and/or NBPE+ (Interview #9 & 10).

Institutional / Finance

1. How can one obtain funds for projects such as your own? / Where did you get the funds to start this project?
2. *(extra question case study 1)* Would the school be able to apply for funds like an individual farmer partaking in the NBPE?

Leadership skills

1. What leadership skills / styles do you find work most effective in your work? / How would you describe your leadership style? *
2. What career steps have led to your current position / how did you end up in this job?
3. Is it important to you that your employees work and complete tasks on schedule? / Do you ever need to intervene to ensure a deadline is met? How do you do this?
4. Have you ever noticed tension between workers that are not purely based on personality? Has this ever led to conflict? How did you handle it? What were the results?
5. Do your employees have a precise working discipline or do they need regular reminding and supervision of tasks that are time-sensitive (e.g. refilling of the bio-digester, proper water:dung ratio, maintenance tasks, cleaning tasks, safety procedures, or other tasks that require precise working discipline)?
6. Do you ever feel the need to motivate your employees / co-workers? How do you do this?
7. What is important to your employees? What are reasons for them to stay with your company? What could motivate them to stay longer? What could motivate them to leave?
8. Have you ever used a performance or target-based bonus structure to improve loyalty and incentive? What were the results?
9. How do you determine who to hire? What is their social / educational background?
10. How are your employees paid? (daily, weekly, monthly, etc.)
11. How do you make sure you can trust the workers you selected and that they will perform on the job (e.g. follow orders, be respectful to authority, complete their work goals)? (Are they family members? From the same village? From the same tribe?)
12. Do you have to train new employees? In what areas and how?

*Leadership style background information: "A leadership style refers to a leader's characteristic behaviors when directing, motivating, guiding, and managing groups of people. Great leaders can inspire political movements and social change. They can also motivate others to perform, create, and innovate. ... Leadership styles are classifications of how a person behaves while leading a group. Lewyn's leadership styles are authoritarian (autocratic), participative (democratic), and delegative (laissez-faire)." [178]

Operational / Commitment

1. Do you / your employees / your co-workers ever struggle to gather enough resources for production?
2. Can your employees / co-workers operate the bio-digester on their own over a longer period of time (e.g. month) without your intervention? / Do they need you to operate the bio-digester? / If you transfer the handling of the biogas installation to them, do you have to check them?
3. Tell me about a time when something went wrong during operation. What happened and how did your employees / co-workers address/solve the problem?
4. How often do you require maintenance to be done at your work? Is this scheduled beforehand or done when considered necessary? Who makes this decision?
5. What needs to be maintained?
6. Who is in charge of organizing the maintenance?
7. Who executes the maintenance (internal or external workers)and how?
8. In case of external: Is it difficult to hire someone that can do maintenance?

9. In case of external: Is it expensive to hire someone to come do maintenance?
10. What would you consider the largest inefficiencies in your job? / If you could improve / change anything, what would it be and why? (e.g. technical measure, material availability or management structure)
11. In your opinion, are your employees / co-workers always hired based on their skills and value to the company?
12. Do your employees / co-workers use an agenda or calendar to plan their work?

Entrepreneurial Mindset / Drive

1. Do your employees express their opinion or come up with their own ideas and solutions? / Tell me about a time when an employee / co-worker showed entrepreneurial skills (e.g. came up with idea and made it his task).
2. Do your employees / co-workers let you know directly when something goes wrong? How do they approach the problem?
3. When something goes wrong, do they have the authority to solve the problem or do they need to work through their supervisor(s)?
4. Would some of your co-workers / employees like to start their own business?

Adaptability / Growth Potential

1. Tell me how your employees / co-workers reacted to the introduction of a new working process, method, or piece of technology.
2. Have your employees / co-workers ever proposed using a new / different method? What was it and why? How did you react? What were the results?
3. Do your employees have the opportunity to further develop their skills (e.g. reading, writing, welding, finance, etc.)? Do they make use of them? / Do your employees want to learn more?

Prioritization / Commitment

1. Where do think that the priorities of your employees / co-workers lie?
2. When given the choice, do your employees / co-workers go home, or will they stay and finish a task that is important? What about you?
3. How often do you struggle with tardiness at work / in your team? (e.g. late arrival at work, deadlines missed or non-complete). If so, what are the reasons for tardiness? If not, is there anything you do to prevent this?

Collaboration

1. How do you, your employees / co-workers react to the arrival of a new employee or team member?
2. Do you trust your co-workers? Why / why not? / How do you make sure you can trust your co-workers? (Are they family members? From the same village? From the same tribe?)
3. Are your employees / co-workers keen on sharing knowledge and their experiences? How do they show this? Or in what way do they share knowledge?
4. Would you consider your workplace to have hierarchical structures? If so, on what basis do they rest / why have they formed?
5. Would you consider your work place to be inclusive and give each employee equal rights and opportunities?

E

Interview Results - How to Scale a Commodity Business

The business model in chapter 7.7.1 has been scaled based on the desire to cover own demand at the school. However, is this normally the case? The question asked is: For an average business, should the bio-digester be sized on the goal of self-sufficiency, or based on the cost structure elements?

Consulting an experienced businessman, the advice is as follows: Being self-sufficient has the benefit that you have no or limited interaction with supply and demand or any price fluctuations. However, it limits the options of making the business profitable and reduces incentives to optimize production, which usually means that it is a bad project [28]. Also, since there are two products, biogas and bio-slurry, it is unlikely that both will satisfy your own demand exactly, meaning that you will interact with the market anyway, either through additional purchases or sales of your excess product. If this is managed correctly and intentionally, this can be a benefit [28]. Generally, there are a couple of rules of thumb that should be considered for a commodity business. First, in terms of scaling, if the business' return on capital is low, it is best to install short (too little product) and buy the increment in the market so that the market carries part of the otherwise additional capital costs. If your return on capital is good, however, it is better to always be a bit long (ahead of demand) [28]. Additionally, with a commodity, because margins are low, it is best to have two outlets to generate income, especially if storage of one (here: biogas) is more expensive than the transfer to another (here: biogas to electricity via a generator) [28]. This means for example that it can be more profitable / less costly to under-size your bio-digester and buy additional product on the market. Or, for example, to sell all your organic bio-slurry on the market and buy 'cheaper' chemical fertilizer instead, if that is the case, and so cover the capital expenditures [28]. However, even if you do size for the self-sufficiency of the school, it can be useful to consider seasonal price fluctuations of fertilizer and store organic fertilizer and buy chemical fertilizer when fertilizer prices are low, and when demand for fertilizer drives prices up, sell what you have / don't need on the market [28]. The same and similar reasoning can be used for the production of biogas and/or electricity via a back-up generator. However, if electricity is subsidized, like it is in Ethiopia, trading in electricity will likely never be attractive or profitable as a business.

All these options can increase the affordability of the business, but it also increases the complexity because of the interaction with the market and its trends. Considering the statement that the skills of the labor should not be overestimated [42], decisions need to be made wisely and based on the known level of skill of the work force. Therefore, in developing nations, the simplest option may be the best, although the motto of "work smart, not hard", as discussed in table 3.2, also still applies.

F

The Modular Business Model Framework Modules

On the next four pages, the four modules developed for the Modular Business Model Framework (MBMF) for developing nations in this thesis are depicted enlarged.

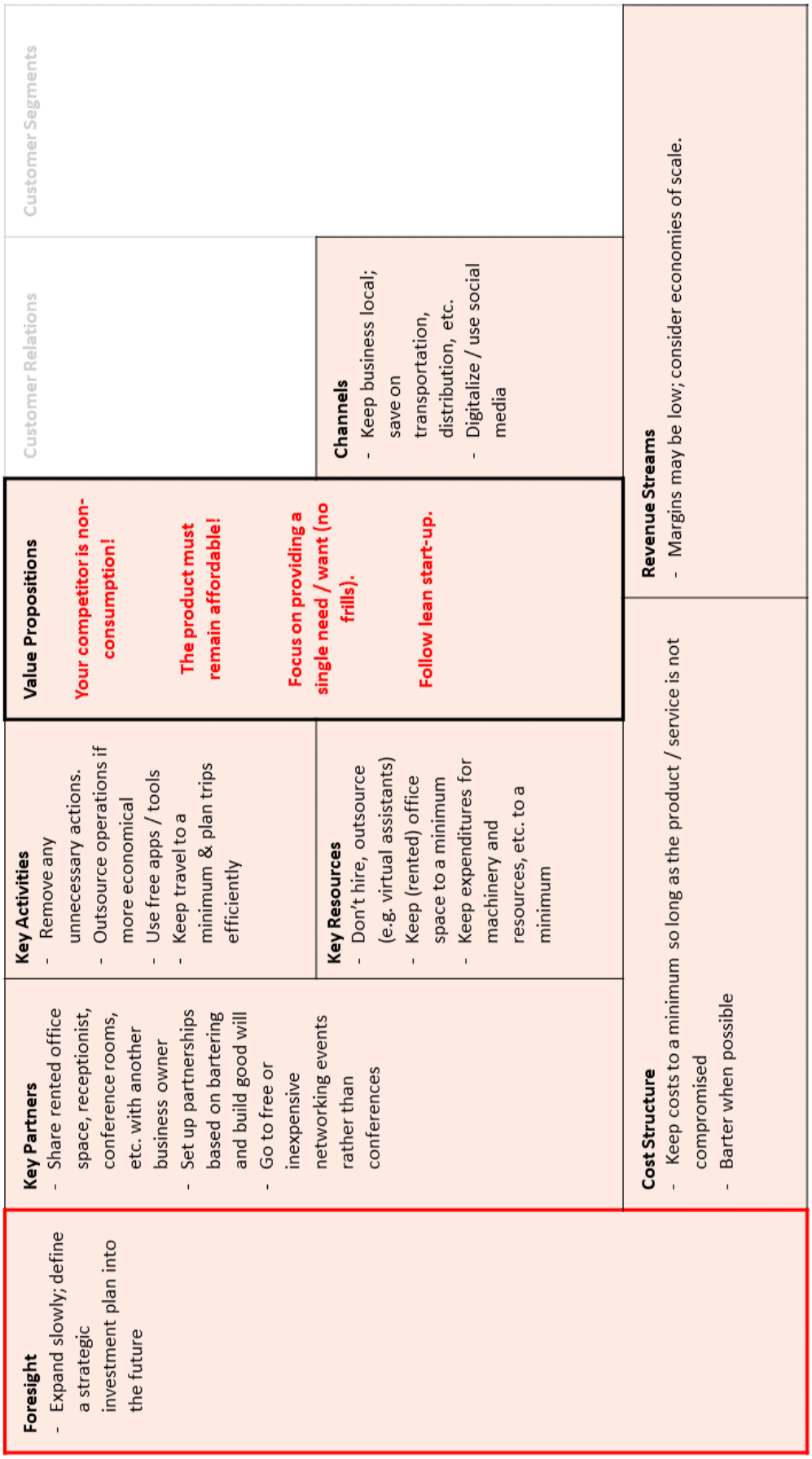

Figure F.1: Module Frugality of the Modular Business Model Framework (MBMF).

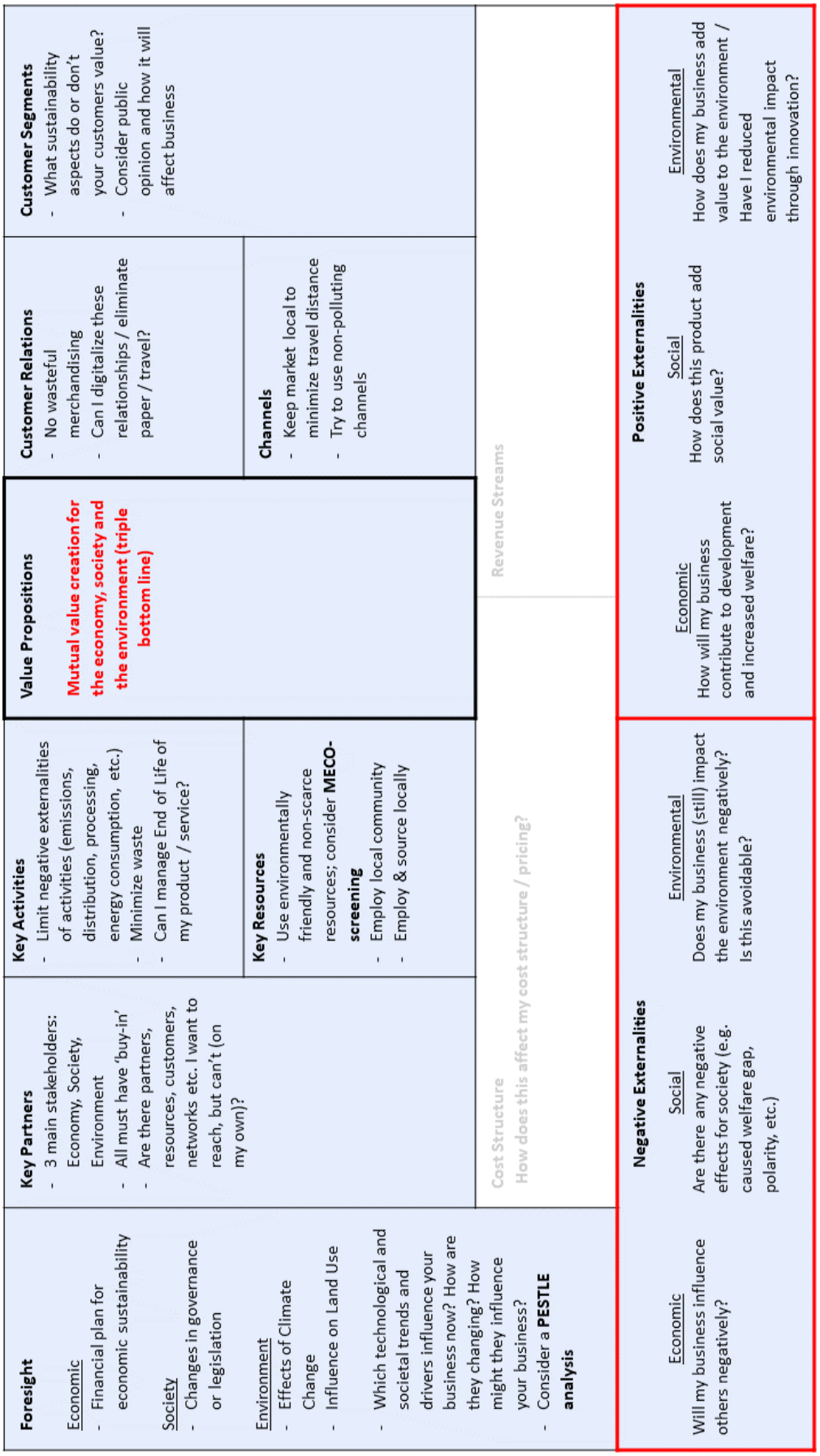

Figure F.2: Module Sustainability of the Modular Business Model Framework (MBMF).

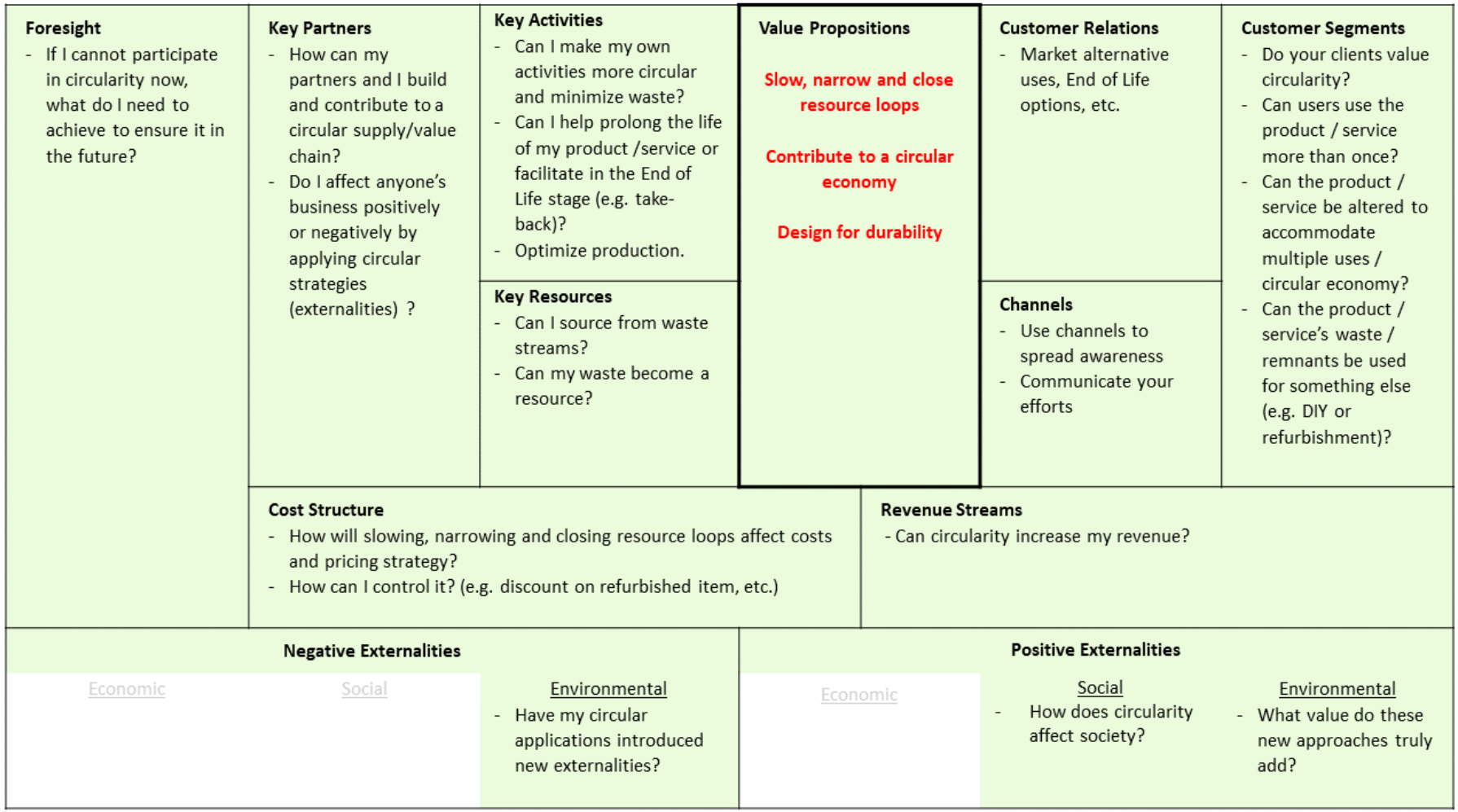

Figure E3: Module Circularity of the Modular Business Model Framework (MBMF).

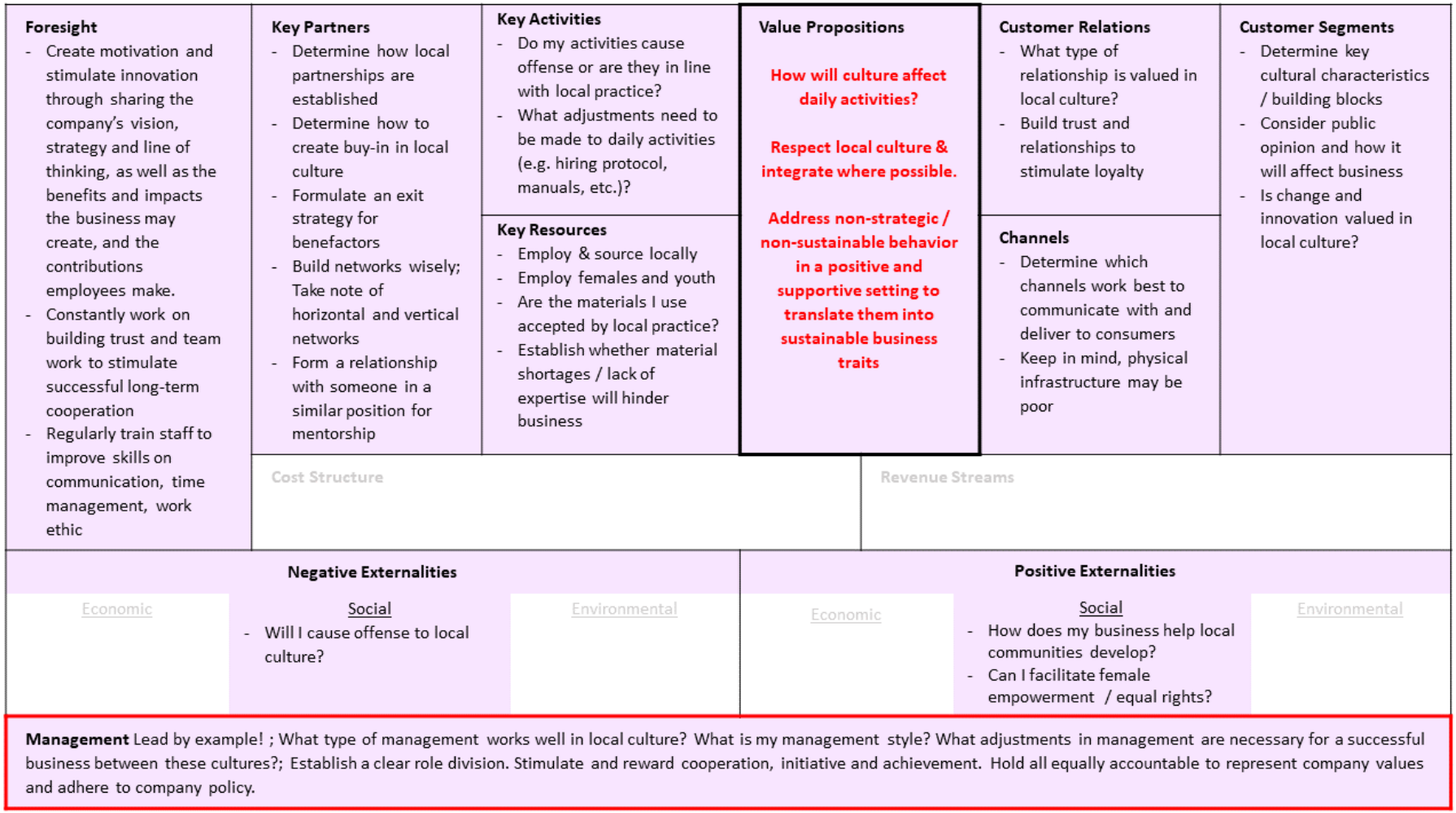

Figure F4: Module Socio-Cultural Aspects of the Modular Business Model Framework (MBMF).